

M.Sc (Zoology)

Sr.No	Course code	Title of the Course	CIA Max.	ESE Max.	TOT Max.	C
I YEAR						
I semester						
1	35011	Animal Diversity	25	75	100	4
2	35012	Biochemistry	25	75	100	4
3	35013	Cell and Molecular Biology	25	75	100	4
4	35014	Practical Lab.I: Animal Diversity, Biochemistry and Cell and Molecular Biology	25	75	100	4
Total			100	300	400	16
II semester						
5	35021	Developmental Biology and Evolution	25	75	100	4
6	35022	Genetics	25	75	100	4
7	35023	Microbiology	25	75	100	4
8	35024	Practical Lab. II: Developmental Biology and Evolution, Genetics and Microbiology	25	75	100	4
Total			100	300	400	16
II YEAR						
III semester						
9	35031	Animal Physiology	25	75	100	4
10	35032	Immunology	25	75	100	4
11	35033	Environmental Biology	25	75	100	4
12	35034	Practical Lab. III: Animal Physiology, Immunology, Environmental Biology	25	75	100	4
Total			100	300	400	16
IV semester						
13	35041	Fisheries & Aquaculture	25	75	100	4
14	35042	Animal Biotechnology	25	75	100	4
15	35043	Biophysics, Biostatistics and Bioinformatics	25	75	100	4
16	35044	Practical Lab. IV: Fisheries and Aquaculture, Animal Biotechnology, Biophysics, Biostatistics and Bioinformatics	25	75	100	4
Total			100	300	400	16
Total			400	1200	1600	64

DETAILED SYLLABI

Objectives:

35011- ANIMAL DIVERSITY

- To study the classification and phylogeny of invertebrate and vertebrate animals.
- To understand the general characteristics and functions of the animals

BLOCK – I: CLASSIFICATION OF ANIMALS

Unit I

Introduction to the diversity of animals, Principles of classification, types of classification and Binomial Nomenclature; Linnaeus

Unit II

Species concept –Typological, Biological and evolutionary species concept.

Unit III

Taxonomic characters and theories of taxonomy- Numerical taxonomy, Cladistics and Molecular taxonomy.

Unit IV

Major divisions and subdivisions of the animal kingdom; Animal architecture- Cephalization Symmetry- Bilateral and Radial symmetry; Coelom in animals: Coelomata, Acoelomata and Psudocoelomata.

BLOCK – II: PROTOZOA, PORIFERA, COELENTERATA AND HELMINTHES

Unit V

Protozoa: General characteristics, classification up to class level, Protozoan parasites: Entamoeba and Plasmodium.

Unit VI

Porifera: General characters and classification, Structure of *Leucosolenia*, Canal system in sponges, Spicules in sponges

Unit VII

Coelenterata: Structure of *Obelia* colony, Polymorphism in coelenterates, Corals and coral reefs.

Unit VIII

Helminth parasites – *Taenia solium*, Nematode parasites – *Ascaris* and Parasitic adaptations.

BLOCK – III: ANNELIDA, ARTHROPODA, MOLLUSCA AND ECHINODERMATA

Unit IX

Annelida: General characters, Classification up to class - Metamerism in Annelids.

Unit X

Arthropoda: General characters, Classification up to class – Larval forms of crustaceans – Adaptive radiations in Arthropoda, Harmful and beneficial insects.

Unit XI

Mollusca and Echinodermata: General characters, Classification up to class- Cephalopod as an advanced Mollusc; Larval forms of Echinodermata -Water vascular system in Echinoderms.

BLOCK – IV: VERTEBRATES

Unit XII

General characters and classification of Prochordates and vertebrates; Pisces- classification up to orders, structural and functional adaptation of fishes

Unit XIII

Amphibians and Reptiles: Definition, general characters, classification, structural and functional adaptations of amphibians and reptiles- Mesozoic reptiles – Dinosaurs.

Unit XIV

Aves: phylogeny, flight adaptation, flightless birds and migration of birds. Mammals: General characteristics of Prototheria, metatheria and eutheria; Aquatic mammals; adaptive radiation in mammals.

Reference Books:

1. David Eisenhour, Allan Larson, Susan Keen, Larry Roberts, Cleveland Hickman Jr. 2014. Animal Diversity. McGraw Hill International, Boston.
2. Barnes, R. D., 2008. Invertebrate Zoology, *Cengage Learning (Thompson), USA*
3. Ekambaranatha Iyar, E.K. and T.N. Ananthakrishnan, 1992. A Manual of Zoology, Volume II Chordata. Viswanathan & Co.
4. Hickman CP Jr., Roberts LS, Larson A, l'Anson H, Eisenhour DJ. 2006. Integrated Principles of Zoology. 13th ed. Boston: McGraw-Hill.
5. Jordan, E.L. and P.S. Verma, 2010, Invertebrate Zoology, S. Chand & Co Ltd., Ram Nagar, New Delhi.
6. Kotpal, R.L., 2015. Modern text book of Zoology, Vertebrates; Rastogi publications, New Delhi.
7. Kotpal, R.L., 2017. A text book of Animal Diversity; Rastogi publications, New Delhi.
8. Rajesh Karyakarle and Ajit Damle., 2005, Medical Parasitology Books & Allied (P) Ltd. Kolkata.
9. Ruppert, E.E., and Barnes, R.D., 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
10. Russell- Hunter, W.D., 1979. Life of Invertebrates, Macmillan Publishing Company, New York.
11. Young, J. Z. 2004., The Life of Vertebrates. III Edition. Oxford university press.
12. Marshall, A.J., 1995. Textbook of zoology: vertebrates, AITBS publishers, New

Delhi.

35012 - BIOCHEMISTRY

Objectives:

- To provide an advanced understanding of the core principles and topics of biochemistry.
- To understand the structure and function of biomolecules.

BLOCK – 1: INTRODUCTION TO BIOMOLECULES UNIT - I

Carbohydrates: Functions, classification (Mono, di and polysaccharides), Structural aspects of monosaccharide, disaccharides and polysaccharides.

UNIT - II

Lipids: Classification and functions of lipids, fatty acids, essential fatty acids, Triacylglycerols, Phospholipids, Glycolipids, lipoproteins and steroids, Properties of fats and waxes.

UNIT - III

Proteins and aminoacids: Functions, structure (Primary, Secondary, tertiary and quaternary structure), Classification and properties of proteins. General structure, classification and chemical properties of aminoacids.

UNIT - IV

Nucleic acids: Functions and components of nucleic acids. Structure and nomenclature of nucleotides. Structure of DNA (Watson and Crick model), Different forms of DNA double helix and organization of DNA in the cell.

BLOCK – II: ENZYMES, VITAMINS AND HORMONES:

UNIT – V

Enzymes: Nomenclature and classification of enzymes, Active site, factors affecting enzyme activity. Mechanism of enzyme action (Lock and key model, Induced fit model, Substrate strain model).

UNIT – VI

Isoenzymes, Regulation of enzyme activity in living system, Enzymekinetcs (MM equation, Line-Weaver and Burk plot).

UNIT – VII

Vitamins: Classification of vitamins, Chemistry, sources, biochemical functions, Recommended dietary allowances (RDA), deficiency, symptoms and hypervitaminosis.

