



S.V.U.COLLEGE OF SCIENCES, S.V. UNIVERSITY, TIRUPATI
DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY

SEMESTER - I								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total Marks
1	CC	101	Invertebrata & Chordata	4	4	70	30	100
2		102	(A) Biomolecules and Metabolic Regulation	4	3	50	25	75
			(B) Principles of Ecology					
3		103	(A) Developmental Biology	4	3	50	25	75
			(B) Endocrinology					
4	*P	104	Practical-I (related to CC 2 & 3)	6	2	35	15	50
5	SOC	105	(A) Wildlife Conservation and Field Techniques	4	3	50	25	75
			(B) Apiculture					
6		106	(A) Bioanalytical Techniques-I	4	3	50	25	75
			(B) Histology and Histochemistry					
7	*P	107	Practical-II (related to SOC 1 & 2)	6	2	35	15	50
8	Audit Course	109	Indian Knowledge Systems - 1	4	0	0	100	0
			Total	36	20	340	260	500

- CC (Core Courses) - 1st Core Course is mandatory. Student can choose one from 2nd & 3rd Core Courses; *SOC (Skill Oriented Courses)- Student can choose one from each code ; *Practical-I relating to 2nd & 3rd Core Courses and Practical-II relating to 1st & 2nd Skill Oriented Courses (SOC) Audit Course – Zero Credits but Pass mark is mandatory.

SEMESTER - II								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total Marks
1	CC	201	Comparative Animal Physiology	4	4	70	30	100
2		202	(A) Applied Animal Biotechnology	4	3	50	25	75
			(A) Immunotechnology					
3		203	6(A) Neurobiology and Ethology	4	3	50	25	75
			6(B) Genetic Engineering					
4	P	204	Practical III (related to CC 5 & 6)	6	2	35	15	50
5	SOC	205	3(A) Molecularbiology	4	3	50	25	75
			3(B) Health Management in Aquaculture					
6		206	4(A) Enzymology	4	3	50	25	75
			4(B) Economic Zoology					
7	P	207	Practical IV (related to SOC 3 & 4)	6	2	35	15	50
8	OOTC	208	Open Online Transdisciplinary Course – 2	-	2	-	-	-
9	Audit Course	209	Indian Knowledge Systems – 2	4	0	0	100	0
			Total	36	22	340	360	600

- CC (Core Courses) – 4th Core Course is mandatory. Student can choose one from 5th & 6th Core Courses; *SOC (Skill Oriented Courses) – Student can choose one from each code; *Practical - III relating to 5th & 6th Core Courses and Practical - IV relating to 3rd & 4th Skill Oriented Courses (SOC); *Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc., Audit Course – Zero Credits but but Pass mark is mandatory.

SEMESTER - III								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total Marks
1	CC	301	Cell Biology and Immunobiology	4	4	70	30	100
2		302	8(A) Genetics and Evolution	4	3	50	25	75
			8(B) Sustainable Practices in Poultry Farming					
3		303	9(A)Toxicology	4	3	50	25	75
			9(B) Forensic science					
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	5(A) Bioanalytical Techniques-II	4	3	50	25	75
5(B) Biostatistics and Bioinformatics								
6		306	6(A) Microbiology	4	3	40	25	75
			6(B) Techniques in Pathobiology					
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	36	22	340	260	600

- CC (Core Courses) – 7th Core Course is mandatory. Student can choose one from 8th & 9th Core Courses.

*SOC (Skill Oriented Courses) – Student can choose one from each code; *Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,

*Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)

SEMESTER - IV								
S. No	Course	Code	Title of the Course	H/W	C	SEE	IA	Total Marks
1	OOSDC	401	Open Online Skill Development Courses	-	8	-	200	200
2	PW	402	Project Work – Orientation Classes	24	12	300	0	300
*	Conducting classes for competitive exams, communication skills, UGC / CSIR and NET / SLET examinations			12	-	-	-	-
	Total			36	20	300	200	500
Total Semesters				144	84	1320	1080	2200

- Open Online Skill Development Course (OOSDC) - Students can choose any Two relevant courses of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc., to get 8 credits (with 4 credits from each course)

REVISED SYLLABUS W.E.F. 2023-2024

CORE COURSE-101 :INVERTEBRATA & CHORDATA

General Course Objectives:

While studying the Comparative anatomy of Invertebrates and Chordates the student shall be able to:

1. This Course develops concepts in animal Taxonomy and its application, General organization of animal kingdom,
2. Develops concepts regarding various Invertebrate and vertebrate comparative morphology and anatomy.
3. Describes the relationships among animals and the development of coelom
4. Learners gain Knowledge and develop skill over the comparative anatomy of invertebrates and Vertebrates.
6. Enumerate the origin and classification of Vertebrates.

UNIT-1.

- 1.1. Principles and methods of invertebrate taxonomy: Concepts of species and hierarchical taxa, biological nomenclature
- 1.2. Acoelomate, pseudocoelomate, Coelomate, Protostomia and Deuterostomia
- 1.3. Levels of structural organization: Unicellular and multicellular forms; levels of organization of tissues, organs and systems; comparative anatomy.
- 1.4. Patterns of feeding and digestion in lower metazoans, Filter feeding in polychaeta

UNIT-2

- 2.1 Respiratory pigments, Organs of respiration, mechanism of respiration in invertebrates.
- 2.2 Organs of excretion-coelome, coelomoducts, Nephridia, Malpighian tubules. Mechanism of excretion and osmoregulation.
- 2.3 Nervous system in Annelids, arthropods (Crustaceans and insects) and Molluscs (Cephalopoda).
- 2.4 Larval forms of invertebrates (Coelenterata, helminth, Arthropoda, mollusca and Echinodermata).

UNIT-3.

- 3.1 Integumentary derivatives of Vertebrates: - Skin structure and functions- glands, scales, horns, feathers & hair.
- 3.2 Evolution of heart: - structure- blood circulation-aortic arches and portal system.
- 3.3 Respiratory organs in vertebrates – types – structure -mechanism of respiration.
- 3.4 Comparative anatomy of brain -structure & composition in relation to its functions.

UNIT-4

- 4.1 Urino-genital system in vertebrates.
- 4.2 Comparative anatomy of reproductive system among Amphibians, Reptiles, Aves and Mammals: - Organs of male reproductive system – organs of female reproductive system – functions.
- 4.3. Organs of vision & mechanism of vision in mammals.
- 4.4. Structure of hearing organs in mammals - mechanism of hearing.

Invertebrates

Course Outcomes:

1. Understanding the General Characteristics, Principles of classification, general biology of Invertebrate Communities.
2. To understand the various biological functions, the evolutions of life from most primitive to most advanced form with respect to their habit and habitat.
3. To understand the various physiological mechanisms among Invertebrates and their significance among Invertebrate Phyla.

Vertebrates

Course Outcomes:

1. Understanding the comparative aspects of different organ systems among chordate Phyla.
2. Explain the similarity and differences in structure and function of organs in different groups of Chordates.
3. In depth understanding of Anatomical features of Integumentary, Circulatory, Reproductive, Respiratory, Receptor, Nervous systems among Chordate groups.
4. The students may apply this knowledge in taxonomy related research and job opportunities.

SUGGESTED READING MATERIAL:

1. Invertebrate Zoology ----- EL Jordan; P.S. Verma
2. A Text Book of Zoology Vol.I ----- P.S. Dhama; Jk.Dhama.
3. A Text Book of Invertebrate zoology ----- R.L.Kotpal.
4. Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.
5. Vertebrate Zoology ----- EL Jordan; P.S. Verma
- 6 A Text Book of Zoology Vol.II ----- P.S. Dhama; Jk.Dhama.
- 7 A Text Book of Vertebrate zoology ----- R.L.Kotpal.
- 8` Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.
9. Alexander, R.M. The Chordata. Cambridge University Press, London.
10. Barnes, R.D. Invertebrate Zoology, III edition. W.b. Saunders Co., Philadelphia, 1980.
11. Bourne, GH. The structure and functions of nervous tissue. Academic Press, New York.

CORE COURSE-102(A): BIOMOLECULES AND METABOLIC REGULATION

Course Objectives:

While studying the Biomolecules and Metabolic Regulation course, the student shall be able to:

1. This course is designed to introduce the organic structure of living systems mainly dealing with biomolecules like carbohydrates, lipids, proteins and nucleic acids laying foundation for other advanced courses.
2. To develop understanding of chemistry used in biological processes and to perform wide range of analytical techniques to explore biological activities.
3. Physiological and biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed.
4. To understand the Interactions and interdependence of physiological and biochemical processes and thus to help the student to navigate the discipline of Biochemistry that explains how the collection of inanimate molecules.
5. Provide a concise and unifying approach of knowledge-sharing of the structure, function and interaction of biomolecules & bioprocesses at molecular and metabolic levels thus paves way for understanding the biochemical integrity of various life processes and the metabolic Pathways.
6. The Intermediary Metabolism: Concept and Regulation is designed as an advanced course for understanding the interaction, network and regulation of certain important metabolic pathways and their roles in health and disease.
7. The course also explains the interplay and energetics, catalysis and design of living systems. It is designed for students who have already taken up the courses and elementary biochemistry and macromolecular structures at the undergraduate level.

UNIT-1.

- 1.1 Chemical Bonds (Covalent, Ionic and Hydrogen Bonds) and Thermodynamic principles in Biology (Enthalpy, Entropy, Free energy, First law and Second law of thermo-dynamics in relation to Biological system).
- 1.2 Carbohydrates: Definition and Classification- Structure and function of Mono, Oligo and Polysaccharides.
- 1.3 Intermediary Metabolism-I: Glycolysis, TCA Cycle and their Bio-medical importance.
- 1.4 Intermediary Metabolism-II: Gluconeogenesis, HMP Shunt and their Bio-medical importance.

UNIT-2.

- 2.1 Proteins: Definition and Classification- Structure (Primary, Secondary and Tertiary structures, Protein folding, denaturation and Ramachandran plot)
- 2.2 Bio-synthesis of nutritionally non-essential amino acids and their Bio-medical importance.
- 2.3 Catabolism of Proteins and Amino acids-I: Biosynthesis of Urea and detoxification of ammonia, Metabolic disorders of Urea cycle.
- 2.4 Catabolism of Proteins and Amino acids-II: Phenylalanine, Tryptophan, Biosynthesis and degradation of Polyamines and their Bio-medical importance.

UNIT-3.

- 3.1 Biomedical importance, Classification of lipids; Saturated and unsaturated fatty acids; Triacylglycerols (tri-glycerides), Phospholipids, Glycolipids, Steroids, Lipid peroxidation.
- 3.2 β - oxidation of fatty acids, Oxidation of unsaturated fatty acids, Ketogenesis.
- 3.3 Biosynthesis of long chain fatty acids (Palmitic acid), Clinical aspects.
- 3.4 Metabolism of Vitamins.

UNIT-4.

- 4.1 Chemistry of purines, pyrimidines, Nucleosides, Nucleotides, Synthetic derivatives.
- 4.2 Biosynthesis of purine nucleotides, Catabolism of purines.
- 4.3 Biosynthesis of pyrimidine nucleotides, Catabolism of Pyrimidines,
- 4.4 Clinical disorders of purine and pyrimidine metabolism; Hyperuricemia or gout; Hypo- uroemia, Orotic aciduria.

Course Outcomes:

After the completion of the course, student will be able to achieve following outcomes:

- 1. The student will learn about chemical bonding patterns, chemical structures and classification of carbohydrates and their structural and metabolic role in cellular system i.e. different pathways associated with carbohydrate metabolism.
- 2. The student will learn about definition and classification of Proteins, Carbohydrates, Lipids etc and their importance in metabolism
- 3. Student would gain expertise to develop understanding of biological processes at chemical, biochemical and molecular level to perform wide range of analytical techniques to explore biological activities.
- 4. The student will be able to learn carbohydrate metabolism i.e. catabolism and its association with cellular energy production and carbohydrate anabolism in animal cells.
- 5. The student will learn and understand about the Biosynthesis of Purines and Pyrimidine Nucleotides, degradation of Nucleotides, salvage pathways, biosynthesis and biodegradation of Amino acids, inborn errors of metabolism.

SUGGESTED READING MATERIAL:

- 1. D. Voet and J.G Voet, Biochemistry, 1. Wiley & Sons.
- 2. David L. Nelson and Michael M. Cox, Lehninger; Principles of Biochemistry, McMillan Lange Medical. Eighth Edition- 8th
- 3. Robert K.Murrey, D.K. Granner, P.A. Mayes and V.W. Rodwell; Harper's Biochemistry, Worth Publishers. Thirty-First Edition 31st Edition
- 4. Stryer, Lubert, Berg, Jeremy M., Tymoczko, John L., Gatto Jr., Gregory J Biochemistry 9th Edition.
- 5. Satyanarayana. U Biochemistry 6th edition.
- 6. James P. Allen Biophysical Chemistry.

CORE COURSE-102(B): PRINCIPLES OF ECOLOGY

Course Objectives:

While studying the **Principles of Ecology**, the student shall be able to:

1. The objectives of the course are to develop the ability to solve the problems related to the environment, to make them aware of various eco-friendly techniques and modern techniques to solve various environment-related problems.
2. The objective of this course is to make awareness among the young students about the surrounding environment, the impact of climate change and its mitigation and biodiversity.
3. The aim of the contents of this course is to introduce and explain about various conservation issues of the ecosystem and animals.
4. Man himself is a part of ecosystem. The ecosystems in the world are continuously under the pressure of anthropogenic activities and human mediated ecological changes. Several animal species are under the survival threats. To introduce the students about wildlife and wild habitats, about depleting wild life and human wildlife conflict.
5. Generate an interest in Ethology in order to understand the complexities of both animal and human behaviour.
6. To understand the basic theories and Principles of Ecology.
7. To learn about current environmental issues based on Ecological principles.
8. To study Environmental pollution and their management.

UNIT-1.

- 1.1 Principles of Ecology: Definition, principles and scope of Ecology; Ecological species concept.
- 1.2 Biomes and their environments, Habitat and Niche
- 1.3 Fresh and Marine water ecosystems: Classification and Characteristics, eutrophication, seasonal changes.
- 1.4 Terrestrial ecosystems: Forests – Grass lands – Tundra – Desert, island biogeography

UNIT-2

- 2.1 Productivity & Energy flow in different ecosystems
- 2.2 Concept of the trophic level-Food chains,web &Ecological pyramid.
- 2.3 Nutrient cycle - Water cycle, Carbon cycle, Phosphorus cycle, Sulfur cycle.
- 2.4 Bioaccumulation and Biological magnification.

UNIT-3

- 4.1 Biomonitoring programme
- 4.2 Bioindicators, Environmental monitoring, Environmental impact assessment
- 4.3. Bioremediation: Need and scope of bioremediation, Environmental applications of bioremediation
- 4.4. Phytoremediation, bio circular economy, Biotechnological cleanup of environment

UNIT-4

- 3.1 Air Pollution– Green house gases and Green House Effect, Stratospheric ozone, Acid rain.
- 3.2 Water and Soil Pollution Criteria and standards in India, health hazards and toxicology.
- 3.3 Role of environmental epidemiological studies and health indices in evaluation of environmental health hazards: environmental epidemiological episodes in India and Abroad.
- 3.4 Environmental Laws; Environmental Laws in India – legislation and Execution.

