B.Sc. (Hons.) Zoology

Detailed Syllabus

Programme Code: ZOOB
Duration: 3 Years

EFFECTIVE FROM SESSION: 2019-2020

Department of Life Sciences & Biotechnology
Faculty of Science
CHHATRAPATI SHIVAJI MAHARAJ UNIVERSITY PANVEL, NAVI MUMBAI

About the Programme

The **B. Sc. (Honors) Zoology** Program is aimed at imparting knowledge on the fundamentals of Zoology. B.Sc., Zoology- Programme provides opportunities for the stake holders to understand the latest advancements in the biosphere. It also helps to understand the physiological, biochemical and genetic principles of animals and their surroundings. It enables the in-service workers to develop their skills in identifying, selecting, innovating and organizing learning experiences for teaching Zoology subjects

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

The programme educational objectives of the B. Sc. (Hons.) Zoology programme are:

PEO1	Students gain knowledge and skill in the fundamentals of animal sciences, understands the complex interactions among various living organisms
PEO2	Analyse complex interactions among the various animals of different phyla, their distribution and their relationship with the environment
PEO3	Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.
PEO4	Understands the complex evolutionary processes and behaviour of animals
PEO5	Correlates the physiological processes of animals and relationship of organ systems
PEO6	Understanding of environmental conservation processes and its importance, pollution control and biodiversity and protection of endangered species
PEO7	Gain knowledge of Agro based Small Scale industries like sericulture, fish farming, butterfly farming and vermicompost preparation.
PEO8	Understands about various concepts of genetics and its importance in human health

PROGRAMME OUTCOMES (PO):

After completion of the B. Sc. (Hons.) Zoology programme students will be able to:

PO1	Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology
PO2	Analyse the relationships among animals, plants and microbes
PO3	Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology,Nematology Sericulture, Biochemistry, Fish biology, Animal biotechnology, Immunology and research methodology
PO4	Understand the applications of biological sciences in Apiculture, Aquaculture, Agriculture and Medicine
PO5	Gains knowledge about research methodologies, effective communication and skills of problem solving methods
PO6	Contributes the knowledge for Nation building.

SEMESTER I

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DSC	ZOOB1010	Non-Chordates	4	0	0	30	70	100	4
DSC	BINB1020	Biomolecules and Cell Biology	4	0	0	30	70	100	4
GE	**	Generic Elective - I	4	0/1	4/0	30	70	100	4
AECC	ENGG1000	English Communication	2	0	0	15	35	50	2
DSC	ZOOB1011	Non-Chordates Lab	0	0	4	15	35	50	2
DSC	BINB1021	Biomolecules and Cell Biology Lab	0	0	4	15	35	50	2
GE	**	Generic Elective - I Lab	0	1/0	0/4	15	35	50	2
		Total	**14**	**0**	**12**	**150**	**350**	**500**	**20**

Ability Enhancement Compulsory Courses (AECC)

Semester	Offering Department	Course Code	Course Name	(L-T-P)	Credits
I	English	ENGG1000	English Communication	2-0-0	2

ZOOB1010	NON-CHORDATES	4L:0T:0P	4 Credits

COURSE OBJECTIVES

- To understand different levels of biological diversity through the systematic classification of invertebrate fauna
- To understand the taxonomic position of protozoa to echinodermatas.
- To understand the general characteristics of animals belonging to protozoa to echinodermatas.
- To understand the body organization of phylum from protozoa to echinodermatas.
- To understand the origin and evolutionary relationship of different phylum from protozoa to to echinodermata.

Unit 1: Protista, Parazoa and Metazoa 12 lectures

1.1.General characteristics and Classification up to classes
1.2.Study of *Euglena*, *Amoeba* and *Paramecium*
1.3.Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
1.4. Locomotion and Reproduction in Protista

Unit 2: Porifera and Cnidaria 12 lectures

2.1.General characteristics and Classification up to classes
2.2. Canal system and spicules in sponges
2.3. General characteristics and Classification up to classes and Metagenesis in *Obelia*
2.4. Polymorphism in Cnidaria
2.5. Corals and coral reefs

Unit 3: Helmimthes, Platyhelminthes and Annelida 12 lectures

3.1.General characteristics and Classification up to classes
3.2. Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Unit 4: Arthropoda 12 lectures

4.1. General characteristics and Classification up to classes
4.2. Type study of palamaneous
4.3. Type study of periplata
4.4. Insect and vectorsof human diseases.

Unit 5 Mollusca and Echinodermata 12 lectures

5.1. General characteristics and Classification up to classes
5.2. Mollusca –type study of prawn
5.3. Echinodermata – study of star fish.
5.4. Minor Phyla- Ectophora and rotifera

Text /Reference Books:

1. Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Student should be able to describe unique characters of protozoa to echinodermata
2. Student should be able to recognize life functions of protozo to echinodermata
3. To recognise the ecological role of phylum protozoa to echinodermata
4. **T**o recognise the diversity from protozoa to echinodermata

ZOOB1011	NON-CHORDATES LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Study of whole mount of *Euglena, Amoeba* and *Paramecium,* Binary fission and Conjugation in *Paramecium*
2. Examination of pond water collected from different places for diversity in protista
3. Study of *Sycon* (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla*
4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora*
5. One specimen/slide of any ctenophore
6. Study of adult *Fasciola hepatica, Taenia solium* and their life cycles (Slides/micro-photographs)
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs

BINB1020	BIOMOLECULES AND CELL BIOLOGY	4L:0T:0P	4 Credits

Course objectives:

The objectives of this course are

1. To understand the structure of cell and various cellular events. .
2. To learn about cell theory and techniques for fractionation of sub cellular organelles.
3. To understand the composition of cytoskeleton and extracellular matrix.
4. To acquire knowledge of cell cycle, cell division and cell death mechanisms

UNIT 1: Biomolecules (12 lectures)

1.1. Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.

1.2. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

1.3. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.

1.4. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

UNIT 2: The cell (12 lectures)

2.1. Cell as a unit of structure and function;

2.2. Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

3. Overview of membrane function; fluid mosaic model; Chemical composition of membranes;

Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

UNIT 3: Cell organelles **(12 lectures)**

3.1. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

3.2. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

3.3. Chloroplast, mitochondria and peroxisomes: Structural organization;Function; Semiautonomous nature of mitochondria and chloroplast.

3.4. Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids;

3.5. Golgi Apparatus and lysosomes– organization, protein glycosylation, protein sorting and export from Golgi Apparatus.

UNIT 4: Cell cycle and cell death **(12 lectures)**

4.1.Phases of eukaryotic cell cycle- mitosis and meiosis;

4.2. Regulation of cell cycle- checkpoints, role of protein kinesis.

4.3. Apoptosis

UNIT 5: Tools of cell biology **(12 lectures)**

5.1. Light Microscope- phase contrast and dark field

5.2. Chromatography

5.3. Cell culture

5.4. Cell fractionation- centrifugation

Text /Reference Books:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th

edition. Pearson Benjamin Cummings Publishing, San Francisco

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Fundamental understanding of Bio-molecules: Building blocks of living system
2. Understanding of structure and function of cell: Prokaryotic and Eukaryotic cells system.
3. Understanding the Basic of cellular transport system and cellular inheritance.
4. Understanding of the function of various subcellular organelles
5. They will be acquainted to various microscopic techniques to visualize subcellular organelles

BINB1021	**BIOMOLECULES and Cell Biology Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Study of microscope
2. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
3. Study of cell and its organelles with the help of electron micrographs.
4. Study the phenomenon of plasmolysis and deplasmolysis.
5. Study the effect of organic solvent and temperature on membrane permeability.
6. Study different stages of mitosis and meiosis.
7. Study of structure of prokaryotic and eukaryotic cell.

SEMESTER II

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DSC	ZOOB2010	Chordates	4	0	0	30	70	100	4
DSC	ZOOB2020	Animal physiology and ecology	4	0	0	30	70	100	4
GE	**	Generic Elective - II	4	0/1	4/0	30	70	100	4
AECC	EVSG2000	Environmental Studies	2	0	0	15	35	50	2
DSC	ZOOB2011	Chordates Lab	0	0	4	15	35	50	2

DSC	ZOOB2021	Animal physiology and ecology lab	0	0	4	15	35	50	2
GE	**	Generic Elective - II Lab	0	1/0	0/4	15	35	50	2
		Total	**14**	**0**	**12**	**150**	**350**	**500**	**20**

Ability Enhancement Compulsory Courses (AECC)

Semester	**Offering Department**	**Course Code**	**Course Name**	**(L-T-P)**	**Credits**
II	Basic Sciences	EVSG2000	Environmental Studies	2-0-0	2

ZOOB2010	**CHORDATES**	**4L:0T:0P**	**4 Credits**

COURSE OBJECTIVES

1. To understand what the chordates are.
2. To understand different categories of chordates.
3. To understand the general characters of chordates.
4. To understands the level of organization in chordate subphylum.
5. To understand the origin and evolutionary relationship in different subphylum of chordates.

UNIT 1:

1.1. General characters of Chordata
1.2 Prochordata
1.2.1 Salient features of Cephalochordata
1.2.2 Structure of Branchiostoma
1.2.3 Affinities of Cephalochordata
1.2.4 Salient features of Urochordata
1.2.5 Structure and life history of Herdmania
1.2.6 Significance of Retrogressive metamorphosis

Unit – 2:

2.1 Cyclostomata
2.1.1 General characters of Cyclostomata
2.1.2 Comparision of the Petromyzon and Myxine
2.2 Pisces
2.2.1 General characters of Fishes
2.2.2 Classification of fishes up to sub - class level with examples
2.2.3 Scoliodon - External features, Digestive system, Respiratory system, Heart, Brain
2.2.4 Migration in Fishes
2.2.5 Types of Scales

Unit – 3:

3.1 Amphibia
3.1.1 General characters of Amphibian
3.1.2 Classification of Amphibia upto orders with examples.
3.1.3 Rana hexadactyla - External features, Digestive system, Respiratory system, Heart, Brain
3.2 Reptilia
3.2.1 General characters of Reptilia
3.2.2 Classification of Reptilia upto orders with examples
3.2.3 Calotes - External features, Digestive system, Respiratory system, Heart, Brain
3.2.4 Identification of Poisonous snakes and Skull in reptiles

Unit :4 Aves

4.1 General characters of Aves
4.2. Classification of Aves upto subclasses with examples.
4.3 Columba livia - External features, Digestive system, Respiratory system, Heart, Brain
4.4 Migration in Birds
4.5 Flight adaptation in birds

Unit -5 Mammalia

5.1 General characters of Mammalia
5.2 Classification of Mammalia upto sub - classes with examples
5.3 Comparision of Prototherians, Metatherians and Eutherians
5.4. Dentition in mammals

COURSE OUTCOME

1. Student should be able to describe unique characters of urochordates, cephalochordates and fishes.
2. Student should be able to recognize life functions of urochordates to fishes.
3. To understand the ecological role of different groups of chordates.
4. To understand the diversity ofchordates

Text Books/ Reference Books

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
4. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

ZOOB2011	Chordates Lab	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS

1. Protochordata : Herdmania, Amphioxus, Amphioxus T.S. through pharynx
2. Cyclostomata : Petromyzon, Myxine
3. Pisces : Pristis, Torpedo, Channapleuronectes, Hippocampus, Exocoetus, Eheneis, Labeo, Catla, Clarius, Auguilla,Protopterus Placoid scale, Cycloid scale, Ctenoid scale
4. Amphibia : Ichthyophis, Amblystoma, Siren, Hyla, Rachophous Axolotl larva
5. Reptilia : Draco, Chemaeleon, Uromastix, Vipera russeli, Naja, Bungarus, Enhydrina, Testudo, Trionyx, Crocodilus
6. Aves : Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo,
7. Study of different types of feathers : Quill, Contour, Filoplume down
8. Mammalia : Ornithorthynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog Osteology : Appenducular skeletons of Varanus, Pigeon Rabbit - Skull, fore limbs, hind limbs and girdles

ZOOB2020	ANIMAL PHYSIOLOGY AND ECOLOGY	4L:0T:0P	4 Credits

Course Objectives:

1. To acquaint students with Physiological Processes in Animals
2. To impart the knowledge of Physiology and Ecology

UNIT 1 :Animal Physiology I (12 lectures)

1.1.Physiology of Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids.

1.2.Mechanism of Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

1.3.Phsiology of excretion: urine formation and osmoregulation, ornithine cycle

UNIT 2: Animal Physiology II (12 Lectures)

2.1. Composition of blood, Plasma proteins & their role, blood cells, Haematopoisis, Mechanism of coagulation of blood.

2.2. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.
2.3. Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters
2.4. Endocrine system-Mechanism of action of hormones (insulin and steroids)
Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

Unit 3: Introduction to Ecology **12 lectures**

3.1. History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors,
3.2. Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem,
3.3. Ecological pyramids and Ecological efficiencies
3.4. Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem

Unit 4: Population **12 lectures**

4.1.Unitary and Modular populations
4.2. Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion
4.3. Exponential and logistic growth, equation and patterns, r and K strategies
4.4. Population regulation - density-dependent and independent factors
4.5. Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses

Unit 5: Community and Applied Ecology **12 lectures**

5.1. Community characteristics: species richness, dominance, diversity, abundance, vertical stratification,
5.2. Ecotone and edge effect;
5.3. Ecological succession with one example
5.4.Theories pertaining to climax community
5.5 Ecology in Wildlife Conservation and Management.