UNIT – VIII

Hormones: General classification, mechanism of action, origin and major functions of hormones - Pituitary and Gonadal.

BLOCK – III: METABOLISM

UNIT – IX

Carbohydrate metabolism: Glycolysis, Citric acid cycle, gluconeogenesis, glycogenesis, glycogenolysis, hexose monophosphate shunt, Uronic acid pathway.

UNIT – X

Lipid metabolism: Fatty acid oxidation, Ketogenesis, Biosynthesis of fatty acids, metabolism of cholesterol.

UNIT – XI

Amino acid metabolism: Amino acid pool, transamination, deamination, metabolism of ammonia, urea cycle, fate of carbon skeleton of amino acids.

UNIT – XII

Nucleotide metabolism: Biosynthesis and degradation of purine and pyrimidine ribonucleotides.

BLOCK IV: METABOLIC DISORDERS UNIT - XII

Diabetes mellitus, Diabetes insipidus, Glycogen storage diseases, ketoacidosis, Hyperlipoproteinemia, fatty liver.

UNIT – XIII

Atherosclerosis; phenylketonuria, maple syrup urine disease, glutaric acidemia type I, Carbamoyl phosphate synthetase I deficiency.

UNIT – XIV

Alcaptonuria; Lesch-Nyhan syndrome; Gout; lipid congenital adrenal hyperplasia; Kearns- Sayre syndrome; Zellweger syndrome; Gaucher's disease, Niemann Pick disease.

REFERENCES

1. Berg, J.M., J.L. Tomoczko, and L. Stryer, 2008. Biochemistry, W. H. Freeman publisher, USA.
2. Lehninger, A., Nelson, D. L., and M.M. Cox 2008. Lehninger Principles of Biochemistry, W.H. Freeman, USA.
3. Voet, D. J., J.G. Voet and C. W. Pratt, 2008. Fundamental of biochemistry: Life at molecular level, Wiley publishers, USA.
4. Biochemistry 4th edition, G. Zubay, 1998. Mc Millan Publishing Co. New York.
5. Davson and Eggleton – Principles of Human Physiology, J and A. Churchill, London.
6. David Randall, 2009. Eckert Animal Physiology, W H Freeman & Co.
7. Nielsen, S, 2000. Animal Physiology, Cambridge Univ. Press, Cambridge.
8. Horton, Principles of Biochemistry, Fourth edition, Prenhall Publishers, USA.
9. RK. Murray, DK. Granner and VM. Rodwell (2006). Harper's illustrated Biochemistry Mc Graw Hill Company, Inc.
10. Rodwell (2015), Harpers Illustrated Biochemistry, 30th Edition, Mc Graw Hill Company, Inc.
11. Satyanarayana, U and Charapany, U. (2017). Biochemistry, 5th Edition, Elsevier.

35013 - CELL AND MOLECULAR BIOLOGY

Objectives:

- To give a firm and rigorous foundation in the principles of cell and molecular biology.
- To describe the fundamental process of gene expression and cellular functions.

BLOCK – I:CELL STRUCTURE

Unit I

Cell theory - Structural organization of Prokaryotic and Eukaryotic cells.

Unit II

Ultrastructure of Cell membrane, Nucleus, Chromosomes, Mitochondria.

Unit III

Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Peroxisomes and their functions.

Unit IV

The cytoskeleton – Microtubules and Microfilaments - Cell cycle - Mitosis and Meiosis.

BLOCK – II: NUCLEIC ACIDS

Unit V

Structure and functions of DNA,Types of RNA and its function

Unit VI

Enzymes involved in Molecular Biology-DNA polymerases, RNA polymerase, Helicase, Primase, Ligase, Exonuclease and endonuclease.

Unit VII

Mechanism of prokaryotic and eukaryotic replication; machinery for replication; Synthesis of leading and lagging strands, Okazaki fragments, Difference between Prokaryotic and Eukaryotic replication.

BLOCK – III: TRANSCRIPTION AND TRANSLATION

Unit VIII

Prokaryotic transcription: Promoters, Properties of bacterial RNA polymerase, Steps: Initiation, Elongation and Termination.

Unit IX

Eukaryotic transcription: Promoters, Enhancers, Factors, properties of RNA polymerase I, II and III. Post transcriptional modification, Reverse transcription.

Unit X

Protein synthesis: Machinery, Formation of initiation complex, Translocation, Chain

elongation and Termination. Post-translational modifications

Unit XI

Cell free protein synthesis, Comparison of protein biosynthesis in prokaryotes and eukaryotes.

BLOCK – IV: REGULATIONS OF GENE EXPRESSION

Unit XII

Concept of operon – Lac and trp operons, Positive and negative control, Repressor and Inducer.

Unit XIII

Hormonal regulation of gene expression, Transcription factors, Steroid receptors; DNA binding motifs in pro- and eukaryotes

Unit XIV

Analysis of Gene expression using Molecular Methodology

Reference Books:

1. Hunter, L. E. 2009. The Process of life- An Introduction to Molecular Biology, The MIT press, USA.
2. Weaver, R.F., 2008. Molecular biology, McGraw Hill higher education, USA.
3. Becker, W, L. Kleinsmith, J. Hardin, and G. Bertoni, 2008. The world of the cell, Pearson Education, London.
4. Alberts, B., A. Johnson, J. Lewis, M. Raff, K. Roberts, and P. Walter, 2007. Molecular biology of the cell, Garland publishing Inc, New York.
5. Lodish, H, A. Berk, C.A. Kaiser, M. Krieger, M. P. Scott, A. Brtscher, H. Ploegh, and P. Matsudaria, 2007. Molecular cell biology, W. H. Freeman, USA.
6. Karp, G, 2007. Cell and molecular Biology- Concepts and Experiments, John Wiley and Sons, Inc. New York.
7. Freifelder, D, 2004. Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
8. De Robertis, E.D.P. and E.M.F. De Robertis, 2006, Cell & Molecular Biology, 8th Edition, Indian Reprint.
9. Brown, T.A., 1991. Molecular Biology, Labfax, Bioscientific publishers Ltd., Oxford.
10. Benjamin Lewin, Gene VII, Oxford University Press. U.K.
11. Rastogi, S.C., 2010, Cell and Molecular Biology, Second Edition
12. Gupta, P.K., 1999, Cell and Molecular Biology, Rastogi Publications, Meerut.
13. Ajay Paul., 2011. Cell and Molecular Biology. Books and Allied Pvt, Kolkata.
14. P.S. Verma and Agarwal, 2001. Concepts of Cell Biology. S. Chand & Co.
15. Helen Kreuzer, An Introduction To Cell And Molecular Biology: Concepts And Experiments, Published October 22nd 2013 by Wiley.

Outcome:

The students will acquire fundamental ideas on organization and functions of the different cell organelles, molecular basis of cellular processes and interrelationship with special emphasize on prokaryotic and eukaryotic systems.