Course Outcomes:

1. The student will get idea about the ecological process in its surrounding and at National and Global level and the use of student knowledge on Ecology, Behaviour can be applied to Education, Research and Extension programmes in his further career.
2. Students will understand the various features and aspects of population ecology, Community ecology and ecosystem ecology. They might have the knowledge about Principles of ecology in details. They will acquire knowledge about various tools and techniques of field ecology.
3. Students will be able to apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.
4. Students will be able to use interdisciplinary approaches such as ecology, economics, ethics and policy to devise solutions to environmental problems.
5. Students will be able to be proficient in ecological field methods such as wildlife survey, biodiversity assessment, mathematical modeling and monitoring of ecological systems.
6. Students will be able to use technology, such as geographical information systems and Computer programming, to assist in problem solving.
7. This paper will help in creating skilled personnel in the field of environment protection and research.
8. Demonstrated an understanding of Ecological relationships between organisms and their environment.

SUGGESTED READING MATERIAL:

1. Animal Physiology - Adaptation & Environment. 4th Edition Knut Schmidt - Nielsen – Cambridge University Press.
2. Biochemical ecology and water pollution - PR Dugan, plenum press, London, 1972.
3. Biodegradation & Bioremediation - 2nd edition, Martein Alexander - Academic Press, 1999 USA.
4. Chemical and biological methods for water pollution studies R.K. Trivedy and P.K. Goel, 1984.
5. Current pollution researches in India - RK. Trivedy and P.K. Goel. Karad.
6. Ecology & Environment - P.D. Sharma, 1991.
7. Ecotechnology for pollution control and environmental management, enviromedia, Karad, RK.Trivedi.
8. Encyclopaedia of environmental pollution and control, enviromedia, Karad, Vol. 1 &2, R.K Trivedi.
9. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publications, Meerut (India), 1998.
10. Environmental Physiology of desert organism. Ed.by N.F. Hadley - Dowden Huchinson and Ross, Inc.Penn.USA.

11. Environmental Science Research Volumes: Vol.1. Indicators of environmental quality - W.A.Thomas, 1972. Vol.3. Environmental pollution by pesticides - C.A. Edwards, 1974.
12. Field Biology & Ecology - Allen H Benton & E. Werner, JR, 1980.
13. Health hazards and human environment, World Health Organization (WHO) 1972.
14. Industrial Pollution - VP. Kudesia, 1990.
15. Methods in Environmental Analysis - Water soil and air by P.K. Gupta - Agrobios (India), Jodhpur, 2001
16. Pesticides in the environment - R White Stevenns, MarcelDekker Inc. New York, 1971.
17. Practical methods in Ecology & Environmental Science, RK. Trivedy, Goel, Trisal, 1997.
18. The Ecology of waste water treatment - H.A. Hawkes pergoman press, 1963a. Vol.5 Environmental Dynamics of pesticides - R. Hague and V.H. Preed, 1975.
19. Water Treatment and purification technology - W.J. Ryan, Agrobios (India), Jodhpur, 2002.

CORE COURSE-103A: DEVELOPMENTAL BIOLOGY

Course Objectives:

While studying the Developmental Biology course, the student shall be able to:

1. The main objective of the Developmental Biology course is to develop students' four-dimensional thinking skills to truly understand the patterns and processes of embryonic development, body plan formation, fate mapping, induction, competence, regulative and mosaic development, as well as the molecular and genetic approaches used in studying embryo development. These concepts are unique to Developmental Biology and not necessarily shared with other disciplines in the biological sciences. The relevance of Developmental Biology to the study of human diseases will be demonstrated using various model organisms.
2. Acquire knowledge of fertilization and morphogenetic movements in the developing embryo.
3. Understand concepts related to the embryo organizer, inductions, and differentiation.
4. Study gametogenesis, fertilization, cleavage, gastrulation, and other stages in embryo development.
5. Introduce students to the basic principles of experimental embryology.

Unit-1:

- 1.1 Potency, specification, determination, differentiation, induction, competence, and commitment of embryonic cells.
- 1.2 Origin and mechanism of cell lineage, fate maps, and embryonic stem cells.
- 1.3 Imprinting; mutants and transgenics in the analysis of development.
- 1.4 Genomic equivalence, cytoplasmic determinants, and nuclear transplantation experiments.

Unit-2:

- 2.1 Origin and migration of germ cells; production of gametes and establishment of polarity.
- 2.2 Fertilization; cell surface molecules in sperm-egg recognition in animals; molecular events post-fertilization.
- 2.3 Cleavage types, blastula formation, gastrulation, and molecular mechanisms in germ layer formation.
- 2.4 Environmental regulation of normal development.

Unit-3:

- 3.1 Axis and pattern formation in *Drosophila* and Amphibia.
- 3.2 Cell aggregation and differentiation in *Dictyostelium*.
- 3.3 Organogenesis-vulva formation in *Caenorhabditis elegans*, eye lens induction.
- 3.4 Development in tetrapod limb (amphibians) and neural fold formation.

Unit-4:

- 4.1 Sex determination in animals (mechanisms of primary and secondary sex determination), hormonal regulation of sexual phenotypes.
- 4.2 Types of regeneration; Axial patterning regeneration in *Hydra*.
- 4.3 Metamorphosis-hormonal regulation of metamorphosis in insects and amphibians.
- 4.4 Aging and senescence - reactive oxygen species and cell senescence; dietary restriction and anti-aging action; genetic control of longevity; age-related diseases.

Course Outcomes:

- 1. Developmental Biology displays a rich array of material and conceptual practices that can be analyzed to better understand the scientific reasoning exhibited in experimental life sciences. Based on learning contents of embryology, students can have a systematic and organized learning about the knowledge and concepts of growth and development.
- 2. Students would gain expertise in explaining how a variety of interacting processes generate an organism's heterogeneous shapes, size and structural features that arise on the trajectory from embryo to adult or more generally throughout a life cycle.
- 3. Gains knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.
- 4. After learning the development of life from cell to multicellularity complex and coordinated systems in organisms the students can apply this knowledge for research, and education, to solve the problems related to development in animals through research.
- 5. Developmental Biology enquires about the fundamental processes that underpin the fertilization of an egg cell and its step-by-step transformation into the fascinating complexity of a whole organism.
- 6. Students will also understand that cells only express a proportion of their genome, and that differential gene expression underlies cell differentiation and any alteration in the entire process of development leads to devastating diseases.

7. Students would have a systematic and organized learning about the knowledge and concepts of growth and development of organisms. Developmental Biology displays a rich array of material and conceptual practices that could be analysed to better understand the scientific reasoning exhibited in experimental life sciences.
8. To understand the overall chronology of the development and the role of various morphogens (protein/mRNA) in specification and determination of various organs and body axis formation.

SUGGESTED READING MATERIAL:

1. Molecular Developmental Biology (2008) by T. Subramonian, Narosa Publishing House
2. Developmental Biology by S.F. Gilbert, Sinauer Associates Inc., Massachusetts
3. Reproduction in Animals by Austen, C.R. and Short, R.V.
4. Molecular Biology of Fertilization by Schatten and Schatten
5. Human Reproduction by R.G. Edwards
6. The Coiled Spring by Ethan Bier, Harlsor Laboratory Press, New York
7. Fertilization by F.T. Longo, Chapman & Hall

CORE COURSE-103B:ENDOCRINOLOGY

Course objectives:

1. Understand the principles of hormonal diagnosis and feedback mechanisms in endocrinology, with a focus on diseases of the hypothalamus and the pituitary gland.
2. Identify and analyze various endocrine disorders, including hypothalamic syndromes, diseases of the adenohypophysis, and hormonally active and inactive tumors such as prolactinoma and acromegaly.
3. Evaluate the clinical presentation, pathogenesis, and forms of hypopituitarism, including isolated forms like hypsomatotropism and hypogonadism, to differentiate and diagnose these conditions.
4. Discuss the regulation and biological effects of hormones of the adrenal cortex, hyperfunction conditions like Cushing's disease, and congenital adrenal hyperplasia, focusing on clinical presentation and differential diagnosis.
5. Examine disorders of carbohydrate metabolism and the endocrine pancreas, including diabetes mellitus, metabolic syndrome, and thyroid diseases, to understand etiology, classification, clinical presentation, diagnosis, and treatment options.
6. Explore the relationship between endocrinology and reproduction, delving into endocrine gland functions, hormone actions, and reproductive processes to comprehend neuroendocrine regulation and its significance in fertility and overall health.
7. These course objectives aim to guide students in mastering the fundamental concepts, principles, and clinical applications of endocrinology, enabling them to diagnose, treat, and manage a variety of endocrine disorders effectively.

Unit 1:

- 1.1. Definition of Endocrinology, Historical Perspective on Endocrinology; Milestones in Endocrinology Research; Early Discoveries of Hormones and Endocrine Glands
- 1.2. Importance of the Endocrine System in Organisms.
- 1.3. Classification of Hormones, Endocrine Glands and Hormones in the Human Body.
- 1.4. Amine Hormones; Functions of Key Hormones: Insulin, Cortisol, Thyroxine, etc.

Unit 2:

- 2.1. Mechanisms of Hormone Synthesis; Biosynthesis of Peptide Hormones; Synthesis of Steroid Hormones in Endocrine Organs.
- 2.2. Regulation of Hormone Secretion; Control of Hormone Release by Hypothalamic-Pituitary Axis; Circadian Rhythms and Hormone Secretion.
- 2.3. Feedback Mechanisms in Endocrine Regulation; Negative Feedback Loops in Hormone Regulation; Positive Feedback Mechanisms in Endocrine Systems.
- 2.4. Role of Neuroendocrine System; Neurotransmitters and Neuropeptides in Endocrine Signaling.

Unit 3:

- 3.1. Endocrine Disorders: Causes and Symptoms; Genetic and Environmental Factors in Endocrine Disorders; Common Symptoms of Endocrine Dysfunction; Diagnostic Techniques for Endocrine Disorders.
- 3.2. Diabetes Mellitus: Types and Management; Pathophysiology of Type 1 and Type 2 Diabetes; Treatment Strategies for Diabetes Mellitus.
- 3.3. Thyroid Disorders: Hypo and Hyperthyroidism; Thyroid Hormone Synthesis and Regulation; Causes and Symptoms of Hypothyroidism and Hyperthyroidism.
- 3.4. Adrenal Disorders: Cushing's Syndrome and Addison's Disease; Role of Adrenal Glands in Endocrine Function.

Unit 4:

- 4.1. Hormonal Control of Reproduction; Role of Gonadotropins in Reproductive Endocrinology; Mechanisms of Puberty and Menopause.
- 4.2. Menstrual Cycle and Ovarian Hormones; Phases of the Menstrual Cycle: Follicular, Ovulatory, and Luteal; Ovarian Hormones: Estrogen and Progesterone.
- 4.3. Testicular and Prostate Hormones in Males, Testosterone Synthesis and Function in Males; Androgen Receptor Signaling in Male Reproductive System.
- 4.4. Infertility and Assisted Reproductive Technologies; Causes of Male and Female Infertility.

Course Outcomes :

1. Understand the structure, function and regulation of endocrine & neuroendocrine glands,
2. Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive Cycle
3. Understand the pathways associated with Biosynthesis and secretion of Endocrine hormones and their role in the control of metabolism
4. Acquiring the knowledge of signal transduction mechanisms
5. Through understanding of several endocrines including Peptide hormones, Steroid hormones, Pituitary hormones, Sex hormones, Thyroid hormones etc in the control of metabolic pathways
6. Understanding the influence of hormones on Growth, Development and Reproduction and their regulatory pattern

SUGGESTED READING MATERIAL:

1. Barrington. E.J.W. General and comparative Endocrinology Cambridge Press, Oxford.
2. Bentley, P.J. Comparative Vertebrate Endocrinology, Cambridge Press, Oxford.
3. Martin, C.R. Endocrine Physiology. Oxford Univ. Press, Oxford.
4. Prakash S. Lohar. Endocrinology-Hormones and human health-2005. MJP Publishers-Chennai.
5. Williams, R.H. Text Book of Endocrinology, W.B. Saunders Co., Philadelphia.

SOC 105(A): WILDLIFE CONSERVATION AND FIELD TECHNIQUES

Course Objectives :

1. While studying the **Wildlife Conservation and Field Techniques** course, the student shall be able to:
2. To make the students equipped with the knowledge of wildlife resources of India having emphasis to the principles and applications of various wildlife management techniques
3. Wildlife management
4. Courses in wildlife management can help students learn about modern concepts, conservation policies, and scientific methods used to assess biodiversity and monitor conservation goals. They can also help students develop skills to resolve conflicts between humans and wildlife.
5. Wildlife conservation biology
6. Courses in wildlife conservation biology can help students learn about wildlife management and conservation planning through hands-on field research. These courses can help students prepare to protect endangered species and tackle environmental challenges.
7. Wildlife conservation action
8. Courses in wildlife conservation action can help students learn about ecosystem and biodiversity conservation and management. These courses can also help students learn how to manage and mitigate wildlife conflict and natural resources

UNIT – I

- 1.1. Wild life in India, importance and values.
- 1.2. List of endangered and Endemic Species, scheduled animals and species on the verge extinction in Andhra Pradesh and India.
- 1.3. Sanctuaries, National parks, Biosphere reserves. Role of Government and Non- Government Agencies in Wild life protection.
- 1.4. Techniques for photographing of animals, landscape photography, Field techniques for identification of indigenous fishes.

UNIT – II

- 2.1. Species Census methods; Species sampling method (Quadrat, Line Transect, Belt Transect)
- 2.2 . Mark-Recapture technique, Radio-telemetry etc.); Ethics in Field Studies
- 2.3. Analysis of animal tracks & signs (General concepts), Scat analysis and evaluation of food.
- 2.4. Basic understanding of Remote sensing and GIS techniques and their applications, Case studies in different National parks.

UNIT-III

- 3.1 Wildlife Management: Poaching, Man-Animal Conflicts, Eco-tourism, Wildlife Crimes, Sustainable Utilization of Biodiversity Resources.
- 3.2 Wildlife Protection Acts and Conventions, Tiger conservation Project in India.
- 3.4 Wildlife Management Strategies: Habitat Loss - Causes and Mitigation Measures; Alien Species - Threats and Management Approaches.