Text /Reference Books:

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand basic life processes of animals

2. Understand important chemical reactions and pathways involved in major processes of plants and animals
3. Have knowledge about hormones and other chemical/ non chemical factors that affect the animal growth characteristics
4. Have knowledge about the basic anatomy of organs and their systems along with their linkage to one another
5. Understand the role and function of organism at a larger level in its environment
6. Link connections between various organisms and their environment

Enlist various factors living and non-living that influence the normal functioning of the ecosystem

ZOOB2021	ANIMAL PHYSIOLOGY AND ECOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary
5. Finding the coagulation time of blood
6. Determination of blood groups
7. Counting of mammalian RBCs
8. Determination of TLC and DLC
9. Demonstration of action of an enzyme
10. Determination of Haemoglobin

SEMESTER III

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DSC	ZOOB3010	Animal Physiology: Controllong and coordinating system	4	0	0	30	70	100	4
DSC	BTEB3040	Basics Of Neuroscience Theory	4	0	0	30	70	100	4

DSC	MCRB3010	Microbiology	4	0	0	30	70	100	4
GE	**	Generic Elective - II	4	0/1	4/0	30	70	100	4
DSC	ZOOB3011	Animal Physiology: Controllong and coordinating system lab	0	0	4	15	35	50	2
DSC	BTEB3041	Basics Of Neuroscience Theory lab	0	0	4	15	35	50	2
DSC	MCRB3011	Microbiology lab	0	0	4	15	35	50	2
GE	**	Generic Elective - II Lab	0	1/0	0/4	15	35	50	2
SEC	**	Skill Enhancement Course-I	0	0	2	15	35	50	2
		Total	**16**	**0**	**22**	**195**	**455**	**650**	**26**

ZOOB3010	**ANIMAL PHYSIOLOGY: CONTROLLONG AND COORDINATING SYSTEM**	**4L:0T:0P**	**4 Credits**

COURSE OBJECTIVE

1. To know about the functioning of various system of organisms and their interrelationship for well-coordinated function.
2. To understand structure and functions of different animal tissues and endocrine glands

Unit 1: Tissues

1.1. Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

1.2. Bone and Cartilage Structure and types of bones and cartilages, Ossification, bone growth and resorption

Unit 2: Nervous System

2.1. Structure of neuron, resting membrane potential,

2.2. Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers;

2.3. Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc;

2.4. Physiology of hearing and vision.

Unit 3: Muscle Histology of different types of muscle;

3.1. Ultra structure of skeletal muscle;

3.2 Molecular and chemical basis of muscle contraction;

3.3. Characteristics of muscle twitch; Motor unit, summation and tetanus

Unit 4: Reproductive System

4.1. Histology of testis and ovary;

4.2. Physiology of male and female reproduction; Puberty,

4.3. Methods of contraception in male and female

Unit 5 : Endocrine System

5.1. Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action;

5.2. Classification of hormones; Regulation of their secretion; Mode of hormone action, Signal transduction pathways for steroidal and non-steroidal hormones;

5.3. Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

COURSE OUTCOME

1. Should be able to recognize and explain how all physiological systems work in unison to maintain homeostasis in the body and use of feedback loops to control the same i.e., should learn about an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body. e.g. Cardiovascular and Respiratory systems to meet the oxygen demand of the body.
2. Synthesize ideas to make connection between knowledge of physiology and real world situations, including healthy life style decisions and homeostatic imbalances i.e. how physiological mechanisms adapt in response to various external and internal stimuli in order to maintain health.
3. Knowledge of role of regulatory systems viz. endocrine and nervous systems and their amalgamation in maintaining various physiological processes

TEXT / REFERENCE BOOKS

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

ZOOB3011	**ANIMAL PHYSIOLOGY: CONTROLLONG AND COORDINATING SYSTEM LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid

5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues (*Subject to UGC guidelines)

BTEB3040	**BASICS OF NEUROSCIENCE THEORY**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

1. To Describe the cellular composition of the nervous system and the process of communication between these cells.
2. To Demonstrate a basic understanding of the functional anatomy of the nervous system.
3. To Explain the neural basis of sensation and perception.
4. To Apply knowledge of the functional anatomy of the nervous system to the analysis of human behaviour.
5. To Discuss the process of development and change in the nervous system.

2. Detailed Syllabus:

Unit 1: Introduction to Neuroscience

1.1.Origins of Neuroscience; Neuroanatomy,

1.2. Neurophysiology, and Systems Neurobiology

Unit 2: The Nervous system

2.1. Introduction to the structure and function of the nervous system:

2.2. Cellular components: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron – axons and dendrites as unique structural components of neurons.

2.3. The ionic bases of resting membrane potential; The action potential- its generation and properties; The action potential conduction.

Unit 3: Cellular and Molecular Neurobiology

3.1. Molecular and cellular approaches used to study the CNS at the level of single molecules,

3.2. Synapse: Synaptic transmission, Types of synapses; synaptic function; Principles of chemical synaptic transmission;

3.3.Principles of synaptic integration; EPSPs and IPSPs. Ion channels, Neural transmission, **Unit 4. Neurotransmitters**

4.1. Different types of neurotranmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels;

4.2. G-protein coupled receptors and effectors, neurotransmitter receptors; Ionotropic and metabotropic receptors.

Unit 5: Neurobiology And Neuropharmacology Of Behaviour

5.1. The principles of signal transduction and information processing in the vertebrate central nervous system, and the relationship of functional properties of neural systems with perception and behavior; sensory systems, molecular basis of behavior including learning and memory.

5.2. Molecular pathogenesis of pain and neurodegenerative diseases such as Parkinson's, Alzheimer's, psychological disorders, addiction, etc.

Text /Reference Books:

1. Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015

2. From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham
3. Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004
4. Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGrawHill Companies-2000
5. Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David YoungCUP-2003
6. Essential Psychopharamacology- Neuroscientific Basis and Practical Applications2nd Edn.-Stephan M. Stahl-CUP-2000
7. Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998
8. The Human Brain Book - Rita Carter-2009

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. understand major advances in neuroscience, neural basis of emotions, behaviour, learning and memory, and how brain and behaviour can be trained/ modified by experience ever since its emergence as a major field of science, understand the,
2. discuss how the hypothalamus controls various behavioural patterns by releasing neurohormones/ neuropeptides in brain and periphery in response to various signals,
3. construe neural mechanisms of learning and memory (spatial and episodic memory etc.) and how specific circuits contribute to learning and memory,
4. develop an understanding as to what is cognition and how it enables us to react to various situations appropriately and how neurological diseases affect cognition,
5. understand cellular and molecular mechanisms that underlie cognition such as synaptic plasticity and organisation of memory, memory persistence and forgetfulness, the role of sleep in cognition etc.

BTEB3041	**BASICS OF NEUROSCIENCE THEORY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
3. Nerve Cell preparation from the spinal cord.
4. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
5. Study of olfaction in Drosophila.
6. Study of novelty, anxiety and spatial learning in mice.

MCRB3010	MICROBIOLOGY	4L:0T:0P	4 Credits

1. Course learning objectives:

1. To become aware with the contributions of Louis Pasteur, Edward Jenner and Robert Koch in microbiology and immunology.
2. To get acquainted with the discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, hospital acquired infections.
3. To Understand the importance of microorganisms as model systems in genetics and biochemistry.
4. To know the contribution of gut microbiome in human health.
5. To understand the concepts of fight against major killer diseases – tuberculosis, HIV and malaria.

Detailed Syllabus:

Unit 1: Introduction to Microbiology(12 lectures)

1.1. History , application and Status of Microbiology in India.
1.2. Classification of Micro-organisms.
1.3. General features.
1.4. Microbial taxonomy- Bergey manual.

Unit 2: Structure and Diversity of Microorganisms. (12 lectures)

2.1. bacteriology- morphology and structure of Archaebacteria.
2.2. Structure and function of cell organelles of bacteria.
2.3. Structure of viruses.

Unit 3: Staining methods(12 lectures)

1.1. Stains and Dyes
1.2. Simple staining
1.3. Differential staining
1.4. Special staining

Unit 4: Microbial growth(12 lectures)

4.1. Growth curve-mathematical expression of growth.
4.2. Factors affecting microbial growth.
4.3. Batch, continuous, synchronous and diauxic growth
4.4. Quantification of growth.

Unit 5: Microbial Nutrition and metabolism. (12 lectures)

5.1. Nutritional classification of Microorganisms.
5.2. Concept of anabolism and catabolism process.
5.3. Nitrogen fixation- types and mechanism.
5.4. Microbial diseases in plants and animals.

Text/ Reference Books:

1. Microbiology:Pelczar M J

2. Microbiology:Presscott L M,Harley J P and Klein D A
3. Textbook of Micrbiology-Ananthanarayan
4. General microbiology - Powar & Daginawal

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Usage of scientific terminologies to describe & express fundamental concepts in Microbiology.
2. Able to apply basic principles to understand host-microbe relationship in different Infectious diseases.

MCRB3011	**MICROBIOLOGY LAB**	**0L:0T:4P**	**2 Credits**

SUGGESTIVE LIST OF EXPERIMENTS:

1. Monochrome Staining, Differential Staining, Gram Staining, and Acid Fast Staining and Romonowsky Staining
2. Special Staining Technique for Cell Wall, Capsule and Endospores and Fungal Staining, Lipid granules, metachromatic, flagella, spirochetes
3. Motility test
4. Sterilization of Laboratory Glassware and Media using Autoclave
5. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar
6. Isolation of Organisms , Macroscopic and microscopic studies: T-streak, Polygon method, Colony characteristics of microorganisms
7. Enumeration of microorganisms: Serial Dilution, Pour Plate, Spread Plate Method, Nephlometry, Haemocytometry, Breeds count
8. Growth Curve of E.coli
9. Effect of pH and temperature on growth of organisms

SEMESTER IV

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DSC	BTEB4030	Molecular Biology	4	0	0	30	70	100	4
DSC	BTEB4040	Immunology	4	0	0	30	70	100	4
DSC	MCRB4010	Environmental Microbiology	4	0	0	30	70	100	4
GE	**	Generic Elective - III	4	0/1	4/0	30	70	100	4

DSC	BTEB4031	Molecular Biology lab	0	0	4	15	35	50	2
DSC	BTEB4041	Immunology lab	0	0	4	15	35	50	2
DSC	BCHB4211	Biochemistry Of Metabolic Processes lab	0	0	4	15	35	50	2
GE	**	Generic Elective – III Lab	0	1/0	0/4	15	35	50	2
SEC	**	Skill Enhancement Course-II	0	0	2	15	35	50	2
		Total	**16**	**0**	**22**	**185**	**455**	**650**	**26**

BTEB4030	**Molecular biology**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To acquaint students with DNA Replication, Repair and Genetic Engineering.
2. Impart the knowledge of molecular Biology Techniques.

Detailed Syllabus:

Unit 1 Hereditary material- DNA (12 lectures)

1.1 DNA as the vehicle of inheritance- Experimental evidence -Griffith, McLeod, McCarty and Avery, HerscheyChase experiments.

1.2.Definition of Gene, organization of genes and non-coding

1.3.DNA in prokaryotes and Eukaryotes - unique, moderately repetitive and highly repetitive DNA sequence, Satellite DNA.

1.4. Cot value.

Unit 2 DNA replication in prokaryotes (12 lectures)

2.1. DNA Replication in Prokaryotes - Semi-conservative DNA replication,
2.2. DNA Polymerases and its role, E.coli Chromosome Replication,
2.3.Bidirectional Replication of Circular DNA molecules.
2.4. Rolling Circle Replication, DNA

Unit 3 DNA replication (12 lectures)

3.1. Replication in Eukaryotes
3.2. DNA Recombination –Holliday Model for Recombination
3.3. Transformation

Unit 4 Mutations(12 lectures

4.1. Definition and Types of Mutations.
4.2. Mutagenesis and Mutagens.(Examples of Physical, Chemical and Biological Mutagens)
4.3. Types of Point Mutations,
1.1. DNA REPAIR Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair**.**

Unit 5 Genetic and Chromosomal variation (12 lectures)

5.1. Genetic variation and chromosomal basis of inheritance Types: Discontinuous and continuous
5.2. Molecular basis of allelic variation.
5.3. Historical development of chromosomal theory, nature of chromosome, chromosomal behaviour 5.4. Inheritance in eukaryotes

Text /Reference Books:

1. Upadhya- Molecular Biology- Himalaya pub.
2. Watson – Molecular biology of gene- Pearson pub.
3. David Freifelder- Microbial Genetics – Narosa Pub.
4. David Freifelder– Molecular Biology – Narosa pub.
5. Gardner – Principals of Genetics – Wiley international pub.
6. Albert Bruce- Molecular biology of the cell- garland science.
7. Loddish - Molecular cell biology – W-H. freeman
8. Lewin – Genes X- Oxford
9. Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta

Genome- T.A. Brown- John Wiley

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand basic molecular biology terms and definitions
2. Understand the molecular model of DNA and its replication in various ways
3. Define mutations and predict their outcomes
4. Enlist various possibilities and probable reasons which may lead to mutations
5. Explain certain medical conditions related to one's genetics
6. Elucidate the concept of heredity and passing of information from generation to other

BTEB4031	**Molecular biology lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Isolation and purification of DNA from plant sources (genomic)
2. Agarose Gel Electrophoresis of the genomic DNA
3. Quantitative analysis of DNA by DPA
4. Quantitative analysis of RNA by Orcinol method
5. Study of DNA repair mechanism by photo reactivation
6. Determination of Tm value of DNA

BTEB4040	**IMMUNOLOGY**	**4L:0T:0P**	**4 credits**

Course learning objectives:

The objectives of this course are

1. To Understand of the overview of immune system including cells, organs and receptors.

2. To learn structure and functions of different classes of immunoglobulins, the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.
3. To understand mechanisms involved in different types of hypersensitivity, and the importance of conventional vs.recombinant vaccines.
4. To get acquainted with the importance of antigen-antibody interaction in disease diagnosis.
5. To understand the principles of tolerance, autoimmunity and the role of immunity in protection against pathogens.

Unit 1: Overview of Immune System

1.1 Historical perspective of Immunology, Early theories of Immunology,
1.2. Cells and organs of the Immune system

Unit 2: Innate and Adaptive Immunity

2.1.Anatomical barriers, Inflammation,
2.2.Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral),
2.3. Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity,
2.4. Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).

Unit 3: Antigens

3.1. Antigenicity and immunogenicity,
3.2. Immunogens, Adjuvants and haptens,
3.3. Factors influencing immunogenicity, B and T-Cell epitopes

Unit 4: Immunoglobulins

4.1. Structure and functions of different classes of immunoglobulins,
4.2. Antigenantibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, 4.3. Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

Unit 5: Major Histocompatibility Complex

5.1. Structure and functions of MHC molecules.
5.2. Endogenous and exogenous pathways of antigen processing and presentation

Text /Reference Books:

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Students will be able to understand and apply basic microbiological techniques and correlate them with their fundamental concepts in the subject.
2. Students will be able to understand and apply basic immunological techniques and correlate them with their fundamental concepts in the subject.