LAB - I: 35014: ANIMAL DIVERSITY, BIOCHEMISTRY, CELL AND MOLECULAR BIOLOGY

ANIMAL DIVERSITY

1. **Museum specimen:** Invertebrates and vertebrates: Phylum wise (at least one from each phylum)
2. **Mounting:** Earthworm – Body and pineal setae, Honey bee – sting apparatus, Cockroach – Mouth parts, Prawn – Appendages and Shark - Placoid scales
3. **Dissections:** Understanding the anatomy of frog using an appropriate software package (CarolinaTM Biolab^R – Frog), Dissection of cockroach: Digestive, reproductive & nervous systems. Dissection of available fish: General anatomy (Viscera)

BIOCHEMISTRY

1. Preparation of solutions: Molarity, Normality and Percentage.
2. Buffer preparation and Determination of pH.
3. Estimation of glucose and total protein.

CELL AND MOLECULAR BIOLOGY

1. Cell organelles from slide preparation/images.
2. Buccal mucosal epithelium – Smear preparation to detect Barr bodies.
3. Isolation and detection of DNA from gel electrophoresis (Demo only).
4. Onion root tip – Squash preparation and study of mitosis.
5. Grasshopper testis - Squash preparation and study of meiosis (Demo only).
6. *Chironomus* larva - Squash preparation of giant chromosome.
7. Separation of amino acid by paper chromatography.
8. Separation of protein by electrophoresis - SDS and Native PAGE.

Reference Books:

1. Amsath A., 2010. Practical Manual in Zoology.
2. Amsath, A. 2013. Practical manual in Zoology. MMA Publications, Adirampattinam.
3. Shivraja Sankara, 2008. Laboratory Manual for Biochemistry.
4. David A Thompson., 2011. Cell and Molecular Biology Lab Manual.
5. Helen Kreuzer, An Introduction To Cell And Molecular Biology: Concepts And Experiments, Published October 22nd 2013 by Wiley.
6. Jordan E.L. and Verma P.S., 2005. Invertebrate Zoology, S. Chand & co. India.
7. Joe Sambrook and David W. Rusell., 2001. Molecular Cloning: A Laboratory Manual, Cold spring harbour laboratory press, U.S.A.
8. Lundblad R. L., 2009. Practical Handbook of Biochemistry and Molecular Biology, CRC publications.

35021- DEVELOPMENTAL BIOLOGY AND EVOLUTION

Objectives:

- To understand and master in the basic concept of developmental biology and evolution of animals.

BLOCK – I: GAMETOGENESIS & FERTILIZATION

Unit I

General introduction to Developmental Biology, Spermatogenesis, Physiological maturation of sperm, Sperm structure and physiology.

Unit II

Oogenesis, Egg - size, shape, Egg membranes and organization of egg - yolk, pigments, egg cortex.

Unit III

Maturation of egg, Polarity and Symmetry, Classification of eggs.

Unit IV

Fertilization : Types and Mechanism, Monospermy and Polyspermy. Activation of egg and Egg metabolism.

BLOCK – II: CLEAVAGE AND GASTRULATION

Unit V

Types of cleavage, Factors affecting cleavage, Chemodifferentiation.

Unit VI

Blastulation, Types of blastula – Gastrulation in frog and chick, Mechanism of morphogenetic movement.

Unit VII

Metabolic and molecular changes during gastrulation; Cell motility and Differential cell affinity; Fate maps construction.

BLOCK – III: ORGANOGENESIS AND ASSISTED REPRODUCTIVE TECHNOLOGY

Unit VIII

Development of eye, brain and heart in chick. Formation of muscle and neural crest. Embryonic induction, concept of organizer.

Unit IX

Foetal membranes in chick, placenta in mammals. Origin of gene theory, Nuclear transplantation, Differential gene activation, Factors involved in teratogenesis.

Unit X

Concept of Assisted Reproductive Technology (ART) – Monitoring of ovulation phase, Super-ovulation and Cryopreservation.

Unit XI

Sperm banking, Artificial insemination, IVF, Embryo transfer and Test tube babies, Gene knock out and knock in.

BLOCK – IV: EVOLUTION

Unit XII

Lamarckism, Neolamarckism, Darwinism, Neodarwinism, Theory of natural selection, Genetic and non-genetic variations and Evolution of races to species.

Unit XIII

Evidences for evolution (Anatomical, Embryological, Physiological and Biochemical). Patterns of behavioural adaptations, Isolating mechanism and speciation.

Unit XIV

Evolution of gene families, Molecular drive, Assessment of molecular variation, human origin and migration, Phylogenetic tree at molecular level.

Reference Books:

1. Jonathan M. W. Slack, Essential Developmental Biology, 3rd Edition, December 2012, ©2012, Wiley-Blackwell.
2. Gilbert, S. F., and K. Knisely, 2009. Developmental Biology, Sinauer Associates Inc.
3. Minelli, A. 2009. Forms of Becoming: The Evolutionary Biology of Development, Princeton University Press.
4. Futuyma, D. J. (2006) Evolutionary biology, Palgrave publishers, USA.
5. Hodge, R., 2009. Developmental Biology (Genetics and Evolution). Facts on File.
6. Slack, J. M. W. 2005. Essential Developmental Biology, Wiley-Blackwell.
7. Hake S, and F. Wilt, 2003. Principles of Developmental Biology, W.W. Norton & Co.
8. Wolpert, L., R. Beddington, T. Jessell, P. Lawrence, E. Mayerowitz, and J. Smith, 2002. Principles of development, Oxford University Press, UK.
9. Twyman, R.M. Developmental Biology. Viva, New Delhi, 2008.
10. Balinsky, B.I. An Introduction to Embryology. 5th Ed., Thomas Asia Pvt. Ltd., 2004.
11. Russo, V.E.A, Brody, S., Cove, D. and Ottolenghi, S. Development: The Molecular Genetic Approach. Springer Verlag, Berlin, 1992.
12. Rao.V. Developmental Biology: A Modern Synthesis. Oxford IBH New Delhi, 1994.
13. Rastogi, V.B., Organic Evolution, 12th Ed., KedarNath Ram Nath, Meerut.
14. Brian, K. H. and Benedikt Hall, G. Strickberger's Evolution. 4th Ed., Jones and Bartlett Publishers, Inc, 2008.
15. Colbert, E.H., Morales, M. and Minkoff, E.C., 2002. Colbert's Evolution of the Vertebrates: A history of the backboned animals through time, 5th edition, John Wiley – Liss, Inc., New York.

Outcome:

On successful completion of this course students should be able to critically discuss about the concepts, principles and scope of evolution.

35022- GENETICS

Objectives:

- To study the “science of heredity” and molecular process of gene expression.
- To analyze qualitative genetic data and describe the evolution of population.

BLOCK – I: CLASSICAL GENETICS

Unit I

Definition, Terminology and Scope of Genetics - Mendel and his contribution - Hybridization techniques of Mendel.

Unit II

Mendelian principles-Monohybrid and dihybrid crosses, Simple mendelian traits in Man.

Unit III

Polygenetic inheritance, Multiple alleles – Blood group inheritance in man.

Unit IV

Interaction of genes – Allelic and Non-Allelic interaction – Complementary, Supplementary, Duplicate and Epistatic interaction.

BLOCK – II: LINKAGE, CROSSING OVER AND CHROMOSOME MAPPING

Unit V

Mechanism and theories of linkage and crossing over.

Unit VI

Chromosomal and gene mapping methods. Linkage maps, Tetrad analysis, Mapping with Molecular markers and QTL mapping.