UNIT – IV

4.1. Definition, In situ conservation, Ex-situ conservation.

(Botanical & Zoological Gardens, Gene Banks, Seed And Seedling Banks, Pollen Culture,

4.2. Tissue Culture and DNA banks, concept of Biodiversity Hotspots

4.3. Indian Wildlife (Protection) Act, 1972, Concepts of Schedule in Wildlife Protection; – IUCN

4.4. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Course outcomes:

After the completion of the course, a student will be able to achieve these outcomes:

1. Sampling and experimental skills: Demonstrating the ability to use scientific sampling and experimental techniques in conservation science
2. Data analysis: Applying statistical techniques to biological, environmental, and ecological data, and interpreting the results
3. Sampling design: Developing sampling designs to address real-world wildlife conservation issues
4. Technical writing: Demonstrating the ability to write in a technical style for wildlife conservation and management
5. Data presentation: Using graphical methods to present data in wildlife conservation
6. Wildlife identification: Learning to identify species, their characteristics, and their habitat requirements
7. Conservation policy: Understanding conservation policies and legislation, and how they are enforced
8. Wildlife management: Developing skills for scientific wildlife management planning
9. Human-wildlife conflict: Developing skills for resolving conflicts between humans and wildlife
10. Ecological assessment: Learning how to conduct a rapid ecological assessment of a site
11. Resource use survey: Learning how to survey the use of resources

SUGGESTED READING MATERIAL:

1. Saharia, V.B. 1982 Wildlife in India, Nataraj Publishers, Dehra Dun
2. Seshadri, B. 1986 India's Wildlife reserves, Sterling Pub'rs Pvt. Ltd., New Delhi
3. Giles, R.H. Jr. (Ed) 1984. Wildlife Management Techniques 3rd edition. The wildlife Society, Washington. D.C. Nataraj Publishers, Dehradun. India
4. Dasmann, R.F. 1964, Wildlife Biology. John and Wiley and sons Newyork. Pp231.
5. Robinson, W.I. and Eric, G. Bolen, 1984. Wildlife Ecology and Management Mac Millan Publishing Co, Ny. Pp 478.
6. Menon, V. 2003. A Field Guide to Indian Mammals. Dorling Kindersley (India) Pvt. Limited
7. Thomas, A.P. (Ed) 2013. Biodiversity Scope and Challenges. Green leaf Publications, Kottayam
8. Sharma P.D. 2001. Ecology and Environment. Rastogi Publications, Meerut

SOC 105(B): APICULTURE

Course Objectives:

1. Understand the historical significance of apiculture, the evolution of beekeeping practices, and the cultural importance of bees in different societies.
2. Identify and compare the characteristics, behavior, and threats faced by *Apis Mellifera* (European Honey Bee) and indigenous bee species used in beekeeping.
3. Analyze the life cycle of bees, the social structure within bee colonies, and the mechanisms of communication and foraging behavior in bees.
4. Examine the external anatomy of bees, specialized structures such as the proboscis and stingers, and metabolic processes involved in energy production and temperature regulation.
5. Evaluate different types of beehives including Langstroth, Top-Bar, Warre, and Observation hives, considering their pros, cons, and suitability for various purposes.
6. Demonstrate knowledge of essential beekeeping equipment and safety gear such as smokers, hive tools, protective clothing, gloves, and boots, and understand their uses in hive inspection and manipulation.
7. Develop skills in apiary management including site selection, hive orientation, inspection schedules, and swarm prevention techniques across seasons.
8. Explore the diverse range of bee products including varietal honeys, bee pollen, royal jelly, propolis, beeswax, and other bee-derived products, understanding their composition, properties, health benefits, and various applications.

UNIT 1:

- 1.1. History and Importance of Apiculture, Evolution of Beekeeping Practices, Cultural Significance of Bees in Different Societies, Role of Bees in Pollination, Global Impact of Decline in Bee Populations.
- 1.2. Characteristics and Behavior of *Apis Mellifera* (European Honey Bee), Indigenous Bee Species Used in Different Regions, Threats and Challenges Faced by Bee Species in Apiculture.
- 1.3. Life Cycle of Bees: Egg, Larva, Pupa, Adult; Social Structure in Bee Colonies: Queen, Worker, Drone; Communication Among Bees.
- 1.4. External Anatomy of Bees: Head, Thorax, Abdomen; Specialized Structures in Bees: Proboscis, Pollen Baskets, Stingers; Metabolic Processes in Bees: Energy Production, Temperature Regulation.

UNIT 2:

- 2.1. Langstroth Hives: Pros and Cons; Top-Bar Hives: Suitability for Natural Comb Building; Warre Hives: Vertical Hive Design; Observation Hives: Educational and Research Purposes
- 2.2. Smoker: Purpose and Techniques of Smoking Bees; Hive Tool: Uses for Inspecting and Manipulating Hives; Bee Suit and Veil: Importance of Protection in Beekeeping; Gloves and Boots: Safety Gear for Handling Bees
- 2.3. Locating Apiaries: Factors to Consider for Beeyard Placement; Hive Orientation: Sunlight, Wind Protection; Hive Inspection Schedule: Regularity and Best Practices; Swarm Prevention and Control Methods.
- 2.4. Spring Colony Management: Queen Assessment, Brood Inspection; Summer Honey Flow Management: Adding Supers, Harvesting Honey; Winter Hive Management: Insulation, Ventilation, Pest Control

UNIT 3:

- 3.1.** Varietal Honeys: Acacia, Clover, Orange Blossom; Raw Honey vs. Processed Honey: Nutritional Differences; Medicinal Properties of Honey: Antibacterial and Antioxidant Effects; Culinary Uses of Different Honey Varieties.
- 3.2.** Composition of Bee Pollen: Proteins, Vitamins, Minerals; Health Benefits of Bee Pollen: Allergy Relief, Energy Boost; Processing and Storage of Bee Pollen.
- 3.3.** Health Benefits of Royal Jelly: Anti-Aging, Immune Boosting; Propolis: Natural Antibiotic Properties; Use of Royal Jelly and Propolis in Traditional Medicine.
- 3.4.** Composition and Properties of Beeswax; Uses of Beeswax in Cosmetics, Candles, and Crafts; Harvesting and Processing Beeswax; Other Bee Products: Bee Venom, Bee Brood, Bee Bread.

UNIT 4:

- 4.1.** Importance of Pollination in Agriculture and Ecosystems; Decline in Pollinators and Impact on Food Security; Bee-Friendly Farming Practices.
- 4.2.** Common Pests and Diseases Affecting Bee Colonies; Non-Chemical Pest Control Methods.
- 4.3.** Principles of Organic Beekeeping: Avoiding Chemical Inputs; Organic Hive Management Techniques: Hygienic Behaviors, Natural Swarming; Challenges and Benefits of Organic Beekeeping.
- 4.4.** Value-added Bee Products: Honey, Pollen, Propolis Skincare Products; Marketing and Branding for Bee Products; Export Opportunities and International Trade Regulations for Bee Products

Course Outcomes

- 1. Gain a comprehensive understanding of the historical significance and cultural importance of apiculture, beekeeping practices, and the role of bees in pollination.
- 2. Identify and analyze the characteristics, behavior, and challenges faced by different bee species used in apiculture, with a focus on *Apis Mellifera* and indigenous bee species.
- 3. Demonstrate knowledge of the life cycle of bees, social structures within colonies, mechanisms of communication, foraging behavior, and the role of specialized bee structures.
- 4. Acquire a detailed understanding of the external anatomy of bees, metabolic processes involved in energy production and temperature regulation, and the significance of specialized bee structures.
- 5. Evaluate and compare different types of beehives, understanding their design, advantages, and suitability for different beekeeping purposes.
- 6. Develop proficiency in using essential beekeeping equipment and safety gear, ensuring proper hive inspection, manipulation, and personal protection.
- 7. Apply principles of apiary management, including site selection, hive orientation, inspection schedules, and swarm prevention techniques throughout the year.
- 8. Explore the diversity of bee products, their composition, properties, health benefits, and various applications in culinary, medicinal, skincare, and other fields, and understand their value in the market.

SUGGESTED READING MATERIAL:

1. "The Buzz about Bees: Biology of a Superorganism" by Jürgen Tautz (Publisher: Springer, 2008)
2. "The Honeybee Democracy" by Thomas D. Seeley (Publisher: Princeton University Press, 2010)
3. "The Practical Beekeeper: Beekeeping Naturally" by Michael Bush (Publisher: X-Star Publishing Company, 2011)
4. "The Hive and the Honey Bee" edited by Joe M. Graham (Publisher: Dadant & Sons, 2015)
5. "Bees: Their Vision, Chemical Senses, and Language" by Karl von Frisch (Publisher: Cornell University Press, 1967)
6. "The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden" by Kim Flottum (Publisher: Quarry Books, 2010)
7. "Hive Management: A Seasonal Guide for Beekeepers" by Richard E. Bonney (Publisher: Storey Publishing, 1990)
8. "The Complete Idiot's Guide to Beekeeping" by Dean Stiglitz and Laurie Herboldsheimer (Publisher: Alpha, 2004)
9. "Honeybee: Lessons from an Accidental Beekeeper" by C. Marina Marchese (Publisher: Black Dog & Leventhal Publishers, 2009)

SOC 106(A) BIOANALYTICAL TECHNIQUES-I**Course Objectives:**

While studying the Bioanalytical Techniques, the student shall be able to:

1. To study the different acid and base conditions and their effect on the biomolecules in biology and research.
2. To learn about the separation of biomolecules through apply the different centrifugal force.
3. To study different types of chromatography used in biology.
4. To learn about different molecular and cellular separation techniques and their application in biological research.
5. To study principles and methods of different spectroscopic techniques.
6. To know the principle and types of different microscopes

UNIT-I

- 1.1 Electrolytic Dissociation and Electrolytes, Basics of Acidity and alkality - Bronsted-Lowry Theory, Acid-Base Equilibria in Water, Buffers.
- 1.2 Structure and Functions of Biomolecules with variable pH, Measurement of pH, Uses of Indicators.
- 1.3 Ion Specific Electrodes: Ion Selective Electrodes - Glass Membrane Electrodes – Solid-State Ion Exchanger Electrodes – Solid-State Crystal Electrodes – Liquid-Membrane Electrodes - Gas-Sensing Electrodes.
- 1.4 Viscosity: Factors Affecting Viscosity - Measurement of Viscosity – Applications of Viscometry - Significance of Viscosity in Biological Systems.

UNIT-II

- 2.1 Instrumentation -- Desktop Centrifuge - High Speed Centrifuge - The Ultracentrifuge
- 2.2 Basic Principles of Centrifugation - Relative Centrifugal Force (RCF) and RPM Factors Affecting Sedimentation – Sedimentation Velocity, Sedimentation Coefficient, Determination of Molecular Weights.
- 2.3 Fixed-angle Rotors - Vertical-tube rotors - Swinging-bucket Rotors - Wall Effects
- 2.4 Preparative Centrifugation - Differential Centrifugation - Density Gradient Centrifugation - Rate Zonal Centrifugation, Isopycnic Centrifugation - Gradient Materials - Preparation of Density Gradients

UNIT-III

- 3.1 Microscopic techniques: Principles of microscopy Scanning and transmission microscopes. Image processing methods in microscopy.
- 3.2 Different fixation and staining techniques for Light microscope and Electron microscope.
- 3.3 Microtomy and processing of tissues for Light microscope and Electron microscope. Cryopreservation and cryotechniques for microscopy
- 3.4 Freeze-etch and freeze-fracture methods for EM.

UNIT-IV

- 4.1 Basic Principles - The Laws of Absorption - Significance of Extinction Coefficient - Problems - Preparation of Standard Graph - Deviations From Beer's Law-Absorption Spectrum.
- 4.2. The Chromophore Concept-Instrumentation For UV-Visible And Infrared Spectrophotometry. Physicochemical Studies - Control of Purification - Difference Spectrophotometry - Turbidimetry and Nephelometry - Theory and Applications of Infrared Spectrophotometry.
- 4.3 Electronic transitions and optical spectroscopy -X-ray diffraction and extended X-ray absorption fine structure -Magnetic resonance (NMR,MRI).
- 4.4 Spectrofluorimetry - Structural Factors Which give Rise to Fluorescence - Fluorescence and Phosphorescence, Fluorometry: Theory and Instrumentation. - Applications - Fluorescence Spectra and Study of Protein Structure.

Course Outcomes:

- 1. Students would be trained the different acid and base conditions and their effect on the biomolecules in biology and research.
- 2. To learn about the separation of biomolecules through apply the different centrifugal force.
- 3. Students would be expertise different molecular and cellular separation techniques and their application in biological research.
- 4. Students would be trained in various tools and techniques used to gain insight into biological processes.
- 5. Students would be expertise techniques used for imaging, isolation, purification and characterization of various biological substances.
- 6. Students would gain basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes.

7. Identify and describe the different equipment and tools used in a biology laboratory.
6. Correctly operate different laboratory instruments.
7. Identify and Analyse the spectra of biomolecules
8. Isolate and purified the biomolecules through chromatography

SUGGESTED READING MATERIAL:

1. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.W. Goulding, ELBS Edn.
2. Animal Cell Culture – A practical approach, Ed. John. R. W. Masters IRL Press.
3. General Zoological Microtechniques - P.M. Weesner.
4. Principles and techniques of Biochemistry and molecular biology by Kein Wilson and John Walker, VIII volume, Cambridge press Edition.
5. Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New York Heidelberg, Berlin.
6. Principles of Neuro Phychopharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
7. Biophysical chemisty by Upadhyay – Upadhyay - Nath.
8. Analytical Biochemistry (Biochemical techniques) by Dr P. Asokan. Chinnaa publications.
9. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Edition.
10. Vogel's Qantitative Chemical Analysis by Vogel, ArthurI.

SOC106(B): HISTOLOGY AND HISTOCHEMISTRY

Course Objectives:

While studying the Bioanalytical Techniques, the student shall be able to:

1. To study the structural organization of different mammalian tissues at the histological level. Understand the types and causes of morphological alterations in cells due to diseases. Comprehend the relationship between etiology, pathogenesis, and histopathological changes in specific diseases.
2. To study the process of permanent slide preparation, immunofluorescence technique, and mechanism for the Identification of total Proteins and Glycoproteins.
3. To study Explain morphological alterations in cells due to diseases, such as cloud, hyaline, hydrophic, and fatty degeneration.
4. To study Review the application of immunohistochemistry and immunofluorescence techniques to localize proteins in endocrine cells (Pituitary cell types or islet of Langerhans).
5. To study Specify and compile applications of Cryotechniques, Cryo ultramicrotomy, microscope, Importance of Enzyme histochemistry, Application of Histochemical methods for the detection of various types of Carcinoma Immunofluorescent techniques.

UNIT-I

1.1 Histology : Histochemistry and Histopathology : Objectives and applications

- 1.2 Tissues: Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.
- 1.3 Muscle: Histology of different types of muscle (skeletal muscle, smooth muscle, cardiac muscle).
- 1.4 Functional Morphology (mammalian) : Histological organization of GI tract- stomach and intestine, lungs, kidney, spleen, thymus, Bone and bone marrow.

UNIT-II

- 2.1 Endocrine System: Histology of mammalian endocrine glands-pituitary, thyroid, parathyroid, pancreas, adrenal gland, testis, ovary.
- 2.2 Nervous System: Types, structure and function of brain cells (CNS and PNS) and Structure of neuron. Types of synapse, Synaptic transmission and structure and types and functions of bones and cartilages.
- 2.3 Tissue fixation : Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods:-freezing and microwave fixation; choice of fixatives, fixation artifacts.
- 2.4 Classification and properties of dyes; metachromatic dyes and staining.