BTEB4041	IMMUNOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of : a. ELISA b. Immunoelectrophoresis

MCRB4010	Environmental Microbiology	4L:0T:0P	4 Credits

Course learning objectives:

The objectives of this course are

1. To have in-depth knowledge of microbial diversity in different habitats with emphasis on their interactions among themselves and with higher plants and animals.
2. To learn about various environment-related problems and be motivated to think about sustainable and novel ways to solve them.

Unit 1 Microorganisms and their Habitats Lectures: 14

Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

Unit 2 Microbial Interactions Lectures: 12

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation Microbe-Plant interaction: Symbiotic and non symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Unit 3 Biogeochemical Cycling Lectures: 12

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilisation Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese

Unit 4 Waste Management Lectures: 12

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

Unit 5 Microbial Bioremediation Lectures: 5

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inroganic (metals) matter, biosurfactants

Lectures: 5

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Text /Reference Books:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.

11. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will get acquainted with natural habitats of diverse microbial population. And be familiar with microbial succession and concept of metagenomics.
2. Will understand how microbes interact among themselves and with higher plants and animals with the help of various examples.
3. Will become aware of the important role microorganisms play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.
4. Will gain in-depth knowledge of different types of solid wastes and their management with emphasis on advantages and disadvantages of various methods used for their treatment.
5. Will acquire knowledge about composition and strength of sewage and its treatment using primary, secondary and tertiary methods.
6. Will have learnt about treatment and safety of drinking water and be conversant with different methods to test its potability.

	Environment Microbiology lab	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action. 2
2. Isolation of microbes (bacteria & fungi) from soil (28ºC & 45ºC).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of waste water sample. 6
6. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
7. Isolation of Rhizobium from root nodules.

SEMESTER V

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits

DSC	BTEB5010	Principles of genetics	4	0	0	30	70	100	4
DSC	ZOOB5020	Animal Behaviour And Chronobiology	4	0	0	30	70	100	4
DSE	**	Discipline Specific Elective-I	4	0	0	30	70	100	4
DSE	**	Discipline Specific Elective-II	4	0/1	4/0	30	70	100	4
DSC	BTEB5011	Principles of genetics lab	0	0	4	15	35	50	2
DSC	ZOOB5021	Animal Behaviour And Chronobiology lab	0	0	4	15	35	50	2
DSE	**	Discipline Specific Elective-I Lab	0	0	4	15	35	50	2
DSE	**	Discipline Specific Elective-II Lab	0	1/0	0/4	15	35	50	2
		Total	**16**	**0**	**20**	**180**	**420**	**600**	**24**

BTEB5010	**PRINCIPLES OF GENETICS**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

- To understand how the behavior of chromosomes during meiosis can explain mendal law.
- To understand how inheritance patterns are affected by position on chromosomes.
- To understand the similarities and differences between how genetic information is passed on in prokaryotes and eukaryotes.
- To understand gene interactions.
- To understand the chemical nature of heredity.

Unit 1: Mendelian Genetics and its Extension

1.1 Principles of inheritance, Incomplete dominance and co-dominance,
1.2. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy,
1.3. Sex-linked, sexinfluenced and sex-limited characters inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

2.1. Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination,
2.2. Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses,
2.3. Interference and coincidence, Somatic cell hybridization.

Unit 3: Mutations

3.1. Types of gene mutations (Classification),
3.2. Types of chromosomal aberrations (Classification, figures and with one suitable example of each),
3.3. Molecular basis of mutations in relation to UV light and chemical mutagens;
3.4. Detection of mutations: CLB method, attached X method.

Unit 4: Extra-chromosomal Inheritance

4.1. Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondri
4.2.Polygenic Inheritance Polygenic inheritance with suitable examples; simple numericals based on it al mutations in Saccharomyces, Infective heredity in Paramecium and Maternal effects

Unit 5: Recombination in Bacteria and Viruses

5.1. Conjugation, Transformation, Transduction,
5.2. Complementation test in Bacteriophage

Text /Reference Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
4. Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co
6. Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor and Francis Group, New York and London.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Comprehensive and detailed understanding of the chemical basis of heredity.
2. Understanding about the role of genetics in evolution.
3. The ability to evaluate conclusions that are based on genetic data.
4. The ability to understand results of genetic experimentation in animals.

BTEB5011	**Principles of Genetics lab**	**0L:0T:2P**	**2 Credits**

LIST OF EXPERIMENTS:

1. To study the Mendelian laws and gene interactions.
2. Chi-square analyses using seeds/beads/Drosophila.
3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from Drosophila crosses.

5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.

ZOOB5020	ANIMAL BEHAVIOUR AND CHRONOBIOLOGY	4L:0T:0P	4 Credits

1. Course learning objectives:

1. This course aims to provide an overview of animal behaviour and chronobiology starting from historical prospective to types of behaviours and their evolutionary significance.
2. The course also highlights types, mechanisms and importance of the biological rhythms and biological clocks operating in the living organisms.
3. This course will help the learners to understand and appreciate different types of animal behaviours, their adaptive, evolutionary and practical significance.

Unit 1: Introduction to Animal Behaviour

1.1. Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen,

1.2. Proximate and ultimate causes of behaviour,

1.3. Methods and recording of a behaviour

Unit 2: Patterns of Behaviour

2.1. Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour;

2.2. Associative learning, classical and operant conditioning,

2.3. Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour

3.1. Social Behaviour: Concept of Society; Communication and the senses; Altruism;

3.2. Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.

3.3. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology

4.1. Historical developments in chronobiology;

4.2. Biological oscillation: the concept of Average, amplitude, phase and period.

4.3. Adaptive significance of biological clocks

Unit 5: Biological Rhythm and Biological Clocks

5.1.Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms;

5.2. Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

5.3. Relevance of biological clocks; Chronopharmacology, Chronomedicine, Chronotherapy.

Text /Reference Books:

1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
2. Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
4. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
5. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
6. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA
7. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

3. Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understanding and identify behaviors in a variety of taxa
2. Competently discuss the evolutionary origins of various behaviors
3. Designing and implementing experiments to test hypotheses relating to animal behavior
4. Students will be able to demonstrate knowledge to master concepts in the scientific discipline of Chronobiology, such as the functional properties and organization of the circadian rhythms and their relevance to human welfare and diseases

ZOOB5021	**ANIMAL BEHAVIOUR AND CHRONOBIOLOGY LAB**	**0L:0T:2P**	**2 Credits**

LIST OF EXPERIMENTS:

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.

3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

SEMESTER VI

Course Code	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DSC	ZOOB6010	Developmental biology	4	0	0	30	70	100	4
DSC	ZOOB6020	Evolutionary Biology	4	0	0	30	70	100	4
DSE	**	Discipline Specific Elective-III	4	0	0	30	70	100	4
DSE	**	Discipline Specific Elective-IV	4	0/1	4/0	30	70	100	4
DSC	ZOOB6011	Developmental biology lab	0	0	4	15	35	50	2
DSC	ZOOB6021	Evolutionary Biology lab	0	0	4	15	35	50	2
DSE	**	Discipline Specific Elective-III Lab	0	0	4	15	35	50	2
DSE	**	Discipline Specific Elective-IV Lab	0	1/0	0/4	15	35	50	2
		Total	**16**	**0**	**20**	**180**	**420**	**600**	**24**

ZOOB6010	DEVELOPMENTAL BIOLOGY	4L:0T:0P	4 Credits

1. Course learning objectives:

The objectives of this course are

1. To understand how organisms maintain gametic population.
2. To understand fertilization process.
3. To understand way of cleavage and different patterns to form zygote.
4. To understand the fundamental embryonic development.

5. To understand the complete process of formation of germ layers

2. Detailed Syllabus

Unit 1: Introduction

1.1.Historical perspective and basic concepts:
1.2. Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression,
1.3. Cytoplasmic determinants and asymmetric cell division

Unit 2: Early Embryonic Development

2.1. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes;
2.2.Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques);
2.3. Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development

3.1. Fate of Germ Layers; Extra-embryonic membranes in birds;
3.2. Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Unit 4: Post Embryonic Development

4.1. Metamorphosis: Changes, hormonal regulations in amphibians and insects;
4.2. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each);
4.3. Ageing: Concepts and Theories

Unit 5: Implications of Developmental Biology

5.1. Teratogenesis: Teratogenic agents and their effects on embryonic development;
5.2. In vitro fertilization, Stem cell (ESC),
5.3. Amniocentesis

Text /Reference Books:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
3. Carlson, R. F. Patten's Foundations of Embryology
4. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
5. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

3. Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Be able to list the types of characteristics that make an organism ideal for the study of developmental biology.
2. Be familiar with the events that lead up to fertilization.
3. Be able to describe the first four rounds of cell division in different groups.
4. Be able to describe the stages and cellular mechanisms for gastrulation.

ZOOB6011	DEVELOPMENTAL BIOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of the developmental stages and life cycle of Drosophila from stock culture
4. Study of different sections of placenta (photomicropgraph/ slides)

Project report on Drosophila culture/chick embryo development

ZOOB6020	EVOLUTIONARY BIOLOGY	4L:0T:0P	4 Credits

1. Course learning objectives:

The objectives of this course are

1. To obtain an understanding of life and natural world. It is a unifying thread which joins all organisms from prokaryotes to highest of eukaryotes.
2. This course emphasizes on the development of evolutionary thought by dealing in general with the process and pattern of biological evolution.
3. On one hand it offers a chance to students to learn about deciphering of evidences ranging from fossil records to molecular data and arrange them to establish phylogenetic relationships of species, while on the other it provides a platform to understand various forces which bring about variations between populations of a species and cause them to diversify into new species.

2. Detailed Syllabus

Unit 1:

1.1 Life's Beginnings

1.2. Chemogeny, RNA world, Biogeny, Origin of photosynthesis,

1.3. Evolution of eukaryotes

1.4.Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

Unit 2:

2.1. Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse,

2.2. Molecular (universality of genetic code and protein synthesising machinery, three domains of life, neutral theory of molecular evolution, molecular clock ,example of globin gene family, rRNA/cyt c

2.3. Sources of variations: Heritable variations and their role in evolution

Unit 3:

3.1. Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; 3.2.

Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection.
3.3. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies

Unit 4:

4.1. Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, 4.2. Adaptive radiation / macroevolution (exemplified by Galapagos finches Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Unit 5

5.1. Origin and evolution of man,
5.2. Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular analysis of human origin
5.3. Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees

Text /Reference Books:

1. Ridley,M (2004) Evolution III Edition Blackwell publishing
2. Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
3. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
4. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
5. Snustad. S Principles of Genetics.
6. Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition WileyBlackwell

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Problem solving and high order analytical skills will be developed by attempting numerical problems as well as performing simulation studies of various evolutionary forces in action.
2. Application of knowledge gained, on populations in real time, while studying speciation, behavior and susceptibility to diseases will be possible
3. Students will gain knowledge about the relationship of the evolution of various species and the environment they live in. They will be motivated to work towards mitigating climate change so that well adapted species do not face extinction as a result of sudden drastic changes in environment
4. The knowledge gained from study of variations, genetic drift can be applied to ensure that conservation efforts for small threatened populations are focused in right direction
5. The course would allow the students to predict the practical implication of various evolutionary forces acting on the human population in the field of human health, agriculture and wildlife conservation.

ZOOB6021	EVOLUTIONARY BIOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies
5. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (Clustal X, Phylip, NJ) and its interpretation.

LIST OF GENERAL ELECTIVE SUBJECTS

List of Generic Electives Available for students of B.Sc. (Hons.) Zoology

Semester	Offering Department	Course Code (T+P)	Course Name	(L-T-P)	Credits
I	Botany	MCRB1010+ MCRB1011	Microbiology and Phycology	4-0-4	6
II	Botany	BOTB2010+ BOTB2011	Diversity of Archaegoniates&Plant Anatomy	4-0-4	6
III	Botany	BOTB3020+ BOTB2021	Economic botany	4-0-4	6
IV	Botany	BOTB4020+ BOTB4021	Phytogeography	4-0-4	6
II	Bioinformatics	BINB2010+BINB2011	Introduction to Bioinformatics	4-0-4	6
III	Bioinformatics	BINB3010+ BINB3011	Concepts in Bioinformatics	4-0-4	6
IV	Bioinformatics	BINB4010	Computer aided drug design.	4-0-4	6
II	Biotechnology	BTEB2010+ BTEB2011	Introduction to Biotechnology	4-0-4	6

II	Biochemistry	BCHB2020+ BCHB2021	Enzymes	4-0-4	6
III	Biochemistry	BCHB3020+ BCHB3021	Membrane Biology and Bioenergetics	4-0-4	6
IV	Biochemistry	BCHB4030+ BCHB4031	Hormone: Biochemistry and Function	4-0-4	6
III	Biotechnology	BTEB3020+ BTEB3021	Immunology	4-0-4	6
IV	Biotechnology	BTEB4010+ BTEB4011	Pharmagenomics	4-0-4	6
II	Microbiology	MCRB2020+ MCRB2021	Bacteriology	4-0-4	6
III	Microbiology	MCRB3030+ MCRB3031	Medical Microbiology	4-0-4	6
IV	Microbiology	MCRB4020+ MCRB4021	Food and Dairy Microbiology	4-0-4	6
I	Chemistry	CHYB1010 + CHYB1011	Inorganic Chemistry	4-0-4	6
II	Chemistry	CHYB2010 + CHYB2011	Organic Chemistry	4-0-4	6
III	Chemistry	CHYB3010 + CHYB3011	Physical Chemistry	4-0-4	6
IV	Chemistry	CHYB4010 + CHYB4011	Basic Analytical Chemistry	4-0-4	6

----------BOTANY ----------

MCRB1010	**Microbiology and Phycology**	**4L:0T:0P**	**4 Credits**

Course objectives:

The objectives of this course are

1. To gain knowledge of diversity, life forms, life cycles, morphology and importance of microorganisms (Bacteria and algae).

UNIT- 1: Microbial World (Origin and Evolution of Life, Microbial diversity (12Lectures)

1.1. Discovery of microorganisms, origin of life, spontaneous, biogenesis, Pasteur experiments, germ theory of disease.

1.2. Classification of microorganisms – R.H. Whittaker's five kingdom concept, Carl Woese's- Domain system.

1. 3. Brief account of special groups of bacteria- Archaebacteria, Mycoplasma, Chlamydia, Actinomycetes, Rickettsias and Cyanobacteria.