Unit VII

Structure and types of chromosome. Sex chromosomes, Sex determination in animals-human and honey bee. Heterochromatization and Barr bodies.

Unit VIII

Sex Linked inheritance, Non disjunction – Syndromes and Pedigree analysis.

BLOCK – III: MOLECULAR GENETICS

Unit IX

Mutation – Types and its applications, Chromosomal abnormalities, Inbreeding and out breeding.

Unit X

Population genetics: Hardy-Weinberg Equilibrium-gene pool, Gene frequency, Genotypic frequency and Factors affecting Hardy-Weinberg equilibrium.

Unit XI

Twin study, Eugenics, Euthenics and Euphenics.

BLOCK – IV: GENETIC CONCEPT

Unit XII

Concept of gene – Gene expression control in prokaryotes, eukaryotes, and phages.

Unit XIII

Genetic regulation in development and Role of cell death.

Unit XIV

Differential and sequential expression of genes with reference to *Drosophila*.

Reference Books:

1. Emmanuel C., Ignacimuthu S., Vincent S., 2006. Applied genetics: Recent trends and Techniques, MJP Publishers.
2. Crew F.A., 2006. Animal Genetics – The Science of Animal Breeding, Lightning Source Inc.
3. Joe Bearden H., John W. Fuquay, and Scott T. Willard., 2003. Applied Animal Reproduction, 6th edition, Prentice Hall.
4. Richard M. Bourdon, 1999. Understanding Animal Breeding, 2nd Edition, Prentice Hall.
5. Terence A. Brown., 1998. Genetics: a molecular approach, Thrones Publishers.
6. Benjamin Pierce, 2007. *Genetics a conceptual approach*, W.H. Freeman & Company, USA
7. Hartwell L., 2004. Genetics from genes to genomes, McGraw-hill, USA.
8. Gahalain S. S., 2004. Fundamentals of Genetics, Anmol Publications Pvt., India.
9. Burton S. Guttman, Anthony Griffiths, David T. Suzuki., 2002. *Genetics: A Beginner's Guide*, One world Publications Epz.
10. Verma, P.S. and V.K. Agarwal, 2009, Genetics, Revised Edition, S. Chand & Co., New Delhi.
11. Gardner, E.J, Simmons, M.J. and Snustad, D.P., 2007. Principles of Genetics 7th Ed., John Wiley India.
12. Sudbery, P., 2009. Human Molecular Genetics. 2nd Ed., Dorling Kindersley (India) Pvt. Ltd.
13. Snustad, D.P. and Simmons, M.J., 2012. Genetics. VI Ed., John Wiley & Sons, Singapore.
14. Russel, P.J., 2006. iGenetics: A Molecular Approach. 2nd Ed., Pearson Education.
15. Strickberger, M.W., 2008. Genetics, MacMill Publishing.
16. Singh, B.D., 2003. Genetics, Kalyani Publishers, Ludhiana.
17. Bruce R. Korf, Mira B. Irons, Human Genetics and Genomics, Includes Wiley E- Text, 4th Edition, January 2013, Wiley-Blackwell

Outcome:

The students will understand the basic concepts of mendelian, molecular, evolutionary and applied genetics.

35023- MICROBIOLOGY

Objectives:

- To inculcate knowledge on fundamentals of microorganisms.
- To learn the structural organization, morphology and reproduction of microbes.
- To know the principles of Microscopy and advancements in Microscopy.

BLOCK – I: INTRODUCTORY MICROBIOLOGY

Unit I

Introduction to Microbiology, Haeckel's three-kingdom concept, Whittaker's Five-kingdom concept, Three-domain concept of Carl Woese.

Unit II

Classification of Bacteria according to Bergey's Manual.

Fungi: Classification of fungi based on Alexopoulos system. General Characteristics of Fungi, Industrial uses of Yeast and Moulds. Lichens - Structural organization and their properties.

Unit III

Viruses: ICTV system of classification, General properties, Morphology and ultra-structure of virus (RNA, DNA).

BLOCK – II: MICROSCOPY, METHODS, NUTRITION AND MICROBIAL GROWTH

Unit IV

Principles and their applications of Simple, Compound, Fluorescent, Electron microscopes. (SEM & TEM) and Confocal microscopes.

Unit V

Stains and staining techniques: Simple, Differential and Structural staining methods, Imaging techniques.

Unit VI

Preservation methods of microbes for storage and microscopic studies, Culture collections, Sterilization and disinfection

Unit VII

Auxenic and Synchronous culture, Aerobic and Anaerobic Culture media and Nutritional types. Growth curve, Generation time and growth kinetics. Factors influencing microbial growth.

Block – III: General characteristics of bacteria, algae and Protozoa

Unit VIII

Prokaryotic cell structure & Organization: Cell membrane, Plasma membrane, Cytoplasmic matrix, Inclusion bodies, Ribosome, Nucleoid, Prokaryotic cell wall, Capsule, Slime layers, S layers, Pili and Fimbriae, Flagella and Motility.

Unit IX

Classification of Algae based on Fritsch system – General characteristics of Micro and Macroalgae - Biological and Economic importance.

Unit X

Protozoa –General characteristics, Importance of *Entamoeba histolytica* and *Plasmodium* sp.

BLOCK – IV: MOLECULAR TECHNIQUES FOR IDENTIFICATION, INFECTIOUS DISEASES

Unit XI

Molecular Taxonomy, 16S/18S rRNAs and its importance in identification of microorganisms.

Unit XII

Phylogenetic tree, Types and construction of Phylogenetic tree, Molecular tools in assessing microbial diversity.

Unit XIII

Metagenomics - Sequencing methods, Data Analysis and applications.

Unit XIV

Bacterial Diseases (Tuberculosis, Typhoid, Leprosy) Viral diseases (Hepatitis, HIV, Ebola)

Reference Books:

1. Tortora, G.J., Funke B.R. and Case C.L. (2010). Microbiology an Introduction (10th Edition), Benjamin Cummings, USA.
2. Dubey, R.C. and Maheswari, D.K. (2013). A Textbook of Microbiology (Revised Edition), S.Chand and Company Ltd., New Delhi.
3. Prescott, L.M., Harley, J.P. and Klein, D.A. (2014). Microbiology (9th Edition), McGraw Hill Publishers, Boston.
4. Brock, T.D., Smith, D.W. and Madigan, M.T. (2002). Biology of Microorganisms (Fourth Edition) Prentice Hall International, London.
5. Stanier, R.Y., Ingraham, J.L., Wheels, M.L. and Painter, P.R. (1999). General Microbiology, Mac Millan Educational Limited, London.
6. Boyd, R.F. (1998). General Microbiology, Mosby College Publishing, St. Louis.
7. Nester, E.W., Roberts, C.V. and Nester, M.T. (1995). Microbiology, A Human Perspective. IWOA, U.S.A.
8. Pelzcar, M.J., Chan, E.C.S. and Kreig, N.R. (2001). Microbiology, McGraw Hill Inc., New Delhi.
9. Hogg, S. Essential Microbiology. John Wiley & Sons Ltd., England, 2005.
10. Madigan, M.T. and Martinko, J.M. Brock Biology of Microorganisms. 11th Ed., Prentice Hall, U.S.A, 2006.
11. Srivastava, S.H., 1994. Advances in general Microbiology, Anmol Publications, New Delhi.