Unit-III

- 3.1 Histochemistry Principles and methods of application
- 3.2 Utility of classical histochemical Techniques : for localization of glycoproteins (PAS), nucleic acids(Feulgen) and steroid dehydrogenase activity.
- 3.3 Immunohistochemistry Principles, method of application of Immunohistochemistry
- 3.4 Immunofluorescence techniques for localization of proteins in endocrine cells (Pituitary cell types or islet of Langerhans) In situ hybridization of nucleic acids.

Unit-IV

- 4.1 Histopathology : Morphological alterations in cells due to disease, types of degeneration clouding, hyaline, hydrophic and fatty degeneration.
- 4.2 Etiology, pathogenesis and histopathology of Liver cirrhosis and atherosclerosis, Neuropathology of alcoholism and methanol poisoning.
- 4.3 Histopathology Tumors- malignant and non-malignant, types of carcinoma, histopathology of breast and prostate tumors.
- 4.4 Histochemical classification of Proteins Principles and mechanism for the Identification of Total Proteins and Glycoproteins.

Course Outcomes

1. Explain the structural organization of different mammalian tissues at the histological level. Understand the types and causes of morphological alterations in cells due to diseases. Comprehend the relationship between etiology, pathogenesis, and histopathological changes in specific diseases
2. Illustrate the process of permanent slide preparation, immunofluorescence technique, and mechanism for the Identification of total Proteins and Glycoproteins.
3. Explain morphological alterations in cells due to diseases, such as cloud, hyaline, hydrophic, and fatty degeneration.
4. Review the application of immunohistochemistry and immunofluorescence techniques to localize proteins in endocrine cells (Pituitary cell types or islet of Langerhans).
5. Specify and compile applications of Cryotechniques, Cryoultramicrotomy, microscope, Importance of Enzyme histochemistry, Application of Histochemical methods for the detection of various types of Carcinoma Immunofluorescent techniques.

SUGGESTED READING MATERIAL:

- Boyd,W. 1976:A text book of Pathology. Structure and function in disease, 4 th edition. Lea and Fibiger, Philadephia.
- Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied ,J& A, Churchill Ltd., London.
- Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.
- Telford, I.R. and Bridgman,C.F.(1990). Introduction to Functional Histology, Harper and Row, NY

AUDIT COURSE -109- INDIAN KNOWLEDGE SYSTEMS

Learning Objectives:

- To study the enriched scientific Indian heritage.
- To understanding of Indian Knowledge System.
- Develop an ability to apply the Indian Knowledge System to societal challenges faced today in areas such as holistic health, governance, public administration and sustainable living.

Learning Out comes:

- After completion of study, students able to
- Classify the key concepts of Indian Knowledge System and discuss the multi-faceted nature of knowledge contained in the Traditional Systems of India.
- Identify the importance of Yoga way of living in maintaining a sound physical, emotional and mental health.
- Recognize the relevance of Arthashastra in public administration and effective governance.

SYLLABUS

- Unit I : Introduction to Indian Knowledge Systems (IKS): About Indian Knowledge System; Definition of Indigenous/ Traditional Knowledge; Scope, and Importance of Traditional Knowledge.
- Unit II : Indian Heritage of Knowledge: Ancient Indian Knowledge: The Vedas and its components-the Vedangas Ancient Indian books and treaties: The Sastras.; The Great Indian Epics: The Ramayana and The Mahabharata Epics and religious treaties.
- Unit III : Ancient India- Bharat Varsha: People of Ancient Bharat Varsha; Our great natural heritage: The great Himalayas and the rivers; The civilizations of the Sindhu-Ganga valley, and the Brahmaputra valley; Our coastal plains; Our Nature: Forests and Minerals; Ancient Indian Traditional Knowledge and Wisdom about nature and climate.
- Unit IV : Contribution of Ancient India to Health Sciences: Traditional Indigenous systems of medicines in India: - Ayurveda and Yoga; Elements of Ayurveda: Gunas and Doshas, Pancha Mahabhuta and Sapta-dhatu; Concept of disease in Ayurveda; Ayurvedic lifestyle practices: Dinacharya and Ritucharya; Important Ayurvedic Texts; Hospitals in Ancient India; Ayurveda: Gift of India to the modern world.

Reference Books:

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śārīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.

4. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
5. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Private Ltd.
6. Mukul Chandra Bora, Foundations of Bharatiya Knowledge System. Khanna Book Publishing.
7. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.

SEMESTER-II

C.C-201. COMPARATIVE ANIMAL PHYSIOLOGY

Course Objectives:

1. Comparative Animal Physiology is a comprehensive subject that gives in-depth knowledge of various physiological processes in the animal kingdom.
2. This course provides knowledge of animal body system functions across levels of organization, from subcellular through organismal, in order to reveal physiological homologies, patterns of physiological adaptation to various environments and general physiological principles in a wide range of organisms to understand how organisms evolved their functional characteristics and how they stay alive in the face of constantly changing internal and external environments.
3. Course provides students comprehensive understanding of about Feeding mechanisms & Nutrition, Digestion in comparative basis, Respiration & Metabolism, Circulation of Body fluids, Patterns of Nitrogen excretion, Osmoregulation, Thermoregulation etc.
4. To provide Structure and Functional components of Muscle
5. To provide Physiological and Biochemical basis of Bioluminescence in animal world.
6. To provide information on Biological Rhythms and their occurrence in Animals.

UNIT-1:

- 1.1. Aim and scope of physiology; General physiological functions and principles. Validity of comparative approach of physiology.
- 1.2. Feeding mechanisms and regulation: Nutrition, Autotrophs, Heterotrophs, Digestion in mouth, swallowing, Peristalsis, Digestion in the Stomach, Gastric secretion, Gastric juice.
- 1.3. Comparative physiology of digestion: Mechanical treatment, Movement of gut contents, Chemical Action: intracellular and extracellular digestion. Carbohydrases, Lipases and Esterases, Proteinases, Other Digestive enzymes, Absorption.
- 1.4. Coordination of Digestive activities: Visceral Autonomic system, Role of gastrointestinal hormones in digestion.

UNIT-2:

- 2.1 Respiration and Metabolism: Types of respiration, Respiratory organs, Mechanism of Respiration. Comparative aspects of transport of oxygen and carbon dioxide; regulation of respiration.
- 2.2 Circulation of body fluids: Major types of body fluids, Blood, General properties of blood, Composition of blood, Blood groups and Transfusions.
- 2.3 Circulation-types of hearts - heart beat and its regulation - blood coagulation and theories.
- 2.4 Patterns on nitrogen excretion among different animal groups: Introduction, Nitrogenous Waste Products, Morphology of the excretory system in different groups of animals, Mechanism of urine formation.

UNIT-3:

- 3.1 Osmoregulation: osmolarity and toxicity, cell volume and ionic regulation, osmoregulation in invertebrates and vertebrates, hormonal control of osmoregulation, osmo-regulatory genes.
- 3.2 Thermoregulation: Temperature as an environmental factor, Thermoregulation in Invertebrates and vertebrates.
- 3.3 Poikilothermic animals: Temperature relation in poikilotherms, Aquatic and Terrestrial poikilotherms, Homeothermic animals: Temperature relations of homeotherms, Physical heat regulation, Chemical heat regulation.
- 3.4 Hibernation & Aestivation.

UNIT-4:

4.1 Biological Rhythms.

4.2 Bioluminescence: Occurrence of bioluminescence among different animals, Mechanism of light production, Control of bioluminescence, Functions of luminescence.

4.3 Chromatophores and regulation of their function: Mechanism of action of chromatophore, Movement of pigment, Control of Chromatophores, Factors influencing on chromatophore system.

4.4 Contractile elements in animals. Muscle structure and function-correlation.

Course Outcomes:

1. How Invertebrates and Vertebrate animals work and how these animals biology is influenced by the different environments of their niches.
2. The students will be able to explore an original query in Animal Physiology. The students will appreciate evolutionary changes and environmental adaptations in different taxa of Invertebrates and Vertebrates.
3. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted.
4. Understanding of the basic concepts of Physiological regulation, from cellular to organ to organismal.
5. Understanding of how different groups of animals have different Physiological adaptations appropriate to carry out the required function to the fullest.
6. Appreciation of the gorgeous diversity of Physiological possibilities that animals have developed throughout.

Suggested Reading Material:

1. C.L. Prosser. Comparative Animal Physiology. W.B. Saunders & Company.
2. C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.
3. R. Eckert. Animal Physiology, Mechanism and Adaptation. W.H. Freeman & Company.
4. Schiemdt-Nielsen. Animal Physiology, Adaptation and Environment. Cambridge.
5. W.S. Hoar. General Comparative Animal Physiology.
6. Comp. Animal Physiology by William Hoar. (Pub. E.E.E. IBH).
7. Animal Physiology – Adaptation and Function By F. Reed Hainsworth (Published by Addison–Wesley Publishing Company, California).
8. Animal Physiology and Adaptation by David Gordon.

C.C-202. 5(A): APPLIED ANIMAL BIOTECHNOLOGY

Course Objectives:

1. To introduce a detailed achievement of Biotechnology, Genetic Engineering, and r-DNA technology principles.
2. To gain knowledge on cloning vectors and their uses in gene cloning technologies.
3. Principles of Cloning strategies and screening analysis of Recombinations.
4. To apply principles of Biotechnology concepts in veterinary sciences i.e., production of Transgenic animals, Artificial insemination, In vitro fertilization, Embryo transfer technology.
5. Application of Biotechnological principles in Medicine and Gene transfer techniques.
6. To understand the uses of Fresh and marine pearl culture technology, IPR, Patents, and Copyrights.

UNIT-1:

- 1.1 General Introduction and Achievements of Biotechnology
- 1.2 Enzymes used in gene cloning - Restriction endonucleases, DNA ligases, Kinase, Phosphatase, Nucleases, Polymerases, Reverse transcriptase
- 1.3 Cloning vectors (Plasmids, Phages, cosmids, yeasts Shuttle vectors), viral vectors (SV40, Adenovirus, and Baculovirus) used in Gene cloning.
- 1.4 Cloning and selection strategies of recombinants (antibiotic selection, blue-white screening, colony hybridization, Fluorescence in-Situ Hybridization (FISH), and immunological test.

UNIT-2:

- 2.1 Preparation of cell lines, types of cell lines.
- 2.2 Applications of cell culture in Veterinary - Disease diagnosis.
- 2.3 Application of Biotechnology in Medicine - Production of monoclonal antibodies (Hybridoma technology), Production of vaccines and Production of Growth Hormone
- 2.4 Gene therapy: Introduction, principle of gene transfer, and examples (Adenosine deaminase deficiency disease, Duchenne Muscular dystrophy disease, and Cystic fibrosis)

UNIT-3:

- 3.1 Livestock improvement: Manipulation of reproduction in animals (Artificial insemination, multiple ovulations, in vitro fertilization, Embryo transfer technology)
- 3.2 Methods of gene transfer – Microinjection, electroporation, lipofection, and viral-mediated gene transfer techniques
- 3.3. Gene editing - Gene silencing - CRISPR-associated protein-9 nuclease (Cas9) technology
- 3.4 Potential application of transgenic animals: models for various diseases/disorders.

UNIT-4:

- 4.1 Growth hormone transgenics and stem cell technology for the betterment of aquaculture. Sex reversal in fishes and their applications, Production of monosex populations.
- 4.2 Marine bio/fish resources and its applications in pharmaceutical and Nutraceutical Industries.
- 4.3 Freshwater and marine (oyster) pearl culture technology, pearl culture in India, uses of pearl culture.
- 4.4 Intellectual Property Rights: Introduction; Types of IP; Patents and its types, Trademark Copyright & Related Rights, Protection of GMOs; ethical and legal issues in biotechnology.

Course Outcomes:

1. Imparts the knowledge to cell lines and stem cells in culture media.
2. It gives insight into various cell/tissue culture techniques and their applications.
3. Understanding of in vitro culturing of organisms and production of transgenic animals.
4. Understanding of cloning of mammals, large-scale culture, and production from recombinant microorganisms and cloning vectors.
5. This insight allows students to take into consideration the ethical issues involved in the production of transgenic animals and BT products.
6. Use in gene transfer technology, genetic manipulations and in a variety of industrial processes, and prominence of IVF, Artificial insemination, and embryo transfer techniques.
7. Gives knowledge to the culture of animal cells and its culture medium.
8. Learn basic concepts and principles of recombinant DNA technology, Gene manipulation for transgenic animal production and therapeutics/vaccine production.
9. Provides knowledge on Livestock improvement, aquaculture, and pearl culture.
10. Provides knowledge on Intellectual property rights and genetically modified organisms.

Suggested Reading Material:

1. A textbook of Biotechnology - R.C. Dubey, S. Chand & Company Ltd., New Delhi - 1996.
2. A textbook on Biotechnology - (n Ed.) H.D. Kumar, EWP - Private Ltd., New Delhi - 1998.
3. Animal Biotechnology - M.M. Ranga, Agrobios (India), 2000.
4. Biotechnology - Fundamentals & Applications - S.S. Purohit & S.K. Mathur, AgroBotonics - 1999.
5. Biotechnology - V. Kumaresan, Saras Publication - 1994.

C.C-202. 5(B): IMMUNOTECHNOLOGY**Course Objectives:**

1. To introduce the principles and applications of Immunology in the field of Biotechnology.
2. To understand the fundamentals of Immunotechnology including antigen-antibody interactions, immune responses, and immune system components.
3. To explore the techniques and technologies used in Immunology for diagnosis, treatment, and research purposes.
4. To apply Immunotechnological concepts in various industries including healthcare, agriculture, and environmental science.
5. To analyze the role of Immunology in disease prevention, vaccination, and personalized medicine.
6. To examine the ethical and legal considerations related to Immunotechnology and biopharmaceuticals.

UNIT-1:

- 1.1 Aim and scope of Immunotechnology, Evolution of vaccination strategies, Impact of serological tests in identifying specific antibodies in immune responses.
- 1.2 Regulation of immune tolerance and mechanisms of self/non-self-discrimination, Interplay between the innate and adaptive immune responses in pathogen recognition
- 1.3 Differentiation and functions of effector memory T cells in immune memory responses, Role of marginal zone B cells in early antibody responses to blood-borne pathogens, Specialized functions of antigen-presenting cells in priming T cell responses
- 1.4 Role of Toll-like receptors in recognizing pathogen-associated molecular patterns (PAMPs), Antibody effector functions and complement activation pathways in immune defense

UNIT-2:

- 2.1 Principles of Immunodiagnostics, Development of ELISA assays, Western Blotting , Role of Immunofluorescence in diagnostics.
- 2.2 Applications of Monoclonal Antibodies in therapy, Immunomodulators in disease management, Immunotherapeutic strategies in clinical settings
- 2.3 Genetic basis of immunity in animals, Immunogenomic approaches for disease resistance.
- 2.4 Utilization of Immune-based sensors for environmental monitoring, Role of Biosensors in detecting pollutants and pathogens in ecosystems.