UNIT- 2 : VIRUSES (12 Lectures)

2.1. Viruses- Discovery, general account, structure& replication of –T4 Phage (Lytic, Lysogenic) and TMV, Viroids, Prions.

2.2. Plant diseasescaused by viruses– Symptoms, transmission and control measures (Brief account only).

2.3. Study of Tobacco Mosaic, Bhendi Vein clearing and Papaya leaf curl diseases.

UNIT 3: BACTERIA (12 Lectures)

3. 1. Bacteria: Discovery, General characteristics, cell structure andnutrition.

3.2. Reproduction- Asexual and bacterial recombination (Conjugation, Transformation, Transduction).

3.3. Economic importance of Bacteria.

UNIT –4: ALGAE (12Lectures)

4.1. General account - thallus organization and reproduction in Algae.

4.2. Fritsch classification of Algae (up to classes only) and economic importance.

4.3. Structure, reproduction and life history of Oedogonium, Ectocarpus and Polysiphonia.

UNIT 5: FUNGI (12 Lectures)

5.1. General characteristics and outline classification (Ainsworth).

5.2. Structure, reproduction and life history of Rhizopus (Zygomycota),Penicillium (Ascomycota), and Puccinia (Basidiomycota).

5.3. Lichens-Structure and reproduction; ecological and economic importance.

Text /Reference Books:

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Develop understanding on the concept of microbial nutrition
2. Classify viruses based on their characteristics and structures
3. Develop critical understanding of plant diseases and their remediation.
4. Examine the general characteristics of bacteria and their cell reproduction/ recombination
5. Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance
6. Conduct experiments using skills appropriate to subdivisions

MCRB1011	**Microbiology and Phycology Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).
5. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), Volvox, *Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,Procholoron* through electron micrographs, temporary preparations and permanent slides.

BOTB2010	**Diversity of Archaegoniates &Plant Anatomy**	**4L:0T:0P**	**4 Credits**

Course Objectives:

2. This course aims at making a familiarity with special groups of plants joined together by a common feature of sexual reproduction involving Archegonia.
3. To Create an understanding by observation and table study of representative members of phylogenetically important groups should be able to make students learn the process of evolution in a broad sense.
4. To Study of morphology, anatomy, reproduction and developmental changestherein through typological study should create a knowledge base in understanding plant diversity, economic values, taxonomy of lower group of plants

UNIT – 1: BRYOPHYTES (12Lectures)

1.1 Bryophytes: General characters, Classification (up to classes)

1.2. Structure, reproduction and Life history of Marchantia, and Funaria.
1.3. Evolution of Sporophyte in Bryophytes.

UNIT – 2: PTERIDOPHYTES (12Lectures)

2.1. Pteridophytes: General characters, classification (up to Classes)
2.2. Structure, reproduction and life history of Lycopodium, and Marsilea.
2.3. Heterospory and seed habit.
2.4. Evolution of stele in Pteridophytes.

UNIT – 3: GYMNOSPERMS (12Lectures)

3.1. Gymnosperms: General characters, classification (up to classes)
3.2. Morphology, anatomy, reproduction and life history of Pinus and Gnetum
3.3. Economic importance with reference to wood, essential oils and drugs

UNIT –4: Tissues and Tissue systems (12Lectures)

4.1.Meristems - Root and Shoot apical meristems and their histological organization.
4.2.Tissues – Meristematic and permanent tissues (simple, complex, secretory)
4.3.Tissue systems–Epidermal, ground and vascular.

UNIT – 5. Secondary growth (12Lectures)

5.1. Anomalous secondary growth in Achyranthes, Boerhaavia and Dracaena.
5.2. Study of local timbers of economic importance-Teak, Rosewood, Red sanders and Arjun (Tella maddi).

Course Learning Outcomes:

1. Demonstrate an understanding of archegoniatae, Bryophytes, Pteridophytes and Gymnosperms
2. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms
3. Understanding of plant evolution and their transition to land habitat.
4. Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperm

Text /Reference Books

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.

Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

BOTB2011	**Diversity of Archaegoniates &Plant Anatomy Lab**	**0L:0T:2P**	**4 Credits**

LIST OF EXPERIMENTS

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. *Peziza*: sectioning through ascocarp.
5. *Alternaria:* Specimens/photographs and temporary mounts.
6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of *Stemonitis* sporangia.
9. *Albugo:* Study of symptoms of plants infected with *Albugo*; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

BOTB3020	**ECONOMIC BOTANY**	**4L:0T:0P**	**4Credits**

COURSE OBJECTIVES

1. To relate the principles of Economic Botany to other disciplines in biology.
2. To relate useful plants to the affairs of mankind.
3. To relate useful plants to the local and world economy.

Unit 1: Origin of Cultivated Plants (6 lectures)

Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Unit 2: Cereals and Legumes (6 lectures)

Wheat and Rice (origin, morphology, processing & uses); Brief account of millets. Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Unit 3: Sources of sugars and starches (4 lectures)

Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit 4 : Spices and Beverages (6 lectures)

Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper Tea, Coffee (morphology, processing & uses)

Unit 5 : Sources of oils and fats (10 lectures)

General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

COURSE OUTCOME

1. Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems
2. Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership
3. Develop a basic knowledge of taxonomic diversity and important families of useful plants
4. Increase the awareness and appreciation of plants & plant products encountered in everyday life
5. Appreciate the diversity of plants and the plant products in human use

Text/ Reference Books

1) Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2) Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers,
3) The Netherlands.
4) Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.

BOTB3021	**Economic Botany lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1) **Cereals**: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2) **Legumes**: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3) **Sources of sugars and starches**: Sugarcane (habit sketch; cane juice- micro-chemical tests),
4) Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
5) **Spices:** Black pepper, Fennel and Clove (habit and sections).
6) **Beverages**: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
7) **Sources of oils and fats**: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
8) **Essential oil-yielding plants**: Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus*

(specimens/photographs).

BOTB4010	PHYTOGEOGRAPHY	4L:0T:2P	5 Credits

COURSEOBJECTIVE

1. To give a fundamental understanding of the distribution of vascular plants and of the basic models which describe it.
2. To know about the floristic regions and plant formations of the Planet, in the light of previous continental and climatic evolution.
3. To learn floristic recording of specific habitats and the assessment of their naturality on the basis of chorological and life form spectra of the flora.

Unit I: Introduction, soil and water 15 lectures

Basic concepts; Levels of organization. Abiotic and biotic Components and their interrelationships and dynamism, homeostasis. Soil: Origin; Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils in India. Water: States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Atmospheric moisture; Water in soil; Ground water table. Water
resources of India

Unit II: Ecological adaptations, Population ecology 15 lectures

Variations in adaptation of plants in relation to light, temperature, water, wind and fire. Biotic interactions: Competition: Inter- and intraspecific competition; Ammensalism, heterotrophy; mutualism, commensalism, parasitism; herbivory, carnivory, protocooperation, Population ecology: Characteristics and population growth, population regulation, life history strategies; *r* and *k* selection. Ecological Speciation.

Unit III: Plant Communities and Ecosystem 15 lectures

Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. Ecosystem: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India.

Unit IV: Functional Aspects of Ecosystem and Phytogeography 15 lectures

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus. Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division of India; Local Vegetation.

Course outcomes

On completion of this course, the students will be able to:

1. Understand core concepts of biotic and abiotic
2. Classify the soils on the basis of physical, chemical and biological components
3. Analysis the phytogeography or phytogeographical division of India
4. Evaluate energy sources of ecological system
5. Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
6. Conduct experiments using skills appropriate to subdivisions

Text/ Reference Books

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India.

8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

BOTB4011	PHYTOGEOGRAPHY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (with pH meter, universal indicator/Lovibond comparator and/or pH paper strip)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid
5. titration method.
6. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
7. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
8. Study of morphological adaptations of hydrophytes and xerophytes (four each).
9. Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).
10. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
11. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.

----------BIOTECHNOLOGY----------

BTEB2010	INTRODUCTION TO BIOTECHNOLOGY	4L:0T:0P	4 Credits

COURSE OBJECTIVE

1. To study the different types of marine microorganisms, marine ecosystem
2. To study the use of marine organisms in production of drugs, enzymes, functional foods, nutraceuticals and cosmetics
3. To acquaint students with various fields of Biotechnology and their applications
4. To impart the knowledge of Healthcare and Food-Agri Biotechnology

Unit 1: History & Introduction to Biotechnology 12L

What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology-Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare,

Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology. Biotechnology Research in India. Biotechnology Institutions I n India

(Public and Private Sector)

Unit 2: Healthcare Biotechnology **12 L**

Introduction, Disease prevention (Vaccines),types of vaccines,Disease Diagnosis, Detection of genetic diseases, Disease treatment, Drug designing, Drug delivery and targeting, Gene therapy

Unit 3: Food Biotechnology **12L**

Biotechnological applications in enhancement of Food Quality Microbial role in food products Yeast, Bacterial and other Microorganisms based process and products Unit Operation in Food Processing, Food Deterioration and its Control.

Unit 4: Agriculture biotechnology **12L**

GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants Bt Crops, BT Cotton and BT brinjal, Golden Rice

Unit 5: Marine Biotechnology

Introduction to Marine Biotechnology, Bioprospecting, Methods for Microbial Bioprospecting in Marine Environments , Biotechnological Potential of Marine Microbes **,** Bioactive compounds from other Marine Organisms:fungi, Microalgae, Seaweeds, Actinomycetes, sponges

COURSE OUTCOME

1. Obtain clarity on the functioning of marine ecosystem
2. Elucidate on the use of marine organisms and their applications in industry
3. Define biotechnology and its growth over time
4. Enlist and explain its major applications and areas under research
5. Link major allied sciences to this field
6. Focus on major application areas of healthcare, food, beverage and drug industry
7. Enlist and distinguish its past and existing commercial products from major biotech industries

Text/ References

1) Biotechnology: Environmental Processes- Rehm and Reed- Wiley
2) Molecular Biotechnology- Glick and Pasterman ASM Press

BTEB2011	**INTRODUCTION TO BIOTECHNOLOGY LAB**	**0L:0T:4P**	**2Credits**

LIST OF EXPERIMENTS

1. Biotechnology Lab
2. Lab Equioments
3. Detection of food adulterants.
4. Study of marine organisms.

BTEB3020	Immunology	4L:0T:0P	4 Credits

COURSE OBJECTIVE

- To Understand of the overview of immune system including cells, organs and receptors.
- To learn structure and functions of different classes of immunoglobulins, the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.
- To understand mechanisms involved in different types of hypersensitivity, and the importance of conventional vs.recombinant vaccines.
- To get acquainted with the importance of antigen-antibody interaction in disease diagnosis.
- To understand the principles of tolerance, autoimmunity and the role of immunity in protection against pathogens**.**

Unit 1 Introduction to Immunology (12 lectures)

Immune Response - An overview, components of mammalian immune system Molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

Unit 2 Immunoglobulin regulation (12 lectures)

Regulation of immunoglobulin gene expression – clonal selection theory, Allotypes & idiotypes, allelic exclusion immunologic memory, Heavy chain gene transcription, genetic basis of antibody diversity, Hypotheses (germ line & somatic mutation), antibody diversity.

Unit 3. MHC(12 lectures)

Major Histocompatibility complexes – class I & class II MHC antigens, Antigen processing.

Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

Unit 4. Immunotechniques (12 lectures)

Antigen antibody interaction techniques- Precipitation Reactions: Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis Agglutination Reactions: Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests. Synthesis of Monoclonal antibodies & Applications.

Unit 5 DNA Vaccines (12 lectures)

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents,Passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA

COURSE OUTCOME

- Students will be able to understand and apply basic microbiological techniques and correlate them with their fundamental concepts in the subject.
- Students will be able to understand and apply basic immunological techniques and correlate them with their fundamental concepts in the subject.

Text/ Reference Books

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
3. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
5. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
6. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
7. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publications.

BTEB3021	Immunology Lab	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Passive Agglutination- RA Factor Test.
8. ELISA (Kit based).
9. Dot ELISA
10. Single radial immunodiffusion
11. Ouchterlony double immunodiffusion

BTEB4010	PHARMAGENOMICS	4L:0T:0P	4 Credits

Course learning objectives:

The objectives of this course are

1. To understand different antimicrobial agents
2. To learn the general principles of pharmacology
3. To understand the concept of toxicology
4. To study the mechanism of drug absorption and distribution
5. To understand basic and regulatory toxicology

Detailed Syllabus:

Unit I- Chemotherapeutic agents

Discovery and Design of antimicrobial, Classification of Antibacterial agents, Selective toxicity, MIC, MLC, Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin Injury to plasma membrane: Polymyxin, Inhibition of protein synthesis: Aminoglycosides, Tetracyclines, Chloramphenicol, Macrolides Erythromycin, Inhibition of nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole, Antimetabolites: Sulphonamides, Trimethoprim Drug resistance: Mechanism origin, transmission, Use and misuse of antimicrobial agents, Antifungal drugs, Antiviral drugs.