Outcome:

1. Basic knowledge on historical perspectives of microbiology.
2. Knowledge on different structure, culture conditions, growth and applications of microbes in various fields.
3. Ideas on different type of microscopes.

LAB - II: 35024- DEVELOPMENTAL BIOLOGY AND EVOLUTION, GENETICS AND MICROBIOLOGY

DEVELOPMENTAL BIOLOGY AND EVOLUTION

1. Frog: Egg, blastula and yolk plug stage.
2. Chick: Egg, 24 hrs, 36 hrs, 48 hrs, 72 hrs and 96 hrs developmental stages.
3. Placental types in Mammals.
4. Animals of evolutionary importance.
5. Analogous and homologous organs.
6. Fossils.
7. Mimicry and coloration.

GENETICS

1. Klinefelter's Syndrome, Turner's Syndrome, Down's Syndrome and Cri- Du – Chat.
2. Pedigree analysis using charts and data.
3. Human karyotyping and chromosomal abnormalities.
4. Hardy- Weinberg law & Calculation of gene frequencies for dominant and recessive traits.

MICROBIOLOGY

1. Enumeration of bacteria and fungi.
2. Pure culture and preservation of bacteria.
3. Gram Staining and Negative staining.
4. Motility of bacteria.
5. Hydrolysis of starch, gelatin and protein.
6. Antibiotic susceptibility test.

Reference Books:

1. Mary S. Tyler, 1994. Developmental Biology: A guide for experiment study.
2. Bauman R. W, and N. Dolby, 2008. Microbiology Lab Manual (3rd Edition), Pearson Custom Publishing.
3. James G Cappucino, Natalie Sherman, 2007. Microbiology: A laboratory manual, Benjamin – Cummining publications, U.S.A.
4. Melissa Ann Gibbs, 2003. A Practical Guide to Developmental Biology, Oxford University Press, USA.
5. Emmanuel C., Ignacimuthu S., Vincent S., 2006. Applied genetics: Recent trends and Techniques.

35031-ANIMAL PHYSIOLOGY

Objectives:

- To study the basic physiological principles common to humans and other animals.
- To elaborate the physical and chemical functions occur in animals tissue/organ systems.

BLOCK – I: INTRODUCTION TO DIGESTIVE, RESPIRATORY AND EXCRETORY SYSTEMS

Unit I

Definition, Divisions of physiology, Relationship of physiology with other sciences, Significance of the study.

Unit II

Digestive system in man, Physiology of digestion, Absorption and Assimilation, Gastrointestinal hormones and their control in digestion.

Unit III

Respiratory system in man, Types and mechanism of respiration-Transportation of gases, Control of respiration.

Unit IV

Excretory system of human, Structure and functions of nephron, Urine formation and its regulation.

BLOCK – II: CARDIO VASCULAR SYSTEM AND NERVOUS SYSTEM

Unit V

Blood: Composition, Haemopoiesis, formed elements, Blood volume and its regulation, Haemostasis.

Unit VI

Types of heart, Structure of human heart, Heart beat and Cardiac cycle, Blood pressure, ECR and its application.

Unit VII

Types and functions of neurons, Central and Peripheral Nervous System, Synapse and its transmission, Resting and action potential, Neuro-muscular junction.

BLOCK – III: EFFECTORS AND RECEPTORS

Unit VIII

General structure and types of muscles, Sarcomere, Ultra structure of skeletal muscle, Mechanisms of muscle contraction, Chemical changes during muscle contraction, Kymograph.

Unit IX

Physiology of vision, hearing and tactile response.

Unit X

Thermoregulation in animals. Tolerance to high temperature, cold and freezing, Physiology of hibernation and aestivation.

Unit XI

Osmo-ionic regulation in freshwater and marine fishes and crustaceans – Response to hyper and hypo-osmotic media. Adaptation to pressure in high altitude – Buoyancy.

BLOCK – IV: ENDOCRINOLOGY AND ANIMAL BEHAVIOUR

Unit XII

Endocrine glands and their hormones – Mechanism in action of hormones. Hypo and Hyper secretion of hormones (Thyroid, adrenal and pancreas) and their diseases.

Unit XIII

Neuro endocrine control of hormones, Invertebrate hormones and Hormonal control of insect metamorphosis.

Unit XIV

Biological clock, Endogenous rhythm, Circadian, Circannual and Lunar periodicities.

Reference Books:

1. Richard W. Gill, Gordon A. Wyse and Margaret Anderson., 2012. Animal Physiology 3rd edition.
2. Christopher D. Moyes, Patricia M. Schulte., 2008. Principles of Animal Physiology. Pearson Education, Inc., publishing as Benjamin Cummings, San Francisco
3. Gordon A. Wyse, Margaret Anderson., 2008. Animal Physiology, 2nd edition, Richard W. Hill.
4. Neville G. Gregory., 2005. Physiology and Behavior of Animal Suffering (UFAW Animal Welfare), 1st edition, Wiley - Blackwell.
5. McGowan, C., 2016. Animal physiotherapy: assessment, treatment and rehabilitation of animals. John Wiley & Sons.
6. R.H. Williams, 2002. Text Book of Endocrinology-W.B. Saunders.
7. Campbell, A.M. and Paradise, C.J., 2016. Animal Physiology. Momentum Press.
8. Guyton Mc. and Hall, R.T. 2011. Textbook of Medical Physiology. 12th Edition Saunders Publisher, USA.
9. Sherwood L, Klandorf H and Yancey P., 2012. Animal Physiology: From genes to organisms, Cengage Learning. 5. Prosser CL, 1991. Comparative Animal Physiology, Environmental and Metabolic Animal Physiology, John Wiley and Sons.
10. Verma P.S. and V.K. Agarwal.1992. Animal Physiology. S. Chand and Co.
11. Rastogi, S.L., 1997. Essential of Animal physiology. New Age International Publishers, New Delhi

Outcome:

The course provides a comprehensive overview of animal physiology from molecular, cellular and whole animal systems approaches.

35032 - IMMUNOLOGY

Objectives

- To understand the fundamental concepts of immune systems, innate and adaptive immunity mechanism and their response.
- To provide in-depth ideas on immunotechnology and its applications.

BLOCK – I: INTRODUCTION TO IMMUNOLOGY

Unit I

Historical perspectives and scope of immunology, Types of immune cells, Tissues and organs of immune system.

Unit VII

Lymphoid organs- structure and functions of primary and secondary.

Unit II

Molecules of immune system - Antibodies, Complements, Cytokines, Interferons - Types, sources and functions. Antigen: Classification and Epitopes.

Unit III

Elements of immune system: Hematopoiesis, T- Lymphocytes, B- Lymphocytes, Generation of Lymphocyte specificity and diversity.

Unit IV

Antigen processing and presentation, Subsets of T-Cells, Memory, Helper and suppressor cells, Myeloid cells, Major histocompatibility complex (MHC)

BLOCK –II: IMMUNITY AND IMMUNE RESPONSE

Unit V

Immunity: Types of Immunity - Innate, adaptive immunity.

Unit VI

Immune Response: Types of Immune response, Effector mechanism of humoral and cell mediated immune responses.