UNIT-3:

- 3.1 Classification of Vaccines based on technology, Novel vaccine development approaches, Vaccination schedules and strategies.
- 3.2 Genetic components of immune responses, Impact of polymorphisms on disease susceptibility, Applications of Immunogenomic studies in personalized medicine.
- 3.3 Mechanisms of Immunodeficiency disorders, Pathophysiology of Allergic reactions, Autoimmune disease etiology and management.
- 3.4 Genetic manipulation for immune system modification, CRISPR-Cas9 applications in immune cell engineering and disease models

UNIT-4:

- 4.1 Therapeutic Antibodies for targeted therapy, Adjuvants in vaccine formulations, Immune-modulating drugs for treatment strategies.
- 4.2 Immune Biomarkers for diagnostics and prognosis, Detection methods for Immunosuppressants in therapeutic monitoring.
- 4.3 Compliance with Quality Control standards, Implementation of Good Manufacturing Practices in Immunotherapy, Ethical considerations in Immune-based technologies.
- 4.4 Personalized Immunotherapy approaches, Utilization of Immunogenomics for precision medicine, Integration of Immunoinformatics in predicting immune responses and designing novel therapies.

Course Outcomes:

1. Comprehensive understanding of Immunology principles and their applications in Biotechnology.
2. Proficiency in performing various immunological techniques for research and diagnostics.
3. Ability to analyze and interpret immune responses in different contexts.
4. Knowledge of how Immunotechnology is applied in healthcare, agriculture, and environmental sectors.
5. Understanding of the importance of Immunology in disease prevention and treatment strategies.
6. Awareness of the ethical, legal, and regulatory frameworks governing Immunotechnology.
7. Skill development in immune engineering and genetic manipulation for therapeutic purposes.
8. Profound insight into the role of Immunotechnology in personalized medicine and future healthcare trends.

Suggested Reading Material:

1. Immunology - A Clinical & Laboratory Manual by Richard R. Roitt.
2. Basic and Clinical Immunology by Mark Peakman and Diego Vergani.
3. Molecular Immunology by William J. Levinson.
4. Immunotechnology: Discovering Antibodies, Antigens, and Supercells by David Burke.
5. Immunology for Dummies by John T. Conner.

CC-203.6(A): NEUROBIOLOGY AND ETHOLOGY**Course Objectives:****Neurobiology:**

1. To study the microanatomical structure of neuron
2. To describe the different types of Neurons and their organization
3. To understand the Molecular mechanism of transmission
4. To study the chemical composition of Nervous system
5. To understand the principles of different types of neurotransmitters

Ethology(Animal Behavior):

1. To study the types of perception in animal behaviour
2. To study the patterns of social organization of Primates and Insects
3. To know about the Animal aggressive behaviour and homing territoriality
4. To study in depth the patterns of Learning and Memory

UNIT-1:

- 1.1 Micro anatomy of neurons and types of nerve cells, organisation of central nervous system (spinal cord, Brain stem and cerebral cortex).
- 1.2 Types of cranial & Spinal nerves their association to the different organs of the human.
- 1.3 Bioelectrical properties of neurons-Neuronal excitability; The resting membrane potential, Sodium and potassium pump, Generation of action potentials.

- 1.4 Synapse; structure and integration; Morphology of the synapse; Types of Synapses, Ultra structure of synapse, chemical transmission and Electrical transmission.

UNIT-2:

- 2.1 Chemical composition of the nervous system - cerebrospinal fluid - CNS barriers
2.2 Synthesis, Storage, release and mechanism of Acetylcholine
2.3 Synthesis, Storage, release and mechanism of Catecholamines including Epinephrine, Norepinephrine, Dopamine
2.4 Neurodegeneration disorders; Alzheimer's disease, Parkinson's disease and schizophrenia

UNIT-3:

- 3.1 General introduction: An overview of concept of Animal behaviour
3.2 Visual Perception, Auditory perception and Olfactory Perception
3.3 Animal aggression and Homing territoriality
3.4 Social organization, Advantages, Social organization in insects, primates

UNIT-4:

- 4.1 Conditioning Learning (Classical and Operant conditioning and Multiple-response learning)
4.2 Cognitive Learning (Insight Learning, Sign Learning, Latent Learning)
4.3 Kinds of remembering (Red integrative memory – Recall – Recognition - Relearning - Retrieval process - Theories of Memory)
4.4 The nature of forgetting (Decay through disuse - Interference effects, motivated forgetting, Improving memory)

Suggested Reading Books:

1. Basic Neurochemistry - G.J. Siegal, R.W. Albers, B.W. Agranoff, R. Katzman (1981); Little, Brown and company, Boston.
2. Introduction to Nervous system - T.H. Bullock, R. Cork, A. Granner (1977); W.H. Freeman & Co.
3. Mechanism of Drug Action on the Nervous System - M.A.B. Brazil, R.W. Ryall (1979); Cambridge University Press, Cambridge, London and New York.
4. Neuroanatomical Techniques - N.J. Stransfed and T.A. Miller, Springer Verlag, New
5. Neurobiology - Shepherd, G.M., Oxford University Press, London.
6. Principles of Neural Science - E.R. Kandel and J.H. Schwartz (1981); Elsevier North Holland, NY, Oxford.
7. Principles of Neuropsychopharmacology - Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
8. The Biochemical basis of Neuropharmacology - J.R. Cooper, F.E. Bloom, & R.H. Roth (1982); Oxford University Press, NY and London, York Heidelberg, Berlin, 1980.
9. Alcock, J., Animal Behaviour: An evolutionary approach, Sinauer Assoc., Sunderland, Mass., USA.
10. An Introduction to Genetic Analysis - Griffiths, A.J. F., J.B. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbark, W.H. Freeman and Company, New York.
11. Bradbury, I.W. and S.L. Vehrencamp, Principles of Animal Communication, Sinauer Assoc., Sunderland, Mass., USA.

CC-203. (6B): GENETIC ENGINEERING

Course Objectives:

1. To introduce the principles, techniques, and applications of Genetic Engineering.
2. To understand the fundamentals of gene manipulation, recombinant DNA technology, and gene editing.
3. To explore the ethical, social, and environmental implications of Genetic Engineering.
4. To apply Genetic Engineering concepts in various sectors including healthcare, agriculture, and biotechnology.
5. To analyze the role of Genetic Engineering in biopharmaceutical production, gene therapy, and crop improvement.
6. To examine the current trends and future prospects of Genetic Engineering technologies.

UNIT-1:

- 1.1 Evolution of Genetic Engineering: Historical Progression of Genetic Engineering, Contributions of Pioneering Scientists, Impact on Modern Biotechnology Practices.
- 1.2 Genetic Manipulation Techniques: Gene Isolation Methods, Advanced Transformation Techniques.
- 1.3 Precision Gene Editing Technologies (to be added) , TALEN, Zinc Finger Nuclease.
- 1.4 Molecular Analysis of Genetic Variations: Genomic Sequencing, Strategies for Genetic Analysis, Study of Genetic Variation Techniques like RFLP, STR and SNP Analysis.

UNIT-2:

- 2.1 Toolbox of Genetic Engineering: Detailed Understanding of Restriction Enzymes, DNA Ligases, Gene Synthesis Procedures, Versatile Applications of PCR Techniques.
- 2.2 Creating Transgenic Organisms: Fundamentals of Transgenesis, Applications in Developing Transgenic Animals, Genetic Modifications for Trait Enhancement.
- 2.3 Gene Therapy Insights: Types of Gene Therapy Approaches, Innovative Gene Delivery Systems, Clinical Implementations in Therapeutic Gene Editing.
- 2.4 Genomic Manipulation in Evolution: Genetic Engineering Contributions to Evolutionary Studies, Impact on Understanding Species Differentiation, Genomic Adaptations Over Time.

UNIT-3:

- 3.1 Agricultural Genetics Advancements: Genetic Modification Interventions in Agriculture, Enhanced Crop Varieties, Techniques such as Gene Stacking for Crop Productivity.
- 3.2 Biopharmaceutical Production Innovations: Recombinant Protein Manufacturing, Application of Bioreactors in Biopharmaceutical Industry.
- 3.3 Environmental Genetic Engineering Applications: Harnessing Genetic Modification for Bioremediation, Sustainable Biofuels Production using Engineered Microorganisms.
- 3.4 Ethical and Societal Aspects: Ethical Implications of Genetic Engineering Practices, Balancing Advancements with Bioethical Considerations, Institutional Biosafety Committees.

UNIT-4:

- 4.1** Gene Regulation Mechanisms: Gene Silencing Techniques, Exploration of Transcription Factors in Gene Expression Regulation, Epigenetic Modifications Understanding and Implications.
- 4.2** Synthetic Biology Innovations: Designing Artificial Biological Systems, Utilization of Bioinformatics Tools in Designing Biological Constructs.
- 4.3** Societal Impact and Ethical Considerations: Navigating Bioethics in Genetic Engineering, Ensuring Ethical Conduct in Research and Applications, Intellectual Property Protection.
- 4.4** Futuristic Genetic Engineering Vistas: Exploring Future Applications of Genetic Engineering in Zoological Research.

Course Outcomes:

1. Thorough understanding of Genetic Engineering principles and technologies.
2. Proficiency in gene manipulation techniques and gene editing tools.
3. Ability to apply Genetic Engineering in various fields for practical applications.
4. Knowledge of the ethical implications and societal impacts of Genetic Engineering.
5. Understanding of how Genetic Engineering is utilized in healthcare, agriculture, and environmental sectors.
6. Skill development in genetic modification for beneficial purposes and problem-solving.
7. Awareness of the regulatory and safety considerations in Genetic Engineering practices.
8. Insight into the future advancements and emerging trends in Genetic Engineering.

Suggested Reading Material:

1. Molecular Cloning: A Laboratory Manual by Joseph Sambrook and David Russell.
2. Genetic Engineering: Principles and Methods by Jane K. Setlow.
3. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown.
4. Biotechnology and Genetic Engineering by Pranav Kumar.
5. Synthetic Biology: A Primer by Geoff Baldwin and Drew Endy.

SOC-205.(3A): MOLECULAR BIOLOGY**Course Objectives:**

1. This course provides concepts in molecular understanding of structural and functional properties of cells and various processes associated with potential applications in Molecular, Biochemical, and Biomedical research.
2. To provide knowledge about the complex organization in Eukaryotic cells and the molecular mechanisms of cellular processes existing in all cell types.
3. To gain knowledge on DNA models, structure and functions of mitochondrial DNA, DNA repair mechanisms, Transcription, translation, Replication, Gene regulation mechanisms with emphasis on Eukaryotic cells.

UNIT-1:

- 1.1 Watson and Crick Model: Types of DNA; Properties of DNA (C-value paradox, Cot value).
- 1.2 Nuclear and mitochondrial genome, mitochondrial and maternal Inheritance.
- 1.3 Structure of gene (Cistron, Muton, Recon, Cis-trans test).
- 1.4 DNA damage and repair: Biological indication of repair, photo reactivation, Excision repair, Recombination repair, SOS repair, and Mismatch repair.

UNIT-2:

- 2.1 Replication in Prokaryotes: Geometry of DNA replication, semi-conservative replication.
- 2.2 Enzymology of DNA replication: DNA polymerase I, II and III; Replication of Eukaryotic Chromosomes; Eukaryotic DNA polymerases; Multiple fork; Replication of Chromatin.
- 2.3 Discontinuous Replication: Fragments in Replication fork and detection of fragments; Events in the Replication fork; De novo initiation and covalent extension.
- 2.4 Bidirectional replication, Termination of replication.

UNIT-3:

- 3.1 Synthesis of RNA: - RNA Polymerase, Promoter, Auxiliary Proteins, RNA chain initiation, elongation, termination and Splicing mechanism.
- 3.2 Types of RNA, Processing of mRNA, rRNA and tRNA, Ribozyme.
- 3.3 Genetic code, Identification of start and stop codon, Universality of genetic code Degeneracy, Wobble's Hypothesis, Codon usage, Genetic code of Mitochondria.
- 3.4 Ribosome structure (Prokaryotic and Eukaryotic), Protein synthesis: Initiation, Elongation and Termination of the polypeptide chain, Signal peptide hypothesis, Post-translational modification, Polyproteins, Inhibitors of translation.

UNIT-4:

- 4.1 Temporal response, Induction, Repression, Lac Operon, Galactose Operon.
- 4.2 Lambda Operon, Tryptophan Operon.
- 4.3 Gene regulation in Eukaryotes-I: Gene families, Gene alteration (Gene loss, Gene amplification, gene rearrangement), Regulation of synthesis of primary transcripts (gene organization that affects regulation - Activator gene; Transcriptional control by hormones, Methylation).
- 4.4 Gene regulation in Eukaryotes-II: Brief description of Chromatin remodelling, Enhanceosome, Reporter or Chimeric genes, Role of binding motifs in gene expression (Helix-Turn-Helix motif, Zinc finger, and Leucine Zipper), methods of gene expression at RNA and protein levels.

Course Outcomes:

- 1. The study of molecular biology provides the necessary information about the Chemistry of life to allow the students to understand the basis of life.
- 2. The study of Molecular Biology stands as a tribute to human curiosity for seeking to discover, and to human creative intelligence for devising the complex instruments and elaborate techniques by which these discoveries can be made.

3. Comparative analysis of Prokaryotic and Eukaryotic cells.
4. Gain insight into the most significant Molecular and cell-based methods used today to expand our understanding of Biology.
5. Students would gain expertise in understanding the complex molecular mechanisms occurring in cells and the applications of molecular technologies for the betterment of life.
6. Understand and apply the Principles and techniques of Molecular Biology which prepares students for further education, employment in teaching, basic research, or the health Professions.
7. Students will acquire knowledge about replication, transcription, translation, post-transcriptional and post-translational modifications, gene regulation, DNA repair mechanisms, and various molecular tools and techniques like PCR, southern and western blotting, recombinant DNA technology, etc. They will also know the various tools and techniques related to bacterial microbiology.

Suggested Reading Material:

1. Biochemistry by A.L. Lehniger.
2. Cell and Molecular Biology by E.D.P. De Robertis and E.M.F.
3. Concepts in Molecular Biology by S.C. Rastogi, VN. Sharma and Ananda Tandon (1993) Genes VII by Benjamin Lewin.
4. Harper's review of Biochemistry by D.W. Martin et al. (1990).
5. Molecular Biology by David Freifelder (1993).

SOC-205.(3B): HEALTH MANAGEMENT IN AQUACULTURE

Course Objectives:

While studying the Health Management in Aquaculture course, the student shall be able to:

1. Preventing disease: Primary goal is disease prevention through good water quality, nutrition, and sanitation.
2. Early detection: Observing fish behavior and feeding activity daily for early problem identification.
3. Reducing disease spread risk: Technical guidelines to minimize spreading aquatic diseases.
4. Developing a systems approach: Need for a systems approach considering the entire production environment.
5. Using vaccines and immuno-stimulants: Utilizing vaccines and immuno-stimulants for disease prevention.