Unit 2 General principles of pharmacology

Mechanism of drug action , drug receptors and biological responses second-messenger systems, the chemistry of drug–receptor binding, dose–response relationship: therapeutic index, ED, LD, Potency and Intrinsic Activity, Drug antagonism

Unit 3 Drug Absorption and distribution

Absorption of drugs from the alimentary tract, factors affecting rate of gastrointestinal absorption, absorption of drugs from lungs and skin , absorption of drugs after parenteral administration factors influencing drug distribution , binding of drugs to plasma proteins, Physiological barriers to drug distribution

Unit 4 Basic and regulatory toxicology

Background Definitions Causation: degrees of certainty Classification, Causes Allergy in response to drugs, Effects of prolonged administration: chronic organ toxicity , Adverse effects on reproduction Poisons: Deliberate and accidental self-poisoning, Principles of treatment Poison-specific measures General measures , Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, herbicides and pesticides, biological substances (overdose of medicinal drugs is dealt with under individual agents**)**, Incapacitating agents: drugs used for torture, Nonmedical use of drugs

Text /Reference Books:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier
5. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
6. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
7. Medical Microbiology by Patrick Murray 5th edition

8. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
9. Understanding Viruses by Teri Shors
10. Mim's Medical Microbiology 5th edition
11. Casarett & Doull's Toxicology- The Basic Science Of Poisons

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Elucidate the concepts of pharmacology
2. Comment on causes of allergic reactions with response to drug or poison
3. Obtain clarity about mechanism of absorption of drugs from different tissues
4. State the mechanism of action of different antimicrobials

BTEB4011	**PHARMAGENOMICS LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Antibiotic sensitivity test using agar cup method
2. Antibiotic sensitivity test using paper disc method
3. Antibiotic sensitivity test using ditch method.
4. Synergistic action of two drugs
5. LD 50, ED 50 evaluation using suitable models

----------MICROBIOLOGY----------

MCRB2020	**BACTERIOLOGY**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To provide in-depth knowledge of bacterial cell structure, its cultivation, growth and reproduction.
2. To gives insight into bacterial diversity and its significance.
3. To give hands on training of basic and very important bacteriological techniques which will give the student a strong base in microbiology

Detailed Syllabus:

Unit 1 Bacteriological techniques Lectures: 5

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

Unit 2 Microscopy Lectures: 6

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluoresence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

Unit 3 Reproduction in Bacteria Lectures: 3

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit 4Bacterial Systematics Lectures: 8

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and archaebacteria

Unit 5 Important archaeal and eubacterial groups Lectures: 16

Archaebacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus, Thermoproteus) and Euryarchaeota [Methanogens (Methanobacterium, Methanocaldococcus), thermophiles (Thermococcus, Pyrococcus, Thermoplasma), and Halophiles (Halobacterium, Halococcus)] Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative: Non proteobacteria: General characteristics with suitable examples Alpha proteobacteria: General characteristics with suitable examples Beta proteobacteria: General characteristics with suitable examples Gamma proteobacteria: General characteristics with suitable examples

Delta proteobacteria: General characteristics with suitable examples Epsilon proteobacteria: General characteristics with suitable examples Zeta proteobacteria: General characteristics with suitable examples Gram Positive: Low G+ C (Firmicutes): General characteristics with suitable examples High G+C (Actinobacteria): General characteristics with suitable examples Cyanobacteria: An Introduction

Text /Reference Books:

1. Atlas RM. (1997). Principles of Microbiology.
2. 2nd edition. WM.T.Brown Publishers. 2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
7. GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Cappucino J and Sherman N. **(2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited**

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will gain knowledge about morphology, structure and organisation of different cell components and be able to differentiate between cell walls of Gram positive and Gram-negative bacteria, cell walls and cell membranes of archaea and eubacteria.
2. Will also be able to explain gram and acid-fast staining reactions and effect of antibiotics and enzymes on cell wall structure.
3. Will get familiar with various techniques used for isolation, cultivation and preservation of different types of bacterial cultures. Will gain insight into working and importance of compound microscope.
4. understand nutritional requirements of different types of bacteria and formulation of media for bacterial growth.
5. Will be able to briefly explain methods of asexual reproduction in bacteria. Will understand different phases of growth curve and be able to define generation time and growth rate.
6. Can define and differentiate various types of classifications. Will gain insight into techniques used in polyphasic bacterial taxonomy.
7. Will get acquainted with differences between archaea and eubacteria and can list their important general characteristics along with ecological significance and economic importance.

MCRB2021	**BACTERIOLOGY Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Preparation of different media: synthetic media BG-11, Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.

MCRB3030	**MEDICAL MICROBIOLOGY**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

1. To introduce and acquaint the students with the key aspects of medical microbiology related to the diverse microbial pathogens, their virulence mechanisms, diagnostic methods and brief outline of the functional aspects of antimicrobial chemotherapy.
2. To deals with the recent development of new molecular diagnostic methods and the global spread and re-emergence of infectious diseases.

Detailed Syllabus:

Unit 1 Normal microflora of the human body and host pathogen interaction Lectures: 8

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

Unit 2 Sample collection, transport and diagnosis Lectures: 5

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests,Complement fixation, PCR, DNA probes).

Unit 3 Bacterial diseases Lectures: 15

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Respiratory Diseases: Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis Gastrointestinal Diseases: Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum, Clostridium difficie

Unit 4 Viral diseases Lectures: 14

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Unit 5 Protozoan and Fungal diseases Lectures: 5

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis

Text /Reference Books:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition**,** University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will have gained an in depth knowledge about the spectrum of diseases caused by bacterial pathogens, and an understanding of the course of disease development and accompanying symptoms.
2. Will become familiar with the methods of transmission, epidemiological aspects as well as prevention and control methods.
3. Will become acquainted with the spectrum of diseases caused by viral pathogens. Also will understand the course of disease development and symptoms seen in diseases of different organ systems.
4. Will understand the causation of fungal and protozoal diseases and methods of prevention and control.
5. Will learn about the current approaches to diagnosis of diseases.

MCRB3030	**MEDICAL MICROBIOLOGY LAB**	**0L:0T:4P**	**2 Credits**

SUGGESTIVE LIST OF EXPERIMENTS:

1. Identify bacteria (any three of E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method

5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
7. Study of various stages of malarial parasite in RBCs using permanent mounts.

MCRB4020	FOOD AND DAIRY MICROBIOLOGY	4L:0T:0P	4 Credits

Course learning objectives:

The objectives of this course are

1. to acquaint students with the role of microorganisms in association with foods, highlighting both their beneficial and harmful activities and their applications in the food industry
2. to understand the concept of quality control of food.

Detailed Syllabus:

Unit 1 Foods as a substrate for microorganisms Lectures: 8

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2 Microbial spoilage of various foods Lectures: 10

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit 3 Principles and methods of food preservation Lectures: 12

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit 4 Fermented foods Lectures: 10

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5 Food borne diseases (causative agents, foods involved, symptoms and preventive measures) Lectures: 10

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Text /Reference Books:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will be aware of the possible sources of contamination of foods and the parameters affecting microbial growth in foods.
2. Will gain insight into the microbial spoilage of some foods
3. Will acquire an in-depth knowledge of various physical and chemical methods used for food preservation.
4. Will be acquainted with microbial production of fermented dairy and non-dairy food products.
5. Will also be able to understand the health benefits of prebiotics, probiotics and synbiotics.
6. Will be conversant with some food-borne diseases and will be able to explain methods for detection of food borne pathogens.

MCRB4021	**FOOD AND DAIRY MICROBIOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. MBRT of milk samples and their standard plate count.

2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.

----------BIOINFORMATICS----------

BINB2010	**INTRODUCTION TO BIOINFORMATICS**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To Learn and understand basic concepts of Bioinformatics
2. To understand various databases.
3. To learn and understand protein databases.
4. To understand nucleic acid databases.
5. To learn about genomic databases.

Unit 1: Introduction (12 Lectures)

1.1. Definition ,History , branches , scope and research areas in Bioinformatics
1.2. Human genome project
1.3. Role of computer in bioinformatics
1.4. Applications and BIO-IT

Unit 2: Introduction to databases (12 Lectures)

2.1. Introduction to genomics and proteomic data, post genomic era.
2.2. Data acquisition- functions and purposes.
2.3. Biological databases- relational and object oriented concepts.
2.4. Information retrieval from biological databases- ENTREZ and SRS.
2.5. Methods for presenting large quantities of data- sequence and strucrure viewer

Unit 3: Introduction to Nucleic acid Databases (12 Lectures)

3.1. Primary and secondary database, genebanks.
3.2. EVBC nucleotide, sequence data bank-DDBJ.
3.3. RNA sequence databases: 16S & 23S rRNA, mutation databases, HIV sequence database.
3.4. NON CODE sequence submission tools- Sequin, Webin , Sakura, bankIT.

Unit 4: Protein Sequence Databases (12 Lectures)

4.1. Protein Sequence Databases- PIR, SWISSPORT, UNIPORT, EMBL,EXPASY, NCBI MIPS.
4.2. Motiff databases- eblocks, PROSITE
4.3. Protein domain databases-ADDA, INTERPRO, Pfam.

Unit 5: Structural Databse (12 Lectures)

5.1. PDB, PDB sum, CATH/SCOP,MMDB, SWISS- MODEL.
5.2. Repository ModBase, Protein Model Portal.
5.3. Eurocarb DB, DIP, BIND, STRING.

Text /Reference Books:

2. Orpita basu & Sinninder kaur, Thakural ,"Bioinformatics databases tools, Alogrithm, 2007, Oxford University Press.
3. Higgins D, Willie Taylor " Bioinformatics, Sequence, Structure and data bank, A practical approach, 2000, First edition, Oxford University Press.

Allwood T, david Parry Smith; Introduction to bioinformatics, 2008, Pearson education, Singapore

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Gain an understanding of the basic concepts of Bioinformatics and Biostatistics
2. Understand the tools used in Bioinformatics.
3. Apply the various Statistical tools for Analysis of Biological Data

BINB2011	**Introduction to Bioinformatics Lab**	**0L:0T:4P**	**4 Credits**

LIST OF EXPERIMENTS:

1. To explore NCBI.
2. To explore gene bank.
3. To explore PDB.
4. To perform sequence alignment using BLAST.
5. To access the SCOP and CATH databse to study protein classification.
6. To visualize protein using Rasmol.
7. To explore STRING database.

BINB3010	**CONCEPTS IN BIOINFORMATICS**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

1. List the concepts and applications of sequence searching
2. Define the concepts of homology, identity, orthologues, paralogues
3. Provide examples of basic sequence alignment, introducing concepts of point mutations, deletions, insertions etc.
4. Provide an outline of the different approaches to sequence alignment - exhaustive vs. heuristic

Detailed Syllabus:

Unit 1: Introduction (12 lectures)

1.1. Introduction, Sequence alignment
1.2. Scoring Matrix- PAM and BLOSUM
1.3. Gaps and Gap penalties

1.4. Different types of Gap weights and Application of Gaps**.**

Unit 2: Alignments (12 lectures)

2.1. Pairwise alignment: DotPlot analysis.

2.2. Dynamic programming- Needleman- Wunch Algorithm, Smith- Waterman algorithm, Edit distance dynamic program ming.

2.3. Clusrtal W, TCOFFEE, Profile methods- Gribskov profile, PSI_BLAST

2.4. Multiple segment alignment- sum of pairs, Divide and conquer, Progressive and Iterative alignment

Unit 3: Cluster detection (12 lectures)

3.1. Phylogenetic relationships, Clustering and Phylogeny

3.2. Phylogenetic analysis- concept of Phylogenetic tree, Methods of Phylogeny analysis- Diastance and character based methods.

3.3. Motif detection

3.4. Protein family databases.

Unit 4: Data Mining(12 lectures)

4.1. Data Mining- introduction and definition.

4.2. Data Mining problem and Data Mining Techniques, Tools and Methods.

4.3. Management of databases.

4.4. DBMS. Difference between DBMS and file system.

Unit 5 Metabolomics (12 lectures)

5.1. metabolic pathway database (KEGG pathway database)

5.2. Concept of Metablome and Metabolomics

5.3. Drug discovery and Design- target identification, target validation, lead identification, lead optimization, Priclinical Pharmacology and Toxicology.

5.4. Chemoinformatics tools for drug discovery- Chemical structure representation(SMILE & SMART), Chemical datatbases (CSD,ACD,WDI, PUBCHEM and Chembank)

Text /Reference Books:

1. Orpita basu & Sinninder kaur, Thakural ,"Bioinformatics databases tools, Alogrithm, 2007, Oxford University Press.
2. Higgins D, Willie Taylor " Bioinformatics, Sequence, Structure and data bank, A practical approach, 2000, First edition, Oxford University Press.
3. Allwood T, david Parry Smith; Introduction to bioinformatics, 2008, Pearson education, Singapore.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Extract and generate pairwise sequence alignments for a protein sequence of interest
2. Describe and interpret the metrics used to assess the quality of a pairwise sequence alignment, identity versus similarity
3. Describe the differences between homologues, paralogues and orthologues

4. Use a pairwise sequence approach to identify mutations between two sequences

BINB3011	**Concepts in Bioinformatics Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

2. To perform sequence alignemt using clustal W.
3. To study phylogenetic relationship using PHYLIP/MEGA.
4. To find motif using motif search.
5. To explore pathway database: KEGG database.

BINB4010	**COMPUTER AIDED DRUG DESIGN.**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To design potential lead molecules against any disease that may be explored further as a potential candidate for the drug development.
2. To learn QSAR and SAR
3. To understand the concept of molecular docking
4. To learn the details of molecular modeling

Unit 1: Introduction to Drug Discovery and Development (12 lectures)

1.1.Stages of drug discovery and development

1.2. Lead discovery and Analog Based Drug Design Rational approaches to lead discovery based on traditional medicine,

1.3. Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

1.4. Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

Unit 2: QSAR and SAR (12 lectures)

2.1.Quantitative Structure Activity Relationship (QSAR)

2.2. SAR versus QSAR, History and development of QSAR,

2.3. Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Unit 3: Molecular docking (12 lectures)

3.1. MolecularModelingandVirtual Screening techniques: Drug likeness screening,

3.2. Concept of pharmacophore mapping and pharmacophore based Screening,

3.3. Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening.

3.4. *De novo* drug design.

Unit 4: Informatics (12 lectures)

4.1.Informatics & Methods in drug design
4.2. Introduction to Bioinformatics, chemoinformatics.
4.3. ADME databases, chemical, biochemical and pharmaceutical databases.

Unit 5: Molecular Modeling (12 lectures)

5.1. Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.
5.2. Energy Minimization methods and Conformational Analysis,
5.3. Global conformational minima determination.