Unit VIII

Antibody dependent cell mediated cytotoxicity, Natural killer cells. Immunity to infections – Immunoprophylaxis, Vaccines and immunization schedule.

BLOCK – III: IMMUNE DISORDERS

Unit IX

Infectious diseases; Hypersensitivity - Types I, II, III and IV.

Unit X

Autoimmune disorders and Immunodeficiency diseases. Organ Transplantation. antibody engineering

Unit XI

Cancer: Types and nature, Immunotherapy; Immune responses against tumors and transplants.

BLOCK – IV: IMMUNOLOGICAL TECHNIQUES

Unit XII

Immunocytochemistry, Antibody generation and Radioimmuno assay.

Unit XIII

Detection of molecules using Immunoblot techniques, ELISA and Vaccine development

Unit XIV

Immunoprecipitation and immunofluorescence microscopy, Acquired Immuno Deficiency Syndrome (AIDS) detection and Hybridoma technology, FACS, Immunofluorescent assay.

Reference Books:

1. Judith A. Owen, Jenni Punt, Sharon A. Stranford., 2013. Kuby Immunology, 7th edition, W.H. Freeman & Company.
2. Blaine T. Smith., 2008. Concepts in Immunology and Immunotherapeutics.
3. Kannan I., 2007. Immunology.
4. Kuby, Kindt, Goldsby and Osborne, 2007. Kuby Immunology, 6th edition, W.H. Freeman & Company.
5. David Male, Jonathan Brostoff, David B Roth and Ivan Roitt, 2006. Immunology, Elsevier.
6. Helen Chapel, Mansel Haeney, Siraj Misbah and Neil Snowden., 2006. Essentials of Clinical Immunology, Blackwell Publishing.
7. Vaman Rao., 2006. Immunology, Narosa Publishing House Pvt, Ltd.
8. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt's Essential Immunology. 12th Ed., Wiley-Blackwell.
9. Chakravarty, A.K. Immunology and Immunotechnology. Oxford University Press. New Delhi, 2006.
10. Janeway, C.A., 2010, Immunobiology – The Immune System in Health and Disease, Churchill Livingstone, New York.

Outcome:

The course will provide basic mechanisms, distinctions and functional interplay of innate and adaptive immunity and immunological techniques.

35033-ENVIRONMENTAL BIOLOGY

Objectives:

- To understand the dynamics of ecosystem and inter-relationship between organisms.
- To quantify the biological productivity and to restore natural ecosystem.

BLOCK – I: ECOSYSTEM

Unit I

Structure, Functions and types of ecosystem - Trophic structures, Food chains, Food web, Energy flow and Ecological pyramids.

Unit II

Abiotic factors, Soil organisms, Biological effects of light, and temperature.

Unit III

Thermal stratification, Concept of limiting factors, Shelford's law of tolerance and ecotypes - Grassland and Pond ecosystem.

BLOCK – II: MARINE ECOLOGY

Unit IV

Divisions of marine environment, Physical and chemical properties of seawater, Major and minor elements.

Unit V

Primary and secondary production, Estimation and factors influencing productivity; Adaptation of plankton, Red tide, Inter tidal and deep sea ecology.

Unit VI

Unique features of Coral Reefs, Seaweeds, Seagrasses; Mangroves and estuaries.

BLOCK – III: BIOGEOCHEMICAL CYCLE AND POPULATION ECOLOGY

Unit VII

Biosphere: Types - Hydrosphere, Lithosphere and Atmosphere.

Unit VIII

General account of complete and incomplete cycle; Gaseous cycle – Carbon, Nitrogen and Oxygen cycles.

Unit IX

Sedimentary cycle: Phosphorus and Sulphur cycles.

Unit X

The population concept, Natalty, Mortality, Growth rate, Population density and Age distribution, Carrying capacity, Fluctuation and Regulation.

BLOCK – IV: COMMUNITY ECOLOGY AND ENVIRONMENTAL POLLUTION**Unit XI**

Community structure, Ecotone and edge effects, Ecological niche.

Unit XII

Ecological succession, Climax community - Monoclimax and polyclimax theories.

Unit XIII

Air, Water and Soil pollution - Their biological effects - Pollution control measures; Climatic changes - Green house effects, Global warming; Bioremediation and environmental awareness.

Unit XIV

Conservation of natural resources; Biodiversity hot spots of India; Endangered and threatened species, Germplasm conservation - Environmental laws.

Reference Books:

1. Henry, M., and H. Stevens, 2009. A Primer of Ecology with R (Use R), Springer
2. Odum EP, 2008. Fundamentals of Ecology, Cengage Learning (Thompson), USA.
3. Smith, T. M., and R. L. Smith, 2008. Elements of Ecology (7th Edition), Benjamin Cummings.
4. Krebs, C. J. 2008. Ecology: The Experimental Analysis of Distribution and Abundance (6th Edition), Benjamin Cummings.
5. Clark R.S. 2001. Marine Pollution, Clanderson Press Oxford, New York.
6. Strickland, J. D. and T. R. Parsons, 1972. A practical handbook of seawater analysis. Bull of Fish. Res. Bd., No. 167, pp 310.
7. James W. Nybakken and Mark D, 2000. Bertness, marine biology: An ecological approach, Benjamin-Cummings Publishing Company.
8. Saha, T. K. (2008). Ecology and Environmental Biology. Books and Allied (P) Ltd.
9. Beckman, Daniel Beckman, Marine Environmental Biology and Conservation, Published February 13th 2012 by Jones & Bartlett Publishers

Outcome:

The course provides knowledge on ecological principles/concepts and concise critical thinking to solve problems in ecology.

LAB – III: 35034-ANIMAL PHYSIOLOGY, IMMUNOLOGY, ENVIRONMENTAL BIOLOGY

ANIMAL PHYSIOLOGY

1. Estimation of salivary amylase activity.
2. Estimation of ammonia and urea.
3. Estimation of blood chloride.
4. Determination of glucose and glycogen.
5. Estimation of oxygen consumption of fish.

IMMUNOLOGY

1. Study of lymphoid organs.
2. Haemagglutination assay.
3. Study of antibody titre values.
4. Immunodiffusion – Single / Double and Immunoelectrophoresis.
5. Blood grouping
6. Human Chorionic Gonadotropin (hCG) test

ENVIRONMENTAL BIOLOGY

1. Estimation of salinity.
2. Estimation of dissolved oxygen.
3. Mounting of plankton (fresh water / marine).
4. Animal associations.
5. Intertidal fauna.
6. Construction of a food web diagram.
7. Measurement of light intensity in water bodies using Secchi disc.

Reference Books:

1. Ghai C.L., 2007. A text book of practical physiology.
2. Turgeon, M.L. 2008. Immunology & Serology in Laboratory Medicine (Immunology & Serology in Laboratory Medicine (Turgeon)), Mosby publishers.
3. Talwar, G.P., 2006. A hand book of practical & clinical immunology, CBS publishers, New Delhi
4. Hay, F.C., O.M.R. Westwood, and P.N. Nelson, 2002. Practical Immunology, Wiley-blackwell, USA.
5. Phillip L. Watson, Arlene Westhoven, Environmental Biology Laboratory Manual, Published by Hunt Publishing Company.