UNIT- I:

- 1.1 Preparation and Management of Indian major carp culture ponds including nursery, rearing, and production ponds.
- 1.2 Culture of Indian Major Carps and exotic carps at Fish Hatcheries; breeding methodologies.
- 1.3 Culture of brackish water fish species; major constituents of fish and their roles; toxins in fish.
- 1.4 Discussion on the major and minor constituents of fish, including moisture, proteins, lipids, carbohydrates, vitamins, minerals, and toxic substances.

UNIT-II:

- 2.1** Handling, storage, and transport of fishes; maintaining quality standards.
- 2.2** Principles of fish preservation including curing, drying, salting, smoking, chilling, freezing, and canning.
- 2.3** Modern fish preservation techniques such as Accelerated Freeze Drying (AFD) and Irradiation.
- 2.4** Utilization of fishery by-products and wastes.

UNIT-III:

- 3.1.** Viral diseases: Clinical symptoms, pathology, and control measures of Viral Hemorrhagic Septicemia (VHS), White spot and Infectious Hematopoietic Necrosis (IHN).
- 3.2.** Bacterial and Fungal diseases: Clinical symptoms, pathology, prevention, and control measures of various diseases.
- 3.3.** Protozoan, Helminthic, and Crustacean diseases: Clinical symptoms, pathology, and control measures of different diseases.
- 3.4.** Nutritional and Ecological diseases discussion along with control measures.

UNIT – IV:

- 4.1** Health management tools, diagnostic methods, immune detection, DNA, RNA techniques, and vaccine development.
- 4.2** Impact of biofilms on health management, use of genetically modified microorganisms as probiotics, and bioremediation strategies.
- 4.3** Focus on good feed management, zero water exchange, biosecurity concerns, and nitrogen fixation in aquatic environments.
- 4.4** Discussion on post-harvest biotechnology including spoilage prevention and use of biosensors.

Course Outcomes:

After completing the Health Management in Aquaculture course, students will have a good understanding of:

1. Disease management: Learning about pathogens affecting aquatic organisms, disease prevention, and the relationship between disease and aquaculture activities.
2. Water and soil quality management: Understanding of soil health assessment, solving environmental issues like waste water, algal blooms, and aquatic weeds.
3. Nutritional diseases: Knowledge about nutritional diseases and methods for prevention.
4. Feed management: Understanding feed energetics, quality standards, and feeding strategies.
5. Seafood spoilage: Learning prevention strategies and proper storage and packaging of seafood products.
6. Waste utilization: Utilizing waste in seafood processing effectively.
7. By-product preparation: Knowing how to prepare by-products like fish meal, fish oil, chitin, and chitosan for commercial use.
8. Disease management tools: Knowledge about tools for disease management and the ecological impact of diseases on the aquatic environment.

Suggested Reading Material:

1. Bardach, JE et al. 1972. Aquaculture – The farming and husbandry of freshwater and marine organisms. John Wiley & Sons, New York.
2. Landau M. 1992. Introduction to Aquaculture. John Wiley & Sons.
3. Balachandran KK. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publ.
4. Clucas IJ. 1981. Fish Handling, Preservation and Processing in the Tropics. Parts I, II. FAO.
5. Hall GM. (Ed). 1992. Fish Processing Technology. Blackie.
6. Krenzer R. 1971. Fish Inspection and Quality Control. Fishing News.
7. Nambudiri DD. 2006. Technology of Fishery Products. Fishing Chimes.
8. Regenssein JM & Regenssein CE. 1991. Introduction to Fish Technology. Van Nostrand Reinhold.
9. Cheng TC. 1964. The Biology of Animal Parasites. W.B. Saunders Company, Philadelphia, Pennsylvania, USA.
10. Conroy CA and Herman RL. 1968. Textbook of Fish Diseases. TFH (Great Britain) Ltd, England.
11. Reichenbach KH. 1965. Fish Pathology. TFH (Gt. Britain) Ltd, England.
12. Ribelin WE and Migaki G. 1975. The Pathology of Fishes. The Univ. of Wisconsin Press Ltd, Great Russel Street, London.

SOC-206(4A): ENZYMOLOGY**Course Objectives:**

While studying Enzymology, the student shall be able to:

1. To study the Nomenclature and Classification, Enzyme specificity, Enzyme Catalysis, and Enzyme purification mechanisms
2. To study the Enzyme Kinetics mechanisms and impact of several parameters
3. To study the different mechanisms of Inhibitions and their implications at the cellular level
4. To study the Enzyme Regulatory mechanisms
5. To study the Clinical aspects of Enzymology and diagnosis
6. To study the Enzyme Engineering Principles
7. To understand the Enzymes in industrial use – Biotechnological implications

UNIT-1:

- 1.1 Historical Background, overview, and specific examples, nomenclature, and classification of enzymes – IUB system, chemical nature, and properties of enzymes.
- 1.2 Enzyme specificity (Absolute specificity, Group specificity, Broad specificity).
- 1.3 Enzyme catalysis, Quantitative measurement of enzyme activity, Assay of enzyme activity, units of enzyme activity.
- 1.4 Isolation and purification of enzymes, intracellular distribution of enzymes.

UNIT-2:

- 2.1 Theories of enzyme kinetics - kinetic theory and collision theory.
- 2.2 Enzyme kinetics and its importance, derivation of Michaelis-Menton equation, Methods of V_{max} and K_m determination, construction of Line Weaver Burk plots.
- 2.3 Effect of reactant concentrations (Rate constant, First order, Second order, and Zero-order kinetic reactions, determination of slope).

2.4 Effect of Temperature, pH, and enzyme concentration on reaction rate.

UNIT-3:

- 3.1 Inhibition of enzyme activity (competitive, non-competitive, uncompetitive, and mixed inhibition).
- 3.2 Kinetics of allosteric enzymes.
- 3.3 Regulation of enzyme activity (Metabolic regulation), Catalytic efficiency of enzymes (feedback inhibition, covalent modification).
- 3.4 Mechanism of enzyme action (Lock and Key, Induced fit model), catalytic site, role of metal ions.

UNIT-4:

- 4.1 Clinical Aspects of enzymology, Medical and Therapeutic applications of enzymes; Enzymes Clinical diagnosis.
- 4.2 Immobilized enzymes, various methods of immobilization - ionic bonding, absorption, covalent bonding (based on R groups of amino acids).
- 4.3 Isoenzymes and multiple forms of enzymes.
- 4.4 Enzyme engineering – economic importance of enzyme production. Enzymes in industries - food, biotechnology, and other industries.

Course Outcomes:

- 1. Students learn about enzymes, their classification, and nomenclature.
- 2. Students learn about the specificity of enzymes.
- 3. Students learn about the measurement of enzymatic activity.
- 4. Students learn about the isolation, purification of enzymes, and intercellular distribution of enzymes.
- 5. Students learn about kinetic and collision theories.
- 6. Students learn about the mechanism of enzyme action.
- 7. Students learn about the effect of reactant concentration.
- 8. Students learn about the effect of enzyme concentration, pH, and temperature.
- 9. Students learn about the kinetic constant and determination of kinetic constants.
- 10. Students learn about types of inhibitory mechanisms of enzymes.
- 11. Students learn about the kinetics of Allosteric enzymes.
- 12. Students gain knowledge about the regulation of enzyme activity with respective mechanisms.
- 13. Students learn about the mechanism of enzymes in clinical diagnosis and their applications.
- 14. Students gain knowledge about the immobilization of enzymes, applications of immobilized enzymes.
- 15. Students gain knowledge about isoenzymes and their applications.
- 16. Students learn about enzyme engineering, the process of enzyme engineering, and their applications.

Suggested Reading Material:

1. Biochemical Calculations by I.H. Segel, 2nd Ed., John Wiley & Sons.
2. Biochemistry by D. Voet & J.G. Voet, J.Wiley & Sons.
3. Enzyme Kinetics by I.W. Segil.
4. Enzyme Kinetics by D.V. Roberties, Cambridge University Press.
5. Harper's Biochemistry by Robert K. Murrey, Peter A. Mayer, D.K. Granner, V.W. Rodwell, Lange Medical.
6. Biophysical Chemistry by Upadhyay – Upadhyay - Nath.
7. Biophysical Chemistry by James P. Allen.

SOC-206(4B): ECONOMIC ZOOLOGY**Course Objectives:**

While studying the Economic Zoology course, the student shall be able to:

1. Identify various Methodologies and Perspectives of applied branches of Zoology for the possibilities of Self-employment.
2. Study the economic importance of Sericulture, Apiculture, and Animal husbandry.
3. Learn the technical practices of Aquaculture, Sericulture, Apiculture, and Animal husbandry technologies.
4. Gain understanding of disease management technologies and their adaptation in Fisheries, Apiculture, Sericulture, Poultry, etc.

UNIT-1:

- 1.1 Introduction to Aquarium Fish Keeping, potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes.
- 1.2 Biology of Aquarium Fishes, common characters, and sexual dimorphism of Freshwater and Marine Aquarium fishes, live fish feed organisms.
- 1.3 Fish Transportation and Aquarium Maintenance, Live fish transport, packing, and forwarding techniques.
- 1.4 General Aquarium maintenance, budget for setting up an Aquarium Fish Farm as a Cottage Industry.

UNIT-2:

- 2.1 History, scope, and prospective status of Sericulture Industry in India.
- 2.2 Species of silkworm, life history of mulberry silkworm and tasar silkworm.
- 2.3 Silk worm diseases, Entrepreneurship in sericulture.
- 2.4 Economic Prospects: Overview of economic opportunities and challenges in the Sericulture Industry.

UNIT-3:

3.1 Historical background of Vermicompost

3.2 Different methods of Vermiculture

3.3 Advantages and economic importance of Vermiculture, Vermicompost

3.4 Problems involved in Vermicompost

UNIT-4:

4.1 Lac culture – Lac insect, Laccifer lacca, life cycle, Lac processing, Lac products, Economic Importance.

4.2 Pearl culture and Pearl Industry.

4.3 Economics of Poultry keeping, Morphology of different breeds of Chicken, Brooding and Rearing of Chicks, Egg and Meat processing in Poultry.

4.4 Dairy farm management, Milch, Draught, Dual-purpose breeds of Cows and Buffaloes in India.

Course Outcomes:

After completing Economic Zoology, the student will be able to:

1. Explore various concepts and the importance of Economic Zoology.
2. Create self-employment opportunities for rural students through Animal husbandry, Aquaculture, and Sericulture.
3. Understand the significance of economically important animals including cultivable Fishes, Prawns, and their culture practices.
4. Identify animal pathogenic diseases in Fisheries, Sericulture, Apiculture, Aquaculture, and their management strategies.
5. Introduce technologies pertaining to Pearl culture, Poultry keeping, Dairy farm management.

Suggested Reading Material:

1. "Economic Zoology" by G.S. Sukla and V.B. Upadhyay.
2. "A Handbook on Economic Zoology" by Jawaid Ahsan and Subhas Prasad Sinha.
3. "Economic and Applied Entomology" by Ashok Kumar and Prem Mohan Nigam.
4. "Applied Fisheries" by Q.J. Shammi and S. Bhatnagar.
5. "Ponds and Fish Culture" by Major Hall, C.B.
6. "A Handbook of Poultry Practice" by Keith Wilson, N.D.P.
7. "Poultry" by G.C. Banerjee.
8. "A Text Book of Animal Husbandry" by G.C. Banerjee.
9. "Trends in Livestock Research" by S.K. Kaushish.
10. "Vermiculture the Biology of Earthworm" by S.A. Ismail.
11. "Vermitechnology" by A. Mary Violet Christy.

Audit Course
ZOO--209 - Indian Knowledge Systems – 2

Learning Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of Indian Knowledge System.
- To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system.
- To make students acquaint with the facets of traditional knowledge& their relevance and help them be able to apply it to their day to day life.

Learning Out comes:

1. At the end of the course, students will be able to gain insights into the concept of traditional knowledge and its relevance.
2. They will also be able to understand and connect up the basics of Indian traditional knowledge with modern perspective.
3. Apply traditional knowledge for sustainability

SYLLABUS

- Unit I : Diversity and Indian Culture: Diversity and Indian Culture; Indigenous Faith and Religion; Preservation of culture and indigenous knowledge .
- Unit II : Indian Calendar: Panchanga. Adhikamasas. Solar and Luni-Solar systems.Solar and Lunar Eclipses Angular diameters of the Sun, Moon and Earth's shadow. Possibility of eclipses. Finding the middle of an eclipse by iteration. Amount of obscuration at any time.
- Unit III : Indian Architecture and Town Planning: Introduction ancient Indian architecture; Sthapatya-Veda: An Introduction; Indigenous tools & techniques for town planning & Temple Architecture. Lothal, Mohan Jo Daro; Temple Art: Lepakshi Temple, Jagannath Puri Temple, Konark Sun Temple.
- Unit IV : Indian Agriculture: Significance in Human Civilization; Sustainable Agriculture; Historical significance of agriculture and sustainable farming in India; Step Cultivation of India: Special reference to Northeast India; Wet rice cultivation of Assam.

Reference Books:

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śārīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991.
4. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrottthana Sahitya, Bengaluru, 2021.
5. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Private Ltd.
6. Mukul Chandra Bora, Foundations of Bharatiya Knowledge System. Khanna Book Publishing

7. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
8. Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,
9. M. S. Sriram, Man and the Universe- An elementary account of Indian Astronomy, (Unpublished 1993).

SEMESTER-III

COURE COURSE 301: CELL BIOLOGY AND IMMUNOLOGY

Course Objectives:

1. Able to learn organization of prokaryotic and eukaryotic cell, Nucleus structure, Eukaryotic chromosome and polytene and lamp brush chromosomes
2. To learn mechanism of cell division, regulation of eukaryotic cell cycle, chromosomal abnormalities and tumor biology
3. To understand types of immunity, types of cell involved in immune response, structure and function of antibody and complimentary cascade
4. To gain knowledge on Antigen presentation, hypersensitivity reactions, immune tolerance and immunopathology

UNIT-1:

- 1.1 Organization of prokaryotic and eukaryotic cell Structure, function of Plasmamembrane, mitochondria endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes
- 1.2 Nucleus – Structure and function of nuclear membrane, nucleolus.
- 1.3 Eukaryotic chromosome and its high resolution organization
- 1.4 Polytene and lamp brush chromosomes

UNIT-2:

- 2.1 Mechanism of cell division, mitotic apparatus, cytokinesis, chromosome movement –present concept
- 2.2 Regulation of eukaryotic cell cycle – A over view of cell cycle, Mutation causing cell cycle control. Meiotic process - stages, chromosome pairing, chiasma formation Molecular mechanisms of recombination, synaptonemal complex, non-dysjunction,
- 2.3 Chromosomal abnormalities - euploidy, haploidy and their fundamental practical significance, Polyplody - induction -Aneuploidy- type and genetic significance
- 2.4 Tumor biology - cell to cell interaction, cell adhesion, cell transformation mechanism and oncogenesis

UNIT-3:

- 3.1 Immunity - innate and acquired, innate immune mechanisms, Immunogen and antigens – Properties, factors governing immunogenicity, haptens, epitopes - size and identification. Adjuvants - properties and mechanism of action.
- 3.2 Cells involved in the immune response – T cells, B cells, CD antigens, neutrophils, Eosinophils and natural killer cells. Macrophages, dendrites, Phagocytosis, Lymphoid tissues.
- 3.3 Functions of antibody in relation to structure – Antigen - antibody interactions, affinity of antibody, avidity, bonus effect, classical precipitin reaction, antigen - binding site of antibody, forces involved in antigen – antibody complex formation, Generation of antibodies, Theories of antibody formation. Monoclonal and polyclonal antibodies

3.4 Complement-nature, physico-chemical properties, complement cascade pathway, complement fixation

UNIT-4:

4.1 Antigen Presentation – pathways of antigen processing and presentation of intracellular and extracellular antigens. Cell mediated immunity (CMI) : Induction and mechanism

4.2 Hypersensitivity reactions – Classification, Type I – IV reactions. Immunity to bacterial, fungal, viral and parasitic diseases. Allergy : classification and details.