Text /Reference Books:

1. Advanced Concepts in Structural Bioinformatics: Structural Bioinformatics: Philip E. Bourn (Editor), HelgeWeissig (Editor). ISBN: 978-0-471-20199-1
2. Protein Structure Prediction: A Practical Approach (The Practical Approach Series , No 170) by Michael J. E. Sternberg
3. Computer-aided Drug Design: Practical Application of Computer-Aided Drug Design (Hardcover) by Charifson (Author)
4. Computer-Aided Drug Design. Methods and Applications. Edited by Thomas J. Perun and C. L. Propst Marcel Dekker

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Feasibility study of a drug development project
2. Design and optimize lead molecules against drug target, andusing ligand-basedapproach
3. Determination of pharmacophore from lead molecules and active sites and use of pharmacophore for lead discovery
4. Development of potential drug molecule and pharmacophore databases for virtual screening
5. Use of molecular fragments for lead discovery and implementation of statistical approaches for lead molecule discovery

BINB4011	**Computer aided drug design. Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Installation of various drug design software and assignment 'Project'
2. Generation of 3D optimized structure of a "Ligand" molecule
3. Preparation of target and ligand molecules for docking
4. Virtual library Preparation" of lead molecules
5. Docking of ligands into a receptor (active site)
6. Flexible docking of ligand with target
7. Fragment docking using '*De Novo'* Receptor and '*De Novo'* Links (LUDI algorithm)
8. Pharmacophore modeling of ligands
9. Pharmacophore-based database searching and *de novo* design of ligand against an active site
10. Development of 3D QSAR model by using "Discovery Studio"
11. ADME property and toxicity predictions of lead molecule (usingTOPKAT)

----------BIOCHEMISTRY----------

BCHB2012	**ENZYMES**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life,
2. To develop an understanding of enzyme kinetics, mechanism of enzyme action and their regulation.
3. To outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry.

Unit 1 Enzyme kinetics Lectures: 10

Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver- Burk plot, Eadie-Hofstee and Hanes plot. Km and Vmax, Kcat and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme.

Unit 2 Bisubstrate reactions Lectures: 2

Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).

Unit 3 Enzyme inhibition and Mechanism of action of enzymes Lectures: 8

Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues.

Unit 4 Regulation of enzyme activity Lectures: 8

Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage- zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit 5 Involvement of coenzymes in enzyme catalysed reactions and Applications of enzym

TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid. Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

Text /Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-42 92-3414-8.
2. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.
3. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

Course Outcomes:

At the end of this course :

1. Students will learn the nature and importance of enzymes in living systems
2. Students will gain insight into the thermodynamic and molecular basis of catalysis by enzymes and the underlying basis of their specificity

3. Students will learn about the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors
4. Students will also learn to appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the cell
5. students will learn applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.

BCHB2021	**ENZYMES LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
3. Effect of pH on enzyme activity
4. Determination of Km and Vmax using Lineweaver-Burk graph.
5. Enzyme inhibition - calculation of Ki for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.
7. Coupled assay of glucose-6-phosphate dehydrogenase

BCHB3020	**MEMBRANE BIOLOGY AND BIOENERGETICS**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

1. Knowledge of membrane composition, structure-function relationship and properties.
2. Understanding of mechanism of membrane transport
3. Knowledge of basics of Bioenergetics and mechanisms of oxidative phosphorylation and photophosphorylation

2. Detailed Syllabus:

Unit 1 Introduction to biomembranes and Membrane Strucures Lectures: 4

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems. Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.

Unit 2 Membrane dynamics Lectures: 6

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Unit 3 Membrane transport Lectures: 10

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins**.** Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactosepermease, Na+-glucose symporter. ABC family

of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Unit 4 Introduction to bioenergetics Lectures: 6

Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 5 Oxidative phosphorylation Lectures : 12

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Text /Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H.Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641- 0962-1.
2. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
3. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
4. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the general composition and structure of biomembranes.
2. Understand the basic properties of membranes such as membrane fluidity.
3. Have knowledge about the various types of membrane transport mechanisms.
4. Understand the basic tenets of Bioenergetics.
5. Understand the concept of chemiosmotic theory and the mechanism of Oxidative phosphorylation and ATP synthesis.
6. Understand the basic mechanisms of photophosphorylation in plants and microbes

BCHB3021	MEMBRANE BIOLOGY AND BIOENERGETICS LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.

BCHB4030	HORMONE: BIOCHEMISTRY AND FUNCTION	4L:0T:0P	4 Credits

Course learning objectives:

The objectives of this course are

6. To provide an understanding of the process of cellular communication including signal reception, transduction, amplification and response.
7. To imparts an understanding of the different endocrine factors that regulate metabolism, growth, ionic homeostasis, glucose homeostasis and reproductive function

Detailed Syllabus:

Unit 1 Introduction to endocrinology Lectures : 6

Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.

Unit 2 Hormone mediated signaling Lectures : 16

Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP3, DAG, Ca2+, NO. Effector systems - adenyl cyclase, guanyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk.

Unit 3 Hypothalamic and pituitary hormones Lectures : 8

Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus.

Unit 4 Thyroid hormone Lectures : 4

Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease.

Unit 5 Hormones regulating Ca2+ homeostasis Lectures : 6

PTH, Vitamin D and calcitonin. Mechanism of Ca2+ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.

Text /Reference Books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-09621.
2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
4. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893300-6.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand and appreciate the different cognate and non-cognate modes of communication between cells in a multi-cellular organism
2. Understand the role of endocrine system in maintaining ionic and glucose homeostasis
3. Should be able to describe molecular, biochemical and physiological effects of all hormones and factors on cells and tissues.
4. Understand the integrative communications that regulate, growth, appetite, metabolism and reproduction

BCHB4031	**HORMONE: BIOCHEMISTRY AND FUNCTION LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Glucose tolerance test.
2. Estimation of serum Ca2+.
3. Estimation of serum T4.
4. Estimation of serum electrolytes.
5. Case studies

----------**CHEMISTRY**----------

CHYB1010 Inorganic Chemistry-I 4L:0T:0P 4 Credits

Course Objectives:

1. Know the discovery of electron, proton and neutron and their characteristics. 00

2. To understand the nature electromagnetic radiation and quantum theory.
3. To understand the periodic law and significance of atomic no and electronic configuration as the
basic for periodic classification.
4. To understand Chemical Bonding and Nature of Chemical Bonding
UNIT-1: Atomic Structure and Periodicity of Elements (15L)
1.1 Bohr's theory and its limitations. atomic spectrum of hydrogen atom.
1.2 Wave particle duality, Heisenberg uncertainty principle.
1.3 Schrödinger's wave equation, significance of ψ and ψ.
1.4 Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of
wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves.
1.5 Shapes of s, p and d atomic orbitals,
1.6 Electrons filling rules in various orbitals: a)Aufbau's principle b)Hund's rule of Maximum
multiplicity c) Pauli's exclusion principle electonic configuration of Elements, Stability of empty, half filled and completely filled orbitals
1.7 Periodicity of the elements: General discussion of elements: a) Electronic configuration b) atomic radii d) ionization energy e) Electron Affinity f) Electronegetivity g) Mettalic Character h)Reactivity i) Oxidation State j) Melting and Boiling Points
UNIT-2: Chemical Bonding and Molecular structure (VBT)
(15L)

2.1 Valence Bond Theory(VBT)
2.2 Concept of Hybridization, Different types of Hybridization
2.3Geometry of the Molecules Linear geometry- BeCl 2 (sp hybridization), Planer trigonal geometry- BF 3 (sp 2 hybridization), Tetrahedral geometry- SiCl 4 (sp 3 hybridization), Trigonal
bipyramidal geometry- PCl 5 (sp 3 d hybridization), Octahedral geometry- SF 6 (sp 3 d 2 hybridization) Pentagonal bipyramidal geometry -IF 7 (sp 3 d 3 hybridization)
2.4 Shapes of Molecules: Hybridization of orbitals and directional nature of covalent bond. Sidgwick – Powell
theory. Valence Shell Electron Pair Repulsion (VSEPR) theory, shapes of inorganic molecules and anions such
as BeCl 2 , BF 3 , SiF 4 , NH 3 , H 2 O, OF 2 , Cl 2 O, ClO 2 , PCl3 , PCl 5 , SF 4 , CIF 3 , ICI 3 , PPh 3 , BrF 5 , IF 7 , XeF 4 ,
XeF 6 , CO 2- 3 , NO 3 , PO 3- 4 , ClO 4 , SbF4 , SbF2- 5 , TeF5 ,XeF.+ 5 , l - 3 and l + 3 related species.
UNIT-3: Chemical Bonding and Molecular structure (MOT)

(15L)
3.1 Molecular orbital theory (MOT)
3.2 LCAO method, formation of bonding , anti bonding and nonbonding molecular orbitals.
3.3 Conditions for successful overlap, Types of overlaps - S-S ,S-px, Px-Px, Py-Py and Pz-Pz overlaps.
3.4 Bond order and its significance.
3.5 Energy level sequence for molecular orbital when n=1&2.
3.6 MO diagrams for homonuclear diatomic molecule of 1 st & 2 nd period Elements (He 2 , Li 2 , B 2 , N 2 , O 2).
3.7 Molecular orbital diagrams for heteroatomic diatomic molecules. (CO, NO)
UNIT4:Crystal field Theory (15L)
4.1 Introduction
4.2 Assumption of Crystal Field Theory
4.3 Crystal Field Splitting
4.4 CFSE, Calculation of CSFE
4.5 Factors affecting on CFSE
4.6 Magnetic Properties
4.7 Jahn Teller Distortion
Course Outcomes:
1. Apply the fundamental principles of measurement, matter, atomic theory, chemical
2. periodicity, chemical bonding
3. Apply the chemical Bonding theories to understand the bonding in compounds
4. 3)Apply the VSEPR theory to predict the Structures of Molecules
Reference Books:
1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John
Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry:
CHYB1011 Inorganic Chemistry-I LAB. 0L:0T:4P 2 Credits
1. To prepare standard 0.1 N KMnO 4 solution and to determine the strength of given oxalic acid solution.
2. To standardize supplied EDTA solution by titrating with 0.01 M ZnSO 4 solution and to estimate
amount of calcium from given solution by using Eriochrome Black-T as an indicator.
3. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
4. To determine unknown concentration of Hydrochloric acid conductometrycally.
5. To determine unknown concentration of acid mixtures by conductometrycally

CHYB1020 Physical Chemistry-I 4L:0T:0P 4 Credits

Course Objectives:

1. To apply gas laws in various real life situations.
2. To explain the behaviour of real and ideal gas.
3. To differentiate between gaseous state and vapour.
4. Explain the properties of liquids.
5. To understand Kinetics of reactions
6. To write the expressions for equilibrium constants
7. To understand the concept of ionic equillibria

UNIT-1: Chemical Energetics (15L)

1.1 Introduction, Basic concepts of thermodynamics

1.2 First law of thermodynamics Spontaneous and non-spontaneous process with examples.

1.3 Statements of second law of thermodynamics, Carnot's cycle and its efficiency.(Numericals)

1.4 Entropy, Physical Significance of entropy, Statement of Third Law of thermodynamics and calculation of absolute entropies of substances(Numerical)

UNIT-2: Chemical Equilibrium (15L)

2.1 Chemical Equilibrium: Free energy change in a chemical reaction.

2.2 Thermodynamic derivation of the law of chemical equilibrium.

2.3 Distinction between ΔG and ΔG^o , Le Chatelier's principle.

2.4 Relationships between Kp, Kc and Kx for reactions involving ideal gases.

UNIT-3:Ionic equilibria (15L)

3.1 Strong, moderate and weak electrolytes, degree of ionization.

3.2 factors affecting degree of ionization, ionization constant and ionic product of water.

3.3 Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono

and diprotic acids.

3.4 Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.

Buffer solutions; derivation of Henderson equation and its applications.

3.5 Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages).

3.6 Theory of acid– base indicators; selection of indicators and their limitations.

UNIT-4: Chemical Kinetics (15L)

4.1 Introduction, Rate of reaction, Definition and units of rate constant.

4.2 Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.)

4.3 Order and Molecularity of reaction, Zero order reaction, First order reaction, Characteristics of first
order reaction.examples, Pseudo-unimolecular reactions,examples.

4.4 Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants.

Characteristics of Second order reaction.

4.5 Determination of order of reaction by i) integration method ii) graphical method iii)Half life method.

4.6 Effect of temperature on rate of reaction, Arrhenius equation, Concept of energy of activation.

4.7 Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions.

Comparison of the two theories (qualitative treatment only). Numerical problems.

Course Outcome (COs):

Upon successful completion students should be able to:

1. State and apply the laws of thermodynamics; perform calculations with ideal and real gases; design
practical engines by using thermodynamic cycles; predict chemical
equilibrium and spontaneity of reactions by using thermodynamic principles.
2. To apply the concepts of colloids and gels
3. To learn depth knowledge about liquid states

Reference Books

1. Principles of Physical Chemistry Puri, Sharma and Pathania, Vishal Publishing House, 44th Edition
2. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition
3. Essentials of Physical Chemistry,Bahl , Tuli and Bahl
4. Text Book of Physical Chemistry, Soni and Dharmarha
5. Essentials of Nuclear Chemistry by H J Arnikar, New Age, 4th edition.

CHYB1012 Physical Chemistry-I 0L:0T:4P 2 Credits

(Perform any six experiments)

1. Determination of equivalent weight of Mg by Eudiometer.
2. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
3. Determination of heat of ionization of weak acid by using polythene bottle.

4. Determination of heat capacity of calorimeter for different volumes.
5. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6. Determination of integral enthalpy of solution of salts (KNO 3 , NH 4 Cl).
7. Determination of enthalpy of hydration of copper sulphate.
8. Study of the solubility of benzoic acid in water and determination of ΔH.

Reference Books

1. Experimental Physical Chemistry: A. Findlay.
2. Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publication.)
3. Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)
4. Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)

CHYB2010 Organic Chemistry-I 4L:0T:0P 4 Credits

Course Objectives:

1. Difference between activating and deactivating groups.
2. Correlate the preparation of types of Cycloalkanes, Cycloalkenes.
3. Understand the Concept of stereochemistry
4. Study about the chemistry of Aromatic aldehyde, aromatic ketones and acids.
5. Study about the chemistry of aromatic sulphonic acid and Nitro compounds.

UNIT-1: Fundamentals of Organic Chemistry (15L)

1.1 Introduction, Curved arrow notations,

1.2 Cleavage of Bonds: Homolysis and Heterolysis.

1.3 Organic molecular species: Nucleophiles and electrophiles.

1.4 Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation effect,

1.5 Reactive Intermediates: Generation, Structure, Stability and Reactions of Carbocations, Carbanions and carbon free radicals.

UNIT-2:Streochemistry (15L)

2.1 Introduction, Types of Stereoisomerism, Optical Isomerism.

2.2 Concept of Chirality, Elements of Symmetry, Optical Isomerism in tartaric acid, 2, 3 Dihydroxybutanoic acid.

2.3 Enantiomerism, Diastereomerism and Meso compounds, Geometrical isomerism in C=C,

C=N and alicyclic compounds.