35041- FISHERIES AND AQUACULTURE

Objectives:

- To familiarize basic information about fishery biology, resources, management and necessary skills to identify fish species.
- To provide technical knowledge about recent aquaculture practices.

BLOCK – I: CAPTURE FISHERY AND CHARACTERISTIC ANALYSIS

Unit I

Classification of fishes, Economically important marine and freshwater fishes with regard to their fishery potential.

Unit II

Status of Indian Capture fishery, Indigenous and modern craft and gears used for capture fisheries.

Unit III

Morphometric and meristic characters of fish, Food and feeding habits, Age and growth, Spawning and reproduction of fish.

Unit IV

Endangered species and Invasive species; Conservation and Management of Fishery Resources.

BLOCK – II: AQUACULTURE

Unit V

Definition, Status of Indian aquaculture, Types of culture based on stocking density, Cultivable organisms.

Unit VI

Farm design, Structure and construction, Pond preparation, Stocking, Water quality, Feed management, harvesting, and economics; Good Management Practices.

Unit VII

Cage culture, Pen culture, Race ways culture, Poly culture, Composite fish culture and integrated fish farming. Important finfish and shell fish disease and its control measures.

BLOCK – III: HATCHERY MANAGEMENT TECHNIQUES

Unit VIII

Types of Hatchery, Brood Stock, Induced breeding, Spawning, Hatching, Larval rearing, Post larval rearing and hatchery economics

Unit IX

Live feed culture and Good management practices in hatchery.

Unit X

HACCP concept, Biosecurity and Specific pathogen free seed production and Seed packing and transportation.

BLOCK – IV: POST HARVEST TECHNOLOGY AND FISHERY BY-PRODUCTS

Unit XI

Physical and biochemical methods to examine freshness of fish.

Unit XII

Processing methods: Freezing, Canning, Smoking, Drying and Irradiation methods of preservation of fish.

Unit XIII

Quality control: HACCP, National and International standards.

Unit XIV

Fishery by-products: fish liver oil, fish ensilage, Isinglass, chitin, leather from shark skin and other value added by –products.

Reference Books:

1. Jean T. Nolan, 2009. Offshore Marine Aquaculture, Nova Science Pub Inc.
2. Michael King, 2007. Fisheries Biology, Assessment and Management, Wiley-Blackwell.
3. Pillay, T.V.R., and M. N. Kutty, 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
4. FAO, 2012. The State of World Fisheries and Aquaculture 2012 (Manuals from the Fao Training), United Nations Publications.
5. Balachandran, K. K., 2002. Post Harvest Technology of Fish and Fish Products, Daya Publishing House.
6. Bremner, H.A, 2002. Safety and Quality issues in fish processing, Publisher: CRC,(1st edition).
7. Simon Jennings, Michel Kaiser, and John D. Reynolds, 2001. Marine Fisheries Ecology, Wiley-Blackwell.
8. Chandran, K.K., 2000. Post harvest Technology of Fish and Fishery Products, Daya Publishing House, New Delhi.
9. Andy Beaumont, Pierre Boudry, Kathryn Hoare, 2010. Biotechnology and Genetics in Fisheries and Aquaculture, 2nd Edition, Wiley-Blackwell.
10. Stefano B. Longo, Rebecca Clausen, Brett Clark, The Tragedy of the Commodity: Oceans, Fisheries, and Aquaculture, Published June 25th 2015 by Rutgers University

.Outcome:

On successful completion of this course students should be able to critically discuss the fundamental concepts of fishery biology and role of aquaculture and its applications.

35042-ANIMAL BIOTECHNOLOGY

Objectives:

- To understand the principles and application of biotechnology methods in animal.
- To understand recent techniques in animal biotechnology.

BLOCK – I: GENETIC ENGINEERING

Unit I

Over view of animal biotechnology, Basic principles of genetic engineering - Genetic engineering in animal systems.

Unit II

Vectors: Plasmid, Cosmid, Phagemids - Yeast artificial chromosome (YAC) and bacterial artificial chromosome (BAC), Shuttle vectors, Yeast vectors, Minichromosomes.

Unit III

Gene transfer methods in animals –Electroporation; Microinjection; Biolistic Particle Delivery System; Sonoporation, Optical Transfection; Protoplast Fusion, Retrovirus mediated gene transfer.

BLOCK – II: ANIMAL CELL CULTURE AND TRANSGENIC ANIMALS

Unit IV

Media requirements, preparation of media and sterilization techniques; Natural and synthetic media; Culture methods: hanging drop, suspension and monolayer culture; Primary and established cell lines.

Unit V

Characteristics of transformed cells; Methods of cell preservation- Applications of cell culture in product development and tissue repair; Bioreactors and scaling-up technologies.

Unit VI

Production and applications of transgenic animals (Fish, Mice, Sheep and Pig) and chimeras. Dolly.

Unit VII

Trangensis; transgenic animals from foetal cells; transgenic animals in Xenotransplantation, transgenic organisms to interrupt disease cycles. Artificial insemination and embryo transfer.

BLOCK – III: MOLECULAR DIAGNOSTIC TECHNIQUES AND PHEROMONES

Unit VIII

Recombinant vaccines, Subunit vaccines and live vaccines - Production of Insulin and Tissue plasminogen activator.

Unit IX

Gene therapy, somatic gene therapy and germline gene therapy; Applications of advanced techniques – Positron emission tomography–computed tomography (PET-CT), Molecular imaging. Human genome project

Unit X

Ethical Issues in Genetic Engineering and Transgenics - Current Developments; social, extrinsic and intrinsic concerns, Issue of Species Boundaries, The Legal Implications of Transgenics.

Unit XI

Embryonic and adult, hematopoietic, epithelial and mesenchymal stem cells - applications. Knock out and Knock in Technology.

BLOCK – IV BIOTECHNOLOGY IN MEDICINE

Unit XII

Isolation and purification of nucleic acids. Hybridization: Southern, Western and Northern hybridization.

Unit XIII

PCR, RFLP, RAPD, DNA finger-printing. DNA bar coding. Principles, methods and Instrumentation of DNA sequencing (Maxam and Gilbert method, Sanger's di-deoxy method and automated DNA sequencing).

Unit XIV

Pheromones in pest management – Insect and Rodent control; Pheromones in animal breeding – Conservation and management of indigenous Cow, Buffalo, Tiger and Elephant.

Reference Books:

1. Castilho L. 2008. Animal Cell Technology: From Biopharmaceuticals to Gene Therapy, Taylor & Francis.
2. Freshney, I, 2006. Culture of Animal Cells, Publisher: John Wiley & Sons Inc (sea) Pvt. Ltd.
3. Satyanarayana, U., 2006. Biotechnology, Books and Allied (P) Ltd.
4. Animal Biotechnology, M.M. Ranga, 2000. Agrobios, India.
5. Brown, T.A, 2005. Gene cloning- An introduction, 2nd &3rd ed, Chapman &Hall. Publisher: Stanley Thornes Publishers Ltd.
6. Primrose, S.B, Richard M, Twyman, R and W. Old, 2001. Principles of gene manipulation, (6th ed), Published by Wiley-Blackwell.