4.3 Immune tolerance, immune suppression, Transplantation and G.V.H. reactions

4.4 Immuno pathology - Auto immune diseases; immune complex diseases; immune deficiency diseases; immunity to infection.

Course Output:

1. Organization of prokaryotic and eukaryotic cell, Nucleus structure, Eukaryotic chromosome and Polytene and lamp brush chromosomes will be understood
2. Mechanism of cell division, regulation of eukaryotic cell cycle, chromosomal abnormalities and tumor biology can be learnt
3. Types of immunity, types of cell involved in immune response, structure and function of antibody and complement cascade will be proficient
4. Knowledge will be gained on Antigen presentation, hypersensitivity reactions, immune tolerance and immune pathology

SUGGESTED READING MATERIAL:

1. Cell and Molecular biology by EDR De Robertis and EMR DeRobertis Jr, Indian edition by B.I.Publications,Pvt. Ltd.
2. The Cell (A Molecular Approach) by Geoffrey M.Cooper, 7th Edition
3. Kuby,J. Immunology,7th edition, W.H.Freeman and Company, New York.
4. Janeway's Immunobiology, 9th edition, Garland Science.

COURE COURSE 302 (A): DRUG DESIGNING AND DEVELOPMENT

Course Objectives:

1. To learn drug design, analog approach of drug designing
2. To understand SAR Vs QSAR, Partition coefficient, Hammett's substituent constant and Taft's steric constant, Free Wilson mode, 3D-QSAR approach like COMFA and COMIA
3. To gain knowledge on pharmacological screening and assays, pharmacological screening models for therapeutic areas, cell based assay, biochemical assay, radiological binding assay, small molecule manufacturing

4. To learn Drug Laws, FDA, OECD, ICH, Schedule Y, drug registration, Regulations of human pharmaceuticals and biological products, and clinical trial design

UNIT-1:

1. History of drug design, Current approaches and challenges in drug design.
2. Conventional Methods: Lead, Discovery of lead, Lead optimisation, Objective of lead optimization.
3. Analog approach of drug designing : Bioisosteric replacement, rigid analogs
4. Alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

UNIT-2:

- 2.1 SAR versus QSAR, History and development of QSAR, Objectives of QSAR
- 2.2 Types of physicochemical parameters, experimental and theoretical approaches for the determination of physic-chemical parameters such as Partition coefficient, Hammett substituent constant and Taft's steric constant.
- 2.3 Hansch approach, Free-Wilson model, statistical methods, Non-computer-assisted search operations like Topliss decision tree, Simplex method, Fibonacci search technique
- 2.4 3D – QSAR approaches like COMFA and COMSIA.

UNIT-3:

- 3.1 Pharmacological Screening and Assays: General principles of screening, correlations between various animal models and human situations.
- 3.2 Pharmacological screening models for therapeutic areas, Correlation between in - vitro and in – vivo screens
- 3.3 Special emphasis on cell-based assay, biochemical assay, radiological binding assay, high throughput screening, specific use of reference drugs and interpretation of results
- 3.4 Manufacturing & process development; small molecule manufacturing; development of protein therapeutics and vaccines.

UNIT-4:

- 4.1 Drug Laws, FDA, OECD, ICH, Schedule Y, Design non clinical toxicity studies and clinical development, clinical risk / benefit analysis
- 4.2 Drug registration: Regulatory affairs, WTO, Patent regime, Accreditation and harmonization process.
- 4.3 Regulations of human pharmaceuticals and biological products. Clinical Trials: Phases of clinical trial, Non-randomized studies and Randomized controlled trials
- 4.4 Statistics in clinical research, sample size and assessment of clinical trials

Course Output:

1. Drug design, analog approach of drug designing can be understood
2. SAR Vs QSAR, Partition coefficient, Hammett substituent constant and Taft steric constant, Free Wilson mode, 3D-QSAR approach like COMFA and COMIA can be learnt
3. Knowledge will be gained on pharmacological screening and assays, pharmacological screening models for therapeutic areas, cell based assay, biochemical assay, radiological binding assay, small molecule manufacturing
4. Drug Laws, FDA, OECD, ICH, Schedule Y, drug registration, Regulations of human pharmaceuticals and biological products, and clinical trial design can be learnt

SUGGESTED READING MATERIAL:

1. Comprehensive Medicinal Chemistry, Vol. IV, Quantitative Drug Design, C. Hansch, Ed.
2. Burger's Medicinal Chemistry and Drug Discovery, Vol. I, 6th Edition, M.E. Wolff, Ed.
3. Quantitative Drug Design, A Critical Introduction, Y.C. Martin, Marcel Dekker.
4. Theoretical Drug Design Methods, Vol. 7, R. Franke, Elsevier, 1988.
5. The Organic Chemistry of Drug Design and Action, R.B. Silverman, Academic Press.
6. The Organic Chemistry of Drug Design and Drug Action, by R.B. Silverman.
7. An Introduction to Medicinal Chemistry by G. L. Patrick.
8. Martin YC. "Quantitative Drug Design" Dekker, New York.
9. Lien EJ. SAR "Side effects and Drug Design" Dekker, New York.
10. William H, Mallick JB "Drug Discovery and Development" Humana Press Clifton.
11. Foye WO "Principles of Medicinal chemistry", Lea & Febiger.
12. Korolkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.

COURE COURSE 302 (B): ANIMAL GENOMICS AND PROTEOMICS

Course Objectives:

1. To learn structure of Prokaryotic and Eukaryotic genomes, Isolation and purification of genomic DNA, Construction of Physical maps and Whole genome sequence alignment
2. To understand genome annotation, methods for gene identification, functional genomics, transcript profiling
3. To learn protein structure, sample preparation and separation 2D-analysis, Multidimensional liquid chromatography, protein-protein interactions analysis

4. To gain knowledge on DNA /protein sequence homologies, Gene duplication and divergence, and evolution of novel genes and proteins, DNA quantities and non-coding sequences (transposons) in genome evolution

UNIT-1.

- 1.1 The structure of Prokaryotic and Eukaryotic genomes
- 1.2 Isolation and purification of genomic DNA. Generation of BAC and YAC libraries.
- 1.3 Construction of Physical maps–Restriction maps, FISH and STS maps. Maxim & Gilbert, Sanger and Next generation DNA sequencing methods.
- 1.4 Whole genome sequence alignment; Clone by clone and Shot gun sequencing. Finished sequences and DNA sequence data bases.

UNIT-2.

- 2.1 Genome annotation, methods for gene identification (location)
- 2.2 Assigning gene function by experimental analysis: gene inactivation by homologous recombination, RNA interference (RNAi) and gene knockout.
- 2.3 Functional genomics: Array fabrication, types, method and application of DNA Micro arrays.
- 2.4 Transcript profiling: Serial analysis of gene expression (SAGE) and Massively parallel signature sequencing (MPSS)

UNIT-3.

- 3.1 Protein structure: secondary structures, domains, motif and folds
- 3.2 Sample preparation and separation–2D-analysis, Multidimensional liquid chromatography.
- 3.3 Characterization of proteins by Mass spectrometry and protein sequencing. Protein microarrays.
- 3.4 Protein-protein interaction analysis; yeast hybrid systems, phage display and protein complexes.

UNIT-4.

- 4.1 DNA/protein sequence homologies–Analogy, Orthology and Paralogy.
- 4.2 Gene duplication and divergence, and evolution of novel genes and proteins
- 4.3 DNA quantities and non-coding sequences (transposons) in genome evolution.
- 4.4 Molecular clocks, Molecular Phylogenetics and construction of phylogenetic trees. Applications of genomics in medicine, agriculture and industry.

Course Output:

1. Structure of Prokaryotic and Eukaryotic genomes, Isolation and purification of genomic DNA, Construction of Physical maps and Whole genome sequence alignment can be learnt
2. Genome annotation, methods for gene identification, functional genomics, transcript profiling can be understood

3. Protein structure, sample preparation and separation 2D-analysis, Multidimensional liquid chromatography, protein-protein interactions analysis can be proficient.
4. Knowledge will be gained on DNA /protein sequence homologies, Gene duplication and divergence, and evolution of novel genes and proteins, DNA quantities and non-coding sequences (transposons) in genome evolution

SUGGESTED READING MATERIAL:

1. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., and Gelbert, W.M. 2000. An introduction to Genetic Analysis, W.H. Freeman Publishers, New York.
2. Douglas J. Futuyma, 1998. Evolutionary Biology (3rd Ed). Sinauer Associates, Inc. Publishers.
3. Brown, T.A. 1999. Genomes 3. John Wiley & Sons, New York, USA.
4. Primrose, S.B. & Twyman, R.M. 2003. Principles of Genomic Analysis and Genomics. (7th Ed.). Black well Science.
5. Brown, T.A. 2001. Gene cloning and DNA Analysis-An introduction (5th Ed.), Black well Scientific Publications, Oxford, U.K.
6. Robert F. Weaver. 2008. Molecular Biology (4th Ed.). McGraw Hill Higher Education.
7. Gustafson, J.P. 2000. Genomes, Kluwer Academic plenum publishers, New York, USA.
8. Jolls, O. and Jornvall, H. (eds.) 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
9. Biochemistry by Lubert Stryer (5th Ed.) (Freeman-Toppan).

COURE COURSE 303(A): TOXICOLOGY

Course objectives:

While studying the Toxicology course, the student shall be able to:

1. Provides broad theoretical knowledge within toxicology and development of a general working knowledge of the principles and practice of clinical toxicology.
2. Basic toxicology concepts including: mechanisms of toxicology, absorption, distribution and excretion of toxicants, xenobiotic metabolism, toxicokinetics, chemical carcinogenesis,

hepatotoxicology. Based on student interest some of the following areas may be included: genetic toxicology, developmental toxicology, renal toxicology, toxic effects of pesticides, toxic effects of metals, toxic effects of radiation, venoms and animal poisons, air pollution, ecotoxicology, food toxicology, forensic toxicology, occupational toxicology, regulatory toxicology, other.

3. This course includes the study of Pesticides that are agrochemicals and used for preventing, repelling, mitigating or destroying any pests. It includes insecticides, fungicides, rodenticides and herbicides etc. These insecticides are of chemical or biological origin that control the insect. The course indicates the mechanism of Pest control that may result in the form of killing the insects or otherwise preventing it from its destructive behaviors. Insecticides are either natural.

Unit-1

1. Definition and scope of toxicology, History of toxicology and Toxic agents & their classification.
2. Principles of toxicology, Dose-response relationship, Acute and Chronic toxicity tests (LD50, LC50, ED50).
3. Receptor concept, Toxicant-receptor interactions, and Mechanism of toxic action of pesticides.
4. Toxicokinetics: i) Classic toxicokinetics, ii) Physiologic toxicokinetics

Unit-2

1. Translocation, Absorption, Distribution and Excretion of Toxicants.
2. Biotransformation of Xenobiotics and Enzymes reactions.
3. Bioconcentration, Bioaccumulation, and Biomagnification of Xenobiotics, Biomagnification of Lipophilic Pesticides.
4. Toxic Effects of Metals: Mercury, Lead, Cadmium, and Arsenic.

Unit-3

1. Toxic Response of Blood, Toxicology of Erythron, Leukon, Platelets, and Impact on Homeostasis.
2. Toxic Response of Liver and Detoxification Mechanisms.
3. Toxic Response of Kidney, Toxic Injury, Biochemical Mechanisms of Renal Cell Injury.
4. Toxic Response of the Reproductive System, Testicular Dysfunction, Ovarian Dysfunction.

Unit-4

1. Xenobiotic effect on basic metabolism (carbohydrates and proteins).

2. Teratogens and teratology: Relationships between maternal and developmental toxicity.
3. Types of antidotes, Antidotal procedures and Antidotal therapy.
4. Risk assessment: Hazard identification, Risk characterization, and Safety evaluation of chemicals.

Course outcomes:

1. The awareness about toxic agents, their effects and knowledge about mode of transformation of toxicants will help in creating skilled personnel in the field of environment protection and research.
2. It is a discipline overlapping with biology, chemistry, medicine that involves the study of toxicants, their mechanism of action.
3. It involves the study of the adverse effects of chemical substances on living organisms.
4. Skill development in environmental and occupational Toxicology.
5. It provides opportunities for students research projects, internships in assessing the effects of toxic pollutants on the environment and in the food chain.
6. Identification of different routes of exposure of environmental toxins.
7. Understanding of the physiological and genotoxic effects of drugs and environmental toxins.
8. Knowledge of various techniques for Toxicity evaluation.

SUGGESTED READING MATERIAL

1. Casarett& Doull's- Toxicology- The basic science of poisons- C.D. Klassen, Mary, O.D & John Doull.
2. Concepts of Toxicology Dr. Omkar, Vishal Publishing C.2003.
3. Environmental toxicology of pesticides- F. Mastimura, G.M.Boush and T.Misato.
4. Introduction of Biochemical Toxicology- E.Hodgson&F.E.Gutherie.
5. Pesticides action and metabolism- O'Brien.
6. Pesticides and Human Welfare- D.L. Gunn and J.G.R.Stevens. Oxford University Press-1978.
7. The Encyclopedia of Americana- Vol.15

COURE COURSE 303(B): CANCER BIOLOGY

Course Objectives:

1. To gain knowledge on cancer types and tumor development
2. To learn oncogenes, mechanisms of onogene activation and chromosomal translocation
3. To understand cell cycle regulation and cancer, DNA Damage and repair
4. To learn tumor immunology, Vaccine development, tumor cell evasion of immune defenses

UNIT-1

- 1.1 Introduction: Cancer types, Characteristics of cancer cells.
- 1.2 Carcinogenesis: Cancer initiation, promotion and progression, termination.
- 1.3 Factors responsible for carcinogenesis: Physical, chemical and biological.
- 1.4 Tumor Development: Models, Tumor angiogenesis. Overview of invasion and metastasis. Cell-cell interactions in cancer. Invasion and the extra cellular matrix. Specific cases of Prostate, Breast, Intestinal cancers.

UNIT-2

- 2.1 Oncogenes and their role in Cancer: Introduction to oncogenes
- 2.2 Mechanisms of oncogene activation (gene amplification)
- 2.3 Mechanisms of oncogene activation (chromosomal translocations).
- 2.4 Chromosomal translocations with dominant negative effects. Introduction to tumor suppressor

UNIT-3.