2.4 Nomenclature of stereoisomers: D and L, erythro and threo, R and S, E and Z.

UNIT-3:Aromaticity (15L)
3.1 Introduction, Characteristics properties of organic compounds.
3.2 Meaning of terms: Aromatic, Non aromatic, Antiaromatic, Pseudoaromatic.
3.3 Structure of Benzene: Kekule structure, Resonance structure, M.O. picture,
3.4 Modern theory of Aromaticity,
3.5 Mechanism of Electrophilic substitution reactions: Nitration, Sulphonation, Halogenation
and Friedel craft reaction.
UNIT-4: Cycloalkanes, cycloalkenes and alkadienes (15L)
4.1 Cycloalkanes: - Introduction. Method of formation -
a. By addition of carbene to alkene
b. Action of metallic sodium on dihaloalkane c) Diels - Alder reaction d) By reduction of aromatic compounds,
4.2 Chemical properties- a) Photohalogenation b) Catalytic halogenations c) Catalytic hydrogenation d) Effect of heat e) Reaction with hydrogen halide.
4.3 Cycloalkenes : Introduction, Method of formation from cyclic compounds, Chemical
Properties - a) Hydrogenation b) Addition of Halogens and halogen acids, c) Allylic halogenations
Course Outcomes:
1. Working through this course, students are expected to apply their knowledge to problem-solve,
deduce structures, and synthesize simple organic molecules using the studied reactions.
2. Relationships between organic chemistry and other disciplines are noted.
Reference Books
1. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
2. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
3. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
4. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
6. D.Nasipuri :Stereochemistry of Organic compounds

CHYB2011 Organic Chemistry-I lab 0L:0T:4P 2 Credits
Estimations (any two):
1. Estimation of aniline. (by bromination method)
2. Estimation of acetamide.

3. Estimation of Aspirin.
Organic Qualitative Analysis:
1.Detection of physical constant, type, functional group, elements, and Confirmatory test.
2.Identification of Organic Compounds (at least eight) (four containing at least one extra element- N, S,
Cl. Br, I)Acids: Oxalic acid, Benzoic acid, cinnamic acid Phenols: Beta-Naphthol, ResorcinolBase:
Aniline, p-Nitroaniline Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene, Thiourea,
Bromobenzene Purification of organic compounds by crystallization (from water and alcohol) and
distillation.

Reference Books
1. Vogel's Text Book of Quantitative Chemical Analysis. (Longmann) ELBS Edition.
2. Vogel's Text Book of Qualitative Chemical Analysis. (Longmann) ELBS Edition.
3. Hand book of Organic Qualitative Analysis : Clarke.
CHYB2020 Analytical Chemistry-I 4L:0T:0P 4 Credits
Course Objectives:
1. To provide a basic knowledge and understanding of essential chemical and physical principles for
analytical chemistry.
2. To introduce basic analytical techniques and practical aspects of classical chemical analysis.
3. To solve problems related to chemical analysis and interpret analytical results.
UNIT-1: Introduction to analytical Chemistry (20L)
1.1 Importance of analysis
1.2 Analytical processes (Qualitative and Quantitative)
1.3 Methods of analysis (Only classification)
1.3 Sampling of solids, liquids and gases
1.4 Errors, types of errors (determinate and indeterminate).
1.5 Accuracy (Absolute and relative error) (Numericals)
1.6 Significant figures, mean, median, standard deviation (Numerical problems expected)
UNIT-2: Chromatography (20L)
2.1 Introduction to Basic principles of Chromatography, Basic terms, Classification of Chromatography
2.2 Paper chromatography- Principle, Methodology- types of paper and treatment, Sample loading, choice of solvent, development of ascending, descending, circular location of spots, determination of R f value.
2.3 Thin layer chromatography; principle ,solvent system, stationary phases, preparation of TLC

plate
2.4 Preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of
spot, Rf value, Applications, advantages and disadvantages
2.5 Comparison of paper chromatography & TLC
UNIT-3: Theory of titrimetric Analysis (20L)
3.1 Acid-base indicators, Theory of indicators w.r.t. Ostwald's ionization theory and quinoid theory.
3.2 Neutralization curves and choice of indicators for Strong acid-strong base, Strong acid-weak base,
Strong base-weak acid.
3.3 Complexometric titrations: Introduction, Types EDTA titrations, Metallochromic indicators-
Eriochrome black- T, Indicator Action of Eriochrome black- T.
3.4 Physical analysis of water – pH, Conductance, Colour, odour, Turbidity and taste.
3.5 Chemical Analysis – Total Dissolved solids , Hardness, Salinity, Alkalinity, Acidity, Sulphates,
Nitrates,Dissolved Oxygen, Chemical Oxygen Demand, Biological Oxygen Demand
Course Outcome (COs):
After examination the student should be able to:

1. Explain the theoretical principles and important applications of classical analytical methods within
titration (acid/base titration, complexometric titration, redox titration).
2. Various techniques within gravimetric and coulometric methods.
3. Explain the theoretical principles of selected instrumental methods within electroanalytical and
spectrometric/spectrophotometric methods, and main components in such analytical instruments.
Reference Books
1. Textbook of quantitative Inorganic analysis-A.I. Vogel
2. Instrumental methods of Chemical analysis-H. Kaur
3. Instrumental methods of Chemical analysis-B.K. Sharma
4. Instrumental methods of Chemical analysis-Chatwal Anand

CHYB2021 Analytical Chemistry-I lab 0L:0T:4P 2 Credits

I. Separation Techniques by: Chromatography
(a) Separation and identification of the monosaccharide present in the given mixture (glucose &

fructose) by paper chromatography. Reporting the Rf values.
(b)Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the
basis of their Rf values.
(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC Solvent
Extractions: To separate a mixture of Ni2+& Fe2+ by complexation with DMG and extracting the
Ni2+-DMG complex in chloroform, and determine its concentration by pectrophotometer.
II. Analysis of soil:
(i) Determination of pH of soil.
(ii) Estimation of calcium, magnesium, phosphate
III. Ion exchange: Determination of exchange capacity of cation exchange resins and anion exchange resins.
IV. Spectrophotometry
1. Determination of pKa values of indicator using spectrophotometer.
2. Determination of chemical oxygen demand (COD).

Generic Electives offered by Department of Zoology for students in B.Sc. (Hons.) in Allied Programmes

Semester	Course Code	Generic Electives	(L-T-P)	Credits
I	ZOOB1010+ZOOB1011	Non-Chordates	4-0-2	6
I	BINB1020+BINB1021	Biomolecules and Cell Biology	4-0-2	6
II	ZOOB2010+ZOOB2011	Chordates	4-0-2	6
II	ZOOB2020+ZOOB2021	Animal physiology and ecology	4-0-2	6
III	ZOOB3010+ZOOB3011	Animal Physiology: Controllong and coordinating system	4-0-2	6
III	BTEB3040+BTEB3041	Basics Of Neuroscience Theory	4-0-2	6
III	MCRB3010+MCRB3011	Microbiology	4-0-2	
IV	BTEB4030+BTEB4031	Molecular Biology	4-0-2	6
IV	BTEB4040+BTEB4041	Immunology	4-0-2	6
IV	BCHB4210+BCHB4211	Biochemistry Of Metabolic Processes	4-0-2	

*** Detailed Syllabus for these courses are the same as the courses of the same names and codes offered as DSC courses of the B.Sc. (Hons.) Zoology Programme.**

List of Discipline Specific Elective Papers: (Credit: 06 each)

Semester	Course Code (T+P)	Course Name	(L-T-P)	Credits
V	ZOOB5310+ZOOB5311	Computational biology	4-0-2	6
V	ZOOB5320+ZOOB5321	Animal biotechnology	4-0-2	6
V	ZOOB1330+ZOOB1331	Parasitology	4-0-2	6
VI	ZOOB6310+ZOOB6311	Wild life conservation and management	4-0-2	6
VI	BTEB6310+BTEB6311	IPR & biosafety	4-0-2	6
VI	BTEB6310+BTEB6311	Nanotechnology	4-0-2	6

ZOOB5310	COMPUTATIONAL BIOLOGY	2L:0T:0P	4 Credits

Course Learning Objective:

1. To Introduce the students to various computational methods and software tools for understanding biological databases, gene sequence alignments, gene annotation, protein structure predictions, drug discovery, molecular phylogeny, metagenomics, etc

2. To make students get basic hands-on training and develop skill-set required for computational analysis of biological data. Recently many interest groups, such as governments, universities, research institutes and industries find Bioinformatics as a crucial area of research and development due to generation of large-scale genome sequencing data

Unit 1: Introduction to Bioinformatics

1.1. Importance, Goal, Scope; Genomics, Transcriptomics, Systems Biology, Functional Genomics, Metabolomics, Molecular Phylogeny;
1.2. Applications and Limitations of Bioinformatics

Unit 2: Biological Databases

2.1.Introduction to biological databases; Primary, secondary and composite databases;
2.2.Nucleic acid databases (GenBank, DDBJ, EMBL and NDB);
2.3. Protein databases (PIR, SWISS-PROT, TrEMBL, PDB);
2.4. Metabolic pathway database (KEGG, EcoCyc, and MetaCyc);
2.5.Small molecule databases (PubChem, Drug Bank, ZINC, CSD)

Unit 3: Data Generation and Data Retrieval

3.1. Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray),
3.2. Sequence submission tools (BankIt, Sequin, Webin);
3.3. Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); 3.4. Sequence annotation; Data retrieval systems (SRS, Entrez)

Unit 4: Basic Concepts of Sequence Alignment

4.1. Scoring Matrices (PAM, BLOSUM), Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA);
4.2. Local and global alignment, pair wise and multiple sequence alignments;
4.3. Similarity, identity and homology of sequences.

Unit 5: Applications of Bioinformatics

5.1.Structural Bioinformatics (3-D protein, PDB),
5.2. Functional genomics (genomewide and high throughput approaches to gene and protein function),
5.3.Drug discovery method (Basic concepts)

Text /Reference Books:

1. Ghosh Z and Mallick B. (2008). Bioinformatics: Principles and Applications, Oxford University Press.
2. Pevsner J. (2009). Bioinformatics and Functional Genomics, II Edition, Wiley Blackwell.
3. Zvelebil, Marketa and Baum O. Jeremy (2008). Understanding Bioinformatics, Garland Science, Taylor and Francis Group, USA.
4. Zar, Jerrold H. (1999). Biostatistical Analysis, IV Edition, Pearson Education Inc and Dorling Kindersley Publishing Inc. USA
5. Antonisamy, B., Christopher S. and Samuel, P. P. (2010). Biostatistics: Principles and Practice. Tata McGraw Hill Education Private Limited, India.
6. Pagana, M. and Gavreau, K. (2000). Principles of Biostatistics, Duxberry Press, USA

COURSE OUTCOME

- Explain the basic concepts of Bioinformatics and Biostatistics and its various applications in different fields of biological sciences,
- Describe theoretically sources of biological data, and list various biological databases – nucleic acids, protein sequence, metabolic pathways and small molecule,
- Identify various file formats of sequence data and tools for submission of data in databases as well as retrieval of gene and protein data from databases
- Annotation of gene sequence and protein structure prediction,
- Perform and explain the underlying mechanisms of pair-wise and multiple sequence alignments and determine phylogenetic relationships
- Describe various computational tools and methodologies and their application in structural bioinformatics, functional genomics and in silico drug discovery

ZOOB5311	COMPUTATIONAL BIOLOGY LAB	4L:0T:0P	4 Credits

List of Experiments

1. Accessing biological databases
2. Retrieval of nucleotide and protein sequences from the databases.
3. To perform pair-wise alignment of sequences (BLAST) and interpret the output
4. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences
5. Predict the structure of protein from its amino acid sequence

ZOOB5320	ANIMAL BIOTECHNOLOGY	4L:0T:0P	4 Credits

Course Learning Objective:

The objectives of this course are:

1. To provides a toolkit in the form of a number of various techniques and processes developed over time to solve problems involving primarily human welfare with focus on health and medicine.
2. To Equips students with basic tools of biotechnology which are a must for everyone interested in pursuing a career in biotechnology.
3. To makes one aware of the scope of this field which encompasses almost every field of science like engineering, research, commercialization and academics.

Unit 1. Introduction

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation

2.1.Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).

2.2. Restriction enzymes: Nomenclature, detailed study of Type II.

2.3. Transformation techniques: Calcium chloride method and electroporation.

2.4. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

2.5. Southern, Northern and Western blotting DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3. Genetically Modified Organisms

3.1. Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection
3.2. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.
3.3. Production of transgenic plants: Agrobacterium mediated transformation.
3.4. Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications

4.1. Animal cell culture, Expressing cloned genes in mammalian cells,
4.2. Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)
4.3. Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

Unit 5 Transgenesis

5.1. Introduction to transgenesis.
5.2. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect.
5.3. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. It gives insight into various cell/tissues culture techniques
2. Understanding of in vitro culturing of organisms and production of transgenic animals.
3. Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms
4. Gains skills in medical, environmental biotechnology, biopesticides, Biotechnology of aquaculture and use of animals as bioreactors
5. This insight allows students to take into consideration about ethical issues involved in production transgenic animals and BT products.

Reference Books:

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
2. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y.,USA.

ZOOB5321	ANIMAL BIOTECHNOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Genomic DNA isolation from E. coli
2. Plasmid DNA isolation (pUC 18/19) from E. coli

3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided..
6. To study following techniques through photographs a. Southern Blotting b. Northern Blotting c. Western Blotting d. DNA Sequencing (Sanger's Method) e. PCR f. DNA fingerprinting
7. Project report on animal cell culture

ZOOB1330	PARASITOLOGY	4L:0T:0P	4 Credits

Course learning Objectives:

The objectives of this course are:

1. To diagnose parasites correctly, understand their life cycle and control them effectively and use some of them as bio control agents.
2. To see, appreciate and understand the diversities of parasites in the whole spectrum of the study of life.
3. To make the students aware about the possible scopes of the subject which include research and applied aspects including entrepreneurial works

Unit 1: Introduction to Parasitology

1.1. Brief introduction of Parasitism, Parasite,
1.2. Parasitoid and Vectors (mechanical and biological vector)
1.3. Host parasite relationship

Unit 2: Parasitic Protists

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of
2.1. Entamoeba histolytica,
2.2. Giardia intestinalis,
2.3. Trypanosoma gambiense,
2.4. Leishmania donovani,
2.5. Plasmodium vivax

Unit 3: Parasitic Platyhelminthes

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of
3.1. Fasciolopsis buski,
3.2. Schistosoma haematobium,
3.3. Taenia solium and
3.4. Hymenolepis nana

Unit 4: Parasitic Nematodes

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of
4.1.Ascaris lumbricoides,
4.2. Ancylostoma duodenale,
4.3. Wuchereria bancrofti and
4.4.Trichinella spiralis.