7. Tsai C.S, 2001. An introduction to Computational Biochemistry, Publishers: John Wiley and Sons, Inc.,
8. Cartwright, T, 2009. Animal Cells as Bioreactors (Cambridge Studies in Biotechnology), Cambridge University Press, UK.
9. Glick, B.R. and Pasternak, J.J., 2007. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 3rd Ed., ASM Press, Washington.
10. Dubey, R. C., 2009, A Text Book of Biotechnology, S. Chand Co., New Delhi.
11. R. Ian Freshney, 2016. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley Blackwell.
12. V Kumaresan and N. Arumugam, 2014. Animal Biotechnology, Saras Publication.
13. B. Singh and S.K. Gautam, 2013. Text book of animal biotechnology. TERI press.

Outcome:

On successful completion of this course students should be able to critically discuss the applications of biotechnology in research and industry.

35043-BIOPHYSICS, BIOSTATISTICS AND BIOINFORMATICS

Objectives:

- To understand the physical laws and their role in building biomolecules.
- To provide knowledge on biophysical instruments and their application in biology.
- To provide the computational knowledge in biological applications.

BLOCK – I: BIOPHYSICS

Unit I

Introduction to Biophysics: Structure and properties of atoms and molecules-Chemical bonds

– types and properties; Polymerization of organic molecules.

Unit II

Laws of thermodynamics - principle and application; Bio-energetics- coupling of chemical reactions- Redox potential- NADP/NADPH and Free energy.

Unit III

Natural radiations – Properties of light, Absorption of light, energy states of atoms, spin property of electrons- ground state and excited state of atoms and bio-molecules – their effects.

Unit IV

Spectroscopy- principle and applications; Delayed effects of radiation and measurement of radio activity – Geiger Muller counter – Isotopes as tracers - Autoradiography.

BLOCK – II: BIOSTATISTICS

Unit V

Definition and scope of biostatistics - Collection of data -Primary and secondary data.

Unit VI

Types of sampling: Random and stratified random sampling. Types of variables: continuous and discontinuous variables, qualitative and quantitative variables.

Unit VII

Presentation of data: line and bar diagram, histogram, polygon and pie diagram.

Block – III: MEASURES OF CENTRAL TENDENCY AND MEASURE OF DISPERSION

Unit VIII

Mean, Median and mode – Dispersion: Range, variance, SD, SE and CV.

Unit IX

Probability and Hypothesis testing- Normal distribution, confidence interval and P value.

Unit X

Common statistical tools: Chi-square, 't' test, – ANOVA, Correlation and Regression analysis; statistical packages.

BLOCK – IV: BIOINFORMATICS**Unit XI**

Introduction to Bioinformatics, Medical-informatics, Cheminformatics and Pharmacoinformatics.

Unit XII

Current researches in Bioinformatics. Applications of Bioinformatics in cancer detection, Drug targets.

Unit -XIII

Animal genome diversity - Introduction to DNA and Protein Sequence Analysis – Introduction and Concepts to biological Databases.

Unit - XIV

Phylogenetic analysis using PHYLIP, ClustalW.

Reference Books:

1. Daniel, W.W., 2007. Biostatistics, Wiley publishers, USA.
2. Zar, 2006. Biostatistical analysis, Dorling Kindersley Pvt Ltd, India.
3. Nolting, B., 2006. Methods in modern biophysics, Springer, Berlin.
4. Agarwal, S.K., 2005. Advanced biophysics, APH Publishing Corporations, India
5. Daniel, M., 2004. Basic biophysics, Agrobios publications, India
6. Bailey, N.T.J., 1997. Statistical Methods in Biology, III Ed., Cam. University Press, N.Y.
7. McCleery, R.H. and Watt, T.A., 2007. Introduction to Statistics for Biology. 3rd Ed., Chapman & Hall / CRC.
8. Goutham, N, Pattabi, S., 2001. Biophysics, Narossa Publishing company, New Delhi.
9. Mount, D., 2004. "Bioinformatics: Sequence and Genome Analysis"; Cold Spring Harbor Laboratory Press, New York.
10. Lesk, A.M., 2002. "Introduction to Bioinformatics", First edition, Oxford University Press, UK.
11. Lukas, K., Buehler, Hooman, H. Rashidi, 2000. "Bioinformatics Basics: Applications in Biological Science and Medicine"; CRC Press.
12. Jean-Michel, C. Notredame, C., 2003. "Bioinformatics for Dummies"; John Wiley & Sons.
13. R. Durbin, S. Eddy, A. Krogh and G. Hitchison, 2003. Biological Sequence Analysis, Cambridge University Press, Eighth edition.
14. Andrew R. Leach, Valerie J. Gillet, 2007. An Introduction to Chemoinformatics, Springer, Revised Edition.

Outcome:

This course will provide students with the basic concepts of biophysical techniques, statistical, computational skills and their application to assess biological macromolecules.

LAB-IV: 35044- FISHERIES AND AQUACULTURE, ANIMAL BIOTECHNOLOGY, AND BIOPHYSICS, BIOSTATISTICS AND BIOINFORMATICS

FISHERIES AND AQUACULTURE

1. Identification of commercially important fin fishes, shell fishes, molluscs, lobsters and seaweed.
2. Physical, biochemical and microbiological methods to examine freshness of fish.
3. Estimation of protein, lipid, carbohydrate and salt content in fish.
4. Determination of stocking density and feed assessment.
5. Method of transportation of seeds.
6. Modern crafts and gears.

ANIMAL BIOTECHNOLOGY

1. Isolation of genomic DNA.
2. Estimation of DNA.
3. Demonstration of ELISA.
4. RAPD, RFLP (Demo).
5. Extraction and purification of Plasmid DNA.
6. Spotter: Models of PCR, Southern blotting.
7. Cloning vectors – images.

BIOPHYSICS BIOSTATISTICS AND BIOINFORMATICS

1. Spectrophotometer, pH meter, and electrophoretic unit as spotters.
2. Construction of graph and bar diagram using biological data.
3. Calculation of mean, median, mode, variance, standard deviation and standard error and Chi-Square test.
4. IN SILICO Analysis

Reference books:

1. Moyle, P. B. and J. J. Cech, Jr., 1996. Fishes an introduction to Ichthyology, Prentice Hall, New Jersey.
2. Jean T. Nolan, 2009. Offshore Marine Aquaculture, Nova Science Pub Inc.
3. Michael King, 2007. Fisheries Biology, Assessment and Management, Wiley-Blackwell.
4. Laurence Hutchinson, 2006. Ecological Aquaculture: A Sustainable Solution Permanent Publications.
5. David Scarfe, Cheng-Sheng Lee, and Patricia J. O'Bryen, 2006. Aquaculture Biosecurity: Prevention, Control, and Eradication of Aquatic Animal Disease, Wiley-Blackwell.
6. Daniel, W. W. (2007) Biostatistics, Wiley publishers, USA
7. Zar (2006) Biostatistical analysis, Dorling Kindersley Pvt. Ltd. , India.
8. Pillay, T. V. R., and M. N. Kutty, 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
9. Sam brook J., Fritsh E.F., Maniatis T., 1989. Molecular cloning, volume -3, Cold Spring Harbour Laboratory.
10. Glover D.M and Hames B.D., 1995. DNA Cloning, 2nd edition, Volume - I, II, III, IRL press at Oxford University press, New York.