- 3.1 Cell- Cycle Regulation and Cancer: Mutations affecting mitogenic signal transduction pathways. Cell Cycle Regulation - Mutations affecting the cell cycle. Loss of check point control and geneticin stability. Replicative senescence
- 3.2 DNA Damage, Repair failure and Carcinogen Mechanisms: Carcinogens, DNA damage and repair.
- 3.3 Carcinogenesis: Chemical and physical agents
- 3.4 Carcinogenesis: Repair mechanisms. Aberrant repair and genetic instability. Genetic predisposition to cancer.

UNIT-4

- 4.1 Tumor Immunology: Tumor immunology [tumor antigens, cytokines]
- 4.2 Vaccine development, Immuno therapy and its limitations
- 4.3 Tumor cell evasion of immune defenses
- 4.4 Principles of chemotherapy and chemoprevention. Drug screens: High throughput Screening (HTS) approaches

Course Output:

1. Cancer types and tumor development can be understood
2. Oncogenes, mechanisms of onogene activation and chromosomal translocation can be learnt

3. Cell cycle regulation and cancer, DNA Damage and repair can be understood
4. Tumor immunology, Vaccine development, tumor cell evasion of immune defenses can be learnt

SUGGESTED READING MATERIAL:

1. Oxidative Stress and Inflammatory Mechanisms in Obesity, Diabetes and the Metabolic Syndrome, Edited by Lester Packer and Helmut Sies, CRC Press LLC(2007).
2. Oxidative stress and neurodegenerative disorders. G. Ali Qureshi and S. Hasan Parvez, Elsevier, St. Louis, MO 63146 USA (2007).
3. Oxidative Stress Disease and Cancer. Edited by Singh, World Scientific Publishing (2006).
4. Fatty Acids and Oxidative Stress in Neuropsychiatric Disorders. Edited by Ravinder, M.D. Reddy and Jeffrey K. Yao, Nova Science Pub Inc (2007).
5. Oxidative Stress, Inflammation and Health. Edited by Young- Joon Surh and Lester Packer, CRC Press LLC (2005).
6. Critical Reviews of Oxidative Stress & Aging. Edited by Cutler, World Scientific Publishing (2002).
7. Free Radicals, Oxidative Stress, and Antioxidants: Pathological and Physiological Significance Edited by Tomris Özben, Springer (1998).

SOC 305 (A) BIOANALYTICAL TECHNIQUES-II

Course Objectives:

While studying the Bioanalytical Techniques, the student shall be able to:

1. To study the different tools used in biology and research.
2. To learn about the operational handling and maintenance of laboratory instruments and glassware.
3. To study different types of Electrophoresis techniques used in biology.
4. To learn about different microscopic techniques and their application in biological research.
5. To study principles and types of isotopes their application in biological research.
6. To learn about the operational handling and maintenance of laboratory for
Cell culture.

UNIT-I

- 1.1 Migration of an Ion in an Electric Field - Factors Affecting Electrophoretic Mobility - Types of Electrophoresis - 1. Free Electrophoresis - 2. Zone Electrophoresis –
- 1.2 General Techniques of Zone Electrophoresis - 1. Paper Electrophoresis - 2. Cellulose Acetate Electrophoresis 3. Gel Electrophoresis –

1.3 Specialized Electrophoretic Techniques: Discontinuous (Disc) Gel Electrophoresis; Gradient Electrophoresis - 3. High Voltage Electrophoresis (nv.E.) - 4. Isoelectric Focussing - 5. Two-Dimensional Gel Electrophoresis-6 Immunoelectrophoresis - 7. Pulse-Field Gel Electrophoresis - 8. Electrophoresis on Cellular Gels - 9.

1.4 Capillary Electrophoresis - Electrophoresis in Genetic Analysis - 1. Restriction Mapping - 2. Southern Transfer - 3. Gel Retardation or Band Shift Assay 4. DNA and protein Sequencing and - 5. DNA Foot printing.

UNIT-II

2.1 Techniques of Chromatography - Plane Chromatography -Paper Chromatography - Thin-Layer Chromatography-

2.2 Column Chromatography - Types of Chromatography - Adsorption Chromatography – Partition Chromatography-Liquid-Liquid Chromatography -Gas-Liquid Chromatography (GLC)-

2.3. Gel Permeation Chromatography - Ion Exchange Chromatography - Affinity Chromatography –

2.4 High Performance Liquid Chromatography - Some Specialized Techniques - Hydroxyapatite Chromatography - An Affinity System for Base Dependent Fractionation of DNA - An Affinity System for Fractionating supercoiled and Non-Supercoiled DNA - DNA-Cellulose Chromatography.

UNIT-III

ISOTOPES IN BIOLOGY

3.1 Radioactive Decay - Production of Isotopes - Synthesis of Labeled Compounds - Interaction of Radioactivity with Matter - Measurement of Radioactivity –

3.2 Methods Based Upon Gas Ionization - A. Ionization Chambers - B. Proportional Counters - C. Fundamentals of Geiger Counters –

3.3 Photographic Methods

3.4 Methods Based Upon Excitation - A. Liquid Scintillation Counting - Use of Stable Isotopes in Biology - The Tracer Technique - Use of Isotopes as Tracers in Biological Sciences - Some Information About Commonly Used Isotopes - Safety Aspects - Dosimetry.

UNIT-IV

4.1 The Cell Culture Laboratory and Equipment

4.2 Safety Considerations in Cell Culture Aseptic Techniques and Good Cell Culture Practice.

4.3 Types of Animal Cells, Characteristics and Maintenance in Culture

4.4 Cell-Disruption Methods -Preliminary Purification Steps, Monitoring Protein Purification.

Course Outcomes:

While studying the Bioanalytical Techniques II, the student shall be able to:

1. Students will understand the different tools used in biology and research.
2. Students would gain expertise the operational handling and maintenance of laboratory instruments and glassware.
3. Students would gain expertise different types of Electrophoresis techniques used in biology.
4. Students will understand different microscopic techniques and their application in biological research.
5. Students would gain expertise principles and types of isotypes their application in biological research.
6. Students would gain expertise about the operational handling and maintenance of laboratory for Cell culture

SUGGESTED READING MATERIAL:

1. Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.W. Goulding, ELBS Edn.
2. Animal Cell Culture – A practical approach, Ed. John. R. W. Masters IRL Press.
3. General Zoological Microtechniques - P.M. Weesner.
4. Principles and techniques of Biochemistry and molecular biology by Kein Wilson and John Walker, VIII volume, Cambridge press Edition.
5. Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New York Heidelberg, Berlin.
6. Principles of Neuro Phychopharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
7. Biophysical chemisty by Upadhyay – Upadhyay - Nath.
8. Analytical Biochemistry (Biochemical techniques) by Dr P. Asokan. Chinnaa publications.
9. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Edition.
10. Vogel's Qantitative Chemical Analysis by Vogel, ArthurI.

SOC 305(B): BIOSTATISTICS AND BIOINFORMATICS

Course Objectives:

1. To know the importance of bioinformatics, internet basics, sources of websites and data base types
2. To understand prediction of protein structure and protein sequence database, prediction of gene structure, submission of sequence to database, phylogenetic analysis.

3. To learn biostatistics, measures of location and dispersion, curve fitting and correlation and regression
4. To understand probability distribution, tests of significance, student t-test and F-test, chi square test and their application

UNIT-1

- 1.1 Scope, importance and status of Bioinformatics
- 1.2 Internet basics, Tools for web search, Data retrieval tools
- 1.3 Sources of websites
- 1.4 Database types - primary, secondary and specific annotation databases

UNIT-2

- 2.1 Database types, Prediction of protein structure and protein folding, Protein sequence databases.
- 2.2 Prediction of gene structure, Functional genomics, Genomic databases
- 2.3 Submission of sequence to the database, Homology, BLAST- Types of BLAST
- 2.4 Phylogenetic analysis, Human genome project

UNIT-3

- 3.1 Definition of statistics: Biostatistics, classification, variables and attributes, Diagrammatic distribution of biological data.
- 3.2 Measures of location and dispersion: Arithmetic mean, median and mode. Mean deviation, quartile deviation, Standard deviation and co-efficient of variation
- 3.3 Curve fitting: Fitting straight line, parabola exponential curve. Fitting of straight line using Ms-Excel
- 3.4 Correlation and regression: Scatter diagram, types of relationship. Positive and negative correlation, computation of correlation coefficient, Interpretation of correlation coefficient. Simple regression lines and its interpretation

UNIT-4:

- 4.1 Normal probability distribution & its applications
- 4.2 Tests of significance: level of significance, null and alternative hypothesis, power of test and p-value of a test
- 4.3 Student-test for one a sample and two samples means - paired t-tests
- 4.4 F-test, chi square test and their application, concept of ANOVA.

Course Output:

1. Importance of bioinformatics, internet basics, sources of websites and data base types can be understood
2. Prediction of protein structure and protein sequence database, prediction of gene structure, submission of sequence to database, phylogenetic analysis can be learnt

3. Knowledge will be gained biostatistics, measures of location and dispersion, curve fitting and correlation and regression
4. Probability distribution, tests of significance, student t-test and F-test, chi square test and their application can be understood

SUGGESTED READING MATERIAL:

1. Basic Bioinformatics by S. Ignacimuthu, S.J. Narosa publications, 2005.
2. Bioinformatics by Andreas D. Baxevanis and B.P. Francis Ouellette, 2nd Ed., 2002.
3. Bioinformatics, Methods and Applications, Genomics proteomics and drug discovery, S.C.Rastogi, N. Mendiratta and P. Rastogi, prentice-Hall of India, 2004.
4. Microsoft Office, by Setultz, 1997.
5. Bio-Statistics-An introductory text- Goldstein, A The Macmillan Co., New York, 1971.
6. Biostatistics by Lewis Alvin (1971) Affiliated East West Press pvt., Ltd., New Delhi.
7. Interpretation and uses of Medical Statistics – G.J.Bourke & J.Mc.Gilvaray, Bloxwell Science Publication, London, 1969.
8. Introduction to Biostatistics– By Sokal – Rohlf (2nd Edn) Freeman International Editor (1973).
9. Introduction to Biostatistics by Holdan Bancroft (1962) Pual B. Hoebar Inc. New York
10. Introduction to Instrumental analysis Ronert Braun. McGraw Hill International edition

SOC 306(A): MICROBIOLOGY

Course Objectives:

1. To understand microorganisms classification and structure of prokaryotic and eukaryotic microorganism
2. To get knowledge on Nutritional requirements to microorganisms, growth of microorganism, control of microorganism and microbes of biotechnological importance
3. To become proficient in chemical nature of gene, plasmids incompatibility, horizontal transfer of genome among the microbial community and Benzer's classical studies on II locus
4. To learn diseases caused by microorganisms

UNIT-1. Introduction to Microbiology

- 1.1 Discovering the microbial world. Classification of microorganisms up to order level-bacteria, algae, fungi, protozoa.
- 1.2 Structure of prokaryotic and eukaryotic microorganisms. General and distinctive characteristics of the major groups of microorganism bacteria, mycoplasma, chlamydiae, rickettsias, actinomycetes, fungi, algae, protozoa Prions and viruses.

1.3 Isolation, cultivation and enumeration of microorganisms - direct and indirect methods, Maintenance of culture.

1.4 Outlines of characterization and identification of common bacteria, fungi, algae and protozoa.

UNIT-2. Microbial nutrition, growth and regulation

2.1 Nutritional requirements to microorganisms - Mode of nutrition - phototrophy, chemotrophy - methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic, Interaction of microbes.

2.2 Growth of microorganism (bacteria) - normal and biphasic growth curve, batch and continuous cultures, chemostats, shift up and shift down. Growth determination, Microbial metabolism - energy yielding and energy requiring processes.

2.3 Control of microorganisms - principles, physical and chemical agents, Assay of antimicrobial action. Batch and continuous sterilization of media and air. Viruses - nature, cultivation and assay methods, structure, physico-chemical properties, classification, pathogenicity, Replication of viruses.

2.4 Microbes of biotechnological importance - examples of bacteria, yeast, algae and viruses.

UNIT-3. Microbial Genetics

3.1 Chemical nature of gene, Concept of gene, operon, mosaic genes/split genes.

3.2 Plasmids incompatibility. Classification: copy number, control and its significance. Structure and functions of insertion elements (IS)-transposable elements. Mechanism of transposition. Catabolic transposons and their significance.

3.3 Horizontal transfer of genome among the microbial community - transformation, conjugation transduction - generalized transduction, specialized transduction –cotransduction.

3.4 Benzer's classical studies on *Il* locus. Cistron complementation – Elucidation of co-linearity between DNA and protein sequence. Genetics of viruses – bacteriophage, lambda, SV40, retroviral genome (HIV), replication, lytic and lysogenic cascades.

Unit-4. Diseases caused by microorganisms

4.1 Viral diseases: Flu, Dengue fever, Hepatitis,

4.2 Bacterial diseases: Cholera, tuberculosis, anthrax,

4.3 Fungal diseases: Athlete's foot, Dutch Elm disease, ergotism

4.4 Protozoan diseases (Protista): Malaria, Sleeping sickness, dysentery And Plant Pathogens: TMV, Rust

Course Output:

1. Microorganisms classification and structure of prokaryotic and eukaryotic microorganism can be learnt
2. Nutritional requirements to microorganisms, growth of microorganism, control of microorganism and microbes of biotechnological importance can be understood
3. Chemical nature of gene, plasmids incompatibility, horizontal transfer of genome among the microbial community and Benzer's classical studies on *Il* locus can be proficient

4. Diseases caused by microorganisms can be understood
SUGGESTED READING MATERIAL:

1. Microbiology-M.J. Pelczar, E.C.S. Chan, Noel R.Krieg. Tata McGraw-Hill Edition.
2. Prescott's Microbiology-Christopher J. Woolverton, Linda Sherwood, Joanne Willey. Tata McGraw-Hill Edition.
3. Textbook of Microbiology- Ananthanarayan and CJ Paniker, 7th Edition

SOC 306(B): Vaccine Biotechnology and Applications

Course Objectives:

Understanding different approaches of vaccine development and production

UNIT I

History of vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems

UNIT II

Instruments related to monitoring of temperature, sterilization, environment, quality assurance and related areas. Production techniques, growing the microorganisms in maximum titre, preservation techniques to maintain good antigen quality, freeze drying.

UNIT III

Introduction to newer vaccine approaches namely sub-unit vaccines, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines, edible vaccines, Nano particles in vaccine delivery systems, etc.

UNIT IV

Introduction to pharmacopeal requirement, disease security and biosecurity principles and OIE guidelines such as seed management, method of manufacture, in-Process control, batch control, tests on final product.

SUGGESTED READING MATERIAL:

1. Barry R Bloom, Paul-Henri Lambert 2002. The Vaccine Book. Academic Press.
2. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. New Generation Vaccines. 3rd Ed. Informa Healthcare.
3. Lowrie DB & Whalen R. 2000. DNA Vaccines. Humana Press.
4. Robinson A & Cranage MP. 2003. Vaccine Protocols. 2nd Ed. Humana Press.