Unit 5: Parasitic Arthropoda and Parasitic Vertebrates

5.1.Biology, importance and control of ticks, mites, Pediculus humanus (head and body louse), Xenopsylla cheopis and Cimex lectularius
5.2. A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Gain an appreciation the diversity of parasitic infection and the importance of parasitism as a life strategy
2. Know the major groups of parasites and their influence upon animal and human biology and health
3. Have an understanding of the different mechanisms used by different parasites to gain entry to their hosts and survive within them, at the genetic, molecular, cellular, whole organism and population levels
4. Identify key features of the major human parasites, the diseases they cause and understand their life cycles
5. Be able to integrate knowledge about different parasitic organisms and infections; cross reference information from gene to population level, compare and contrast different strategies used within and across different parasitic groups
6. Understand how a parasite interacts with its host at the level of the immune system

Reference Books:

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
5. Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
6. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
7. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.

ZOOB1331	**PARASITOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Study of life stages of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani and Plasmodium vivax through permanent slides/micro photographs

2. Study of adult and life stages of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana through permanent slides/micro photographs
3. Study of adult and life stages of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis through permanent slides/micro photographs
4. Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
5. Study of Pediculus humanus (Head louse and Body louse), Xenopsylla cheopis and Cimex lectularius through permanent slides/ photographs
6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product] Submission of a brief report on parasitic vertebrates

ZOOB6310	WILD LIFE CONSERVATION AND MANAGEMENT	4L:0T:0P	4 Credits

Course Learning Objective:

The objectives of this course are:

1. To acquaint students with varied aspects of wildlife conservation, including its importance, major threats, management of their habitats and populations.
2. The emphasis will be on developing interest and invoking a sense of responsibility among students towards wildlife conservation.
3. The course also explores different techniques, perspectives, and approaches to both identify and achieve wildlife management goals.
4. This course will motivate students to pursue career in the field of wildlife conservation and management.

Unit 1

1.1. Values of wild life - positive and negative;
1.2. Conservation ethics; Importance of conservation;
1.3. Causes of depletion;
1.4. World conservation strategies.

Unit 2: Evaluation and management of wild life

2.1. Habitat analysis, Physical parameters: Topography, Geology, Soil and water;
2.2. Biological Parameters: food, cover, forage, browse and cover estimation;
2.3. Standard evaluation procedures: remote sensing and GIS.

Unit 3: Management of habitats

3.1. Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process;
3.2. Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Unit 4: Population estimation

4.1. Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation;

4.2. Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method.

Unit 5: Management planning of wild life in protected areas

5.1. Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.

5.2. Protected areas National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

Text/ References Books

1. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
2. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.
3. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
4. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
5. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

COURSE OUTCOME

1. Awareness about the importance of wildlife in general, and its conservation and management in particular.
2. Comprehend the application of the principles of ecology and animal behaviour to formulate strategies for the management of wildlife populations and their habitats.
3. Understand the management practices required to achieve a healthy ecosystem for wildlife population along with emphasis on conservation and restoration.
4. Understand the key factors for loss of wildlife and important strategies for their in situ and ex situ conservation.
5. Understand the techniques for estimation, remote sensing and Global Position Tracking for wildlife.
6. Awareness about the wildlife diseases and the quarantine policies.
7. Knowledge about the Protected Area Networks in India, Ecotourism, Ecology of perturbation and Climax persistence.
8. Perform critical thinking, literature review; scientific writing as well as presentations; and participation in citizen science initiatives with reference to wildlife.

ZOOB6311	WILD LIFE CONSERVATION AND MANAGEMENT LAB	0L:0T:4P	2 Credits

List of Experiments:

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

BINB5320	I.P.R. ENTREPRENEURSHIP BIOETIHCS& BIOSAFETY	4L:0T:0P	4 Credits

Course Learning Objective:

The objectives of this course are:

1. To provide an insight and understanding about different aspects of protection of inventions and research developments
2. Learn about procedures for filling protection through Intellectual Property Rights.
3. To provide scopes of protection of diverse intellectual properties and its commercialization forsocio-economic improvement.

Detailed Syllabus

Unit 1. Introduction (12 lectures)

1.1.Introduction to Indian Patent Law.

1.2.World Trade Organization and its related intellectual property provisions.

1.3.Intellectual/Industrial property and its legal protection in research, design anddevelopment.

1.4. Patenting in Biotechnology, economic, ethical and depository considerations.

Unit 2. Entrepreneurship (12 lectures)

2.1. Entrepreneurship: Selection of a product, line, design and development processes

2.2. economics on basic regulations of excise:

2.3. Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

Unit 3 . Bioethics (12 lectures)

3.1. Bioethics – Necessity of Bioethics

3.2. Different paradigms of Bioethics – National & International.

3.3. Ethical issues against the molecular technologies.

Unit 4. Biosafety (12 lectures)

4.1. Biosafety– Introduction to biosafety and health hazards concerning biotechnology.

4.2. Introduction to the concept of containment level

4.3. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. To enable students with basic concepts and knowledge of intellectual property rights.
2. To apply and execute different types of IP protection in research and academics.
3. Able to understand about the mechanisms of different IP protections, registrations and applications Technical
4. To be capable of tackling issues related to IP and its commercialization
5. To learn the strategies for effective IP management and commercialization Analytical skills

Reference Books:

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. 3Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international

BINB5321	**I.P.R. ENTREPRENEURSHIP BIOETIHCS& BIOSAFETY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

BTEB6310	**NANOBIOTECHNOLOGY**	**4L:0T:0P**	**4 Credits**

Course Learning Objective:

The objectives of this course are:

1. Introduction to Nanomaterial and various material used for obtaining nano-materials
2. Learn various approaches or methods used for nanomaterial synthesis.
3. To learn various analytical techniques used for nanomaterial characterization.
4. Learn various applications of nanomaterial in health care, agriculture and environmental monitoring

Detailed Syllabus

Unit 1 Introduction, History &Applications:

1.1**.** Various definitions and Concept of Nano-biotechnology & Historical background. Fundamental sciences and broad areas of Nano-biotechnology.

1.2.Va rious applications of Nanobiotechnology, Cell – Nanostructure interactions

Unit 2 Synthetic methodologies:

2.1. Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterials:
2.2. Lithography method, Electrochemical method, Mechanical Method, Chemical Synthesis, Chemical vapour deposition, Molecular self-assembly, Laser Induced assembly.

Unit 3 Techniques used for the characterization of nanoparticles:
3.1. Principles of microscopy-light, electron, fluorescent confocal, scanning and transmission microscopes, different fixation and staining techniques for EM.
3.2. Principles of spectroscopy-UV, visible, CD, FTIR, NMR, and ESR spectroscopy, structure determination using X-ray diffraction, analysis using light scattering

Unit 4 Nano-biotechnologicalapplications in health and disease:
4.1**.** Properties of different types of nanoparticles normally used in health and disease.
Diagnostics and theranostics application of nanomaterials in health Sciences

Unit 5 Nanobiotechnological applications in Environment and food - detection and mitigation:
5.1**.** Properties of different types of nanoparticles normally used in environmental and food sciences.
5.2 Detection and removal of toxic metal ion from polluted sample and detection and removal of pathogen form food sample.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Introduction to Nano (Basics to Nanoscience and Nanotechnology)
2. Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterial and fundamental properties of Nano-materials(Nano-effect)
3. Introduction to various technique used for the characterization of nanostructures and nanomaterial.
4. Fundamental understanding of nanomaterial/nanobiotechnological application in health and disease.
5. Fundamental understanding of nanomaterial/nanobiotechnological application in Environment and food – detection and mitigation

Reference Books:

1. C. A. Mirkin and C. M. Niemeyer. Nanobiotechnology - II more concepts and applications. (2007) - Wiley VCH.
2. P. Boisseau, P. Houdy, M. Lahmani, Nanoscience: Nanobiotechnology and Nanobiology

List of Skill Enhancement Course (any Two, 1 in each Sem III & Sem IV)

(Credit: 02 each)

Semester	Course Code	Course Name	(L-T-P)	Credits
III	ZOOB3210	Apiculture	2-0-0	2
III	ZOOB3220	Sericulture	2-0-0	2
IV	BTEB4220	Animal Biotechnology	2-0-0	2
IV	BTEB3210	Basics of forensic science	2-0-0	2

ZOOB3210	APICULTURE	2L:0T:0P	2 Credits

Course Objective:

The objectives of this course are:

1. To aware student about the significance of beekeeping as the economically viable industry.
2. To understand the biology and behaviour of bees.
3. To understand techniques of honey bee rearing, optimization of techniques based on climate and the geographical regions, and various measures to be taken to maximize the benefits.
4. To develop entrepreneurial skills required for self-employment in beekeeping sector.

Unit 1: Biology of Bees

History, Classification and Biology of Honey Bees Social Organization of Bee Colony

Unit 2: Rearing of Bees

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: Diseases and Enemies

Bee Diseases and Enemies Control and Preventive measures

Unit 4: Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

COURSE OUTCOME

1. Describe the anatomy of the honeybee including the difference between queens, workers and drones.
2. Explain the importance of honeybees to the horticultural industry.
3. Manage a colony of bees in the spring.

4. Describe honeybee behaviour and explain the factors that influence such behaviour.
5. Diagnose honeybees for common pests and diseases in a laboratory

SUGGESTED READINGS

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Bisht D.S., Apiculture, ICAR Publication.
3. Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi

ZOOB3220	SERICULTURE	2L:0T:0P	2 Credits

Course Objective:

The objectives of this course are:

1. To make the student aware about the significance of sericulture as the profit-making enterprise.
2. To understand the biology of silkworms and its nutritional requirement to secrete quality silk.
3. To understand the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.
4. To know about various uses of silk and develop entrepreneurial skills required for self-employment in sericulture and silk production sector

Detailed Syllabus:

Unit 1: Introduction

Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

Life cycle of Bombyx mori Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

COURSE OUTCOME

1. Gives knowledge of silk worm rearing, mulberry cultivation, pests and diseases associated with silk worm, mulberry and various process involved in silk production.
2. It is an agro based cottage industry in India that enables them to get self-employment
3. Depth knowledge of the study of silkworms both physiological as well as commercial purposes including the various processes involved in the formation of silk .

4. Students gain knowledge about various systems study of silkworms and cocoons, other defective cocoons
5. Reeling and significant diseases seen in the silkworms
6. Students feel confident in teaching Sericulture as well as executing research projects

Text/Reference Books

1. Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
2. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
4. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
6. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
7. Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
8. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
9. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

BTEB4220	ANIMAL BIOTECHNOLOGY THEORY	2L:0T:0P	2 Credits

Course Objective:

1. To provides a toolkit in the form of a number of various techniques and processes developed over time to solve problems involving primarily human welfare with focus on health and medicine.
2. To Equips students with basic tools of biotechnology which are a must for everyone interested in pursuing a career in biotechnology.
3. To makes one aware of the scope of this field which encompasses almost every field of science like engineering, research, commercialization and academics

Detailed Syllabus:

Unit 1. Introduction

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation

2.1.Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).

2.2. Restriction enzymes: Nomenclature, detailed study of Type II.

2.3. Transformation techniques: Calcium chloride method and electroporation.

2.4. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization

2.5. Southern, Northern and Western blotting DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3. Genetically Modified Organisms

3.1. Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection

3.2. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.

3.3. Production of transgenic plants: Agrobacterium mediated transformation.
3.4. Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications

4.1. Animal cell culture, Expressing cloned genes in mammalian cells,
4.2. Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)
4.3. Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

Unit 5 Transgenesis

5.1. Introduction to transgenesis.
5.2. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect.
5.3. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. It gives insight into various cell/tissues culture techniques
2. Understanding of in vitro culturing of organisms and production of transgenic animals.
3. Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms
4. Gains skills in medical, environmental biotechnology, biopesticides, Biotechnology of aquaculture and use of animals as bioreactors
5. This insight allows students to take into consideration about ethical issues involved in production transgenic animals and BT products.

Reference Books:

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
2. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.

BTEB3210	BASICS OF FORENSIC SCIENCE	2L:0T:0P	2 Credits

Course Objective:

The objectives of this course are:

1. To organize students' abilities to evaluate competing explanations.
2. Inculcate moral value, professional ethics and business communication skills in the students.

3. To organise students with skills in reconstructing events surrounding an incident and form an opinion based on scientific evidence.
4. To interpret scientific data in the laboratory and the Crime scene.

Detailed Syllabus

Unit 1 Introduction to forensic science (12 lectures)

1.1.Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science,

1.2. branches of forensic science, causes of crime, role of modus operandi in criminal investigation.

1.3. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit 2 Chemicals and explosives (12 lectures)

2.1 Classification of fire arms and explosives, introduction to internal, external and terminal ballistics.

2.2.Chemical evidence for explosives.

2.3. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit 3 Toxicology 12 lectures)

1.1.Role of the toxicologist, significance of toxicological findings,

1.2. Fundamental principles of fingerprinting, classification of fingerprints,

1.3.development of finger print as science for personal identification,

Unit 4 Techniques in forensic science (12 lectures)

5.1.Principle of DNA fingerprinting, application of DNA profiling in forensic medicine,

5.2.Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers,Introduction to Cyber security

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Demonstrate competency in the collection, processing, analyses, and evaluation of evidence.
2. Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.
3. Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.
4. Identify the role of the forensic scientist and physical evidence within the criminal justice system.
5. Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.
6. Identify and examine current and emerging concepts and practices within the forensic science field.

Reference Books:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press,Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001). _
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002). _
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005). _
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997). _
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). _
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

****