छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI MAHRAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

For

Metric No. – 1.1.1

Programme Outcomes & Course Outcomes

Under the

Criteria - I

(Curriculum Design and Development)

Key Indicator - 1.1

In

Metric No. – 1.1.1

M.Sc. Life Sciences

Co-ordinator
Internal Quality Assurance Cell
CSJM University, Kanpur

(Registrar)
C.S.J.M.University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

Chhatrapati Shahu Ji Maharaj University, Kanpur
Life Sciences
M.Sc. Life Sciences

1. Programme Outcome (PO):

The aim and objectives of the Life Sciences program essentially focus todevelop skills of student for a successful career.

PO.1: Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.

PO.2: Resource Utilization: Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, and ICT tools to enhance knowledge base and stay abreast of recent developments.

PO.3: Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects/limitations.

PO.4: Critical thinking and Problem solving: Identify and critically analyze pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/solutions.

PO.5: Project Management: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyze and interpret data and provide solutions. Exhibit organizational skills and the ability to manage time and resources.

PO.6: Individual and team work: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PO.7: Effective Communication: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.

PO.8: Environment and Society: Analyze the impact of scientific and technological advances on the environment and society and the need for sustainable development.

PO.9: Ethics: Commitment to professional ethics and responsibilities.

PO.10 Life-long learning: Ability to engage in life-long learning in the context of the rapid developments in the discipline.

2. Programme Specific Outcomes (PSO):

PSO.1 To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology etc.

PSO.2 To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific methods.

PSO.3 To enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Life Sciences.

PSO.4 To define and demonstrate utility of basic laboratory skills in the animal and plant biology research with ethics.

PSO.5 They are trained to operate advance and sophisticated instruments that help quantify and analyze the computer-generated data hence develop employability skills.

PSO.6 Communicate deep biological concepts through effective written and oral presentation.

Course – Structure

M.Sc. Semester - I **Total Marks : 450**

Compulsory Courses

S.No.	Couse Code	Course Tittle		Marks
1	L.Sc. - 1001	Physics (Remedial)	For Students with Biological Sciences	50
2	L.Sc. - 1002	Mathematics (Remedial)		50
3	L.Sc. - 1003	Plant Biology		50
4	L.Sc. -1004	Animal Biology	For Students with Physical Sciences	50
5	L.Sc. - 1005	Chemistry of Macromolecules		50
6	L.Sc. - 1006	Biochemistry — 1		50
7	L.Sc. - 1007	Microbiology		50
8	L.Sc. - 1008	Cell Biology — I		50
9	L.Sc. - 1009	Genetics		50
10	L.Sc. - 1010	Life Sciences Practical's		100

M.Sc. Semester - II **Total Marks : 450**

Compulsory Courses

S.No.	Couse Code	Course Tittle	Marks
1	L.Sc. - 2001	Cell Biology — II	50
2	L.Sc. - 2002	Biochemistry — II	50
3	L.Sc. - 2003	Molecular Biology	50
4	L.Sc. - 2004	Immunology	50
5	L.Sc. - 2005	Bio Physics and Structural Biology	50
6	L.Sc. - 2006	Animal Physiology	50
7	L.Sc. - 2007	Plant Physiology	50
8	L.Sc. - 2008	Life Sciences Practical's	100

M.Sc. Semester - III **Total Marks : 450**

Compulsory Courses

S.No.	Couse Code	Course Tittle	Marks
1	L.Sc. - 3001	Animal Developmental Biology	50
2	L.Sc. - 3002	Plant Developmental Biology	50
3	L.Sc. - 3003	Computational Biology and Bioinformatics	50

Optional (Any Paper)

4	L.Sc. - 3004	Biostatistics	75
5	L.Sc. - 3005	Molecular Genetics and Genetic Engineering	75
6	L.Sc. - 3006	Molecular Cancer Biology	75
7	L.Sc. - 3007	Virology	75
8	L.Sc. - 3008	Advanced Microbial Physiology	75
9	L.Sc. - 3009	Neurophysiology	75
10	L.Sc.. -3010	Enzymology and Enzyme Technology	75
11	L.Sc. - 3011	Pluripotent Stem Cells and Reproduction	75
12	L.Sc. - 3012	Ecology and Biodiversity	75

M.Sc. Semester - IV **Total Marks : 450**

Optional (Any Three)

S.No	Couse Code	Course Tittle	Marks
1	L.Sc. - 4001	Neural and Behavioral Biology	75
2	L.Sc. - 4002	Plant Biotechnology	75
3	L.Sc. - 4003	Molecular Parasitology	75
4	L.Sc. - 4004	Radiation Biology	75
5	L.Sc. - 4005	Redox Biology	75
6	L.Sc. - 4006	Microbial Biotechnology	75
7	L.Sc. - 4007	Nano-Biotechnology	75
8.	L.S.C. 4008	Harmon Action & Meta Disorder	75

Compulsory

S.No.	Couse Code	Course Tittle	Marks
9	L.Sc. - 4009	Seminar	25
10	L.Sc. - 4010	Dissertation	200

Chhatrapati Shahu Ji Maharaj University, Kanpur
M.Sc. Life Sciences Syllabus
M.Sc. Life Sciences Semester — I

M.Sc. Life Sciences Ist Semester Course Title - Physics (Remedial) **Course Code - L.Sc. – 1001**

Course Objective(s)

1. Students will be able to apply various fundamental principles and laws of Physics for learning the processes in Life Sciences.
2. Application of the knowledge of fundamental and applied physics for learning concepts for any given requirement in basic and applied Life Sciences.
3. Students will be able to perform and represent studies of a physical situation by means of appropriate mechanisms.
4. To solve problems in an organized, methodical fashion, showing all work and explaining each step.

Marks - 50

S.No.	Topic
1	Quantum Physics: Wave versus particle. Heisenberg and Uncertainty,Schrodinger and Matter waves, Photoelectric effect, Atom and Nuclei, The elements- Fermions, The quantum Vacuum. Particles
2	Properties of Matter: Elasticity, Hydrostatic, Surface tension, Microscopic consideration for study of properties of matter, Atomic and Molecular structure, Structure of solids, amorphous solids, Structure of single crystals. Broad classification of Solids
3	Thermal Physics: Laws of Thermodynamics and its application in Biological system.Temperature and related topics, Internal energy, Heat and First law of Thermodynamics, The ideal monatomic gas. Application of first law to Ideal Gases. Entropy and the second law
4	Fundamental Electromagnetism: Charge and Current, Coulomb's law, Electric field,Electrostatic potential. Guass's law for Electronics, Magnetic effects on study currents, Forces on current in a magnetic field, Forces on charges in Electric and Magnetic field, Electromagnetic induction
5	X-ray crystallography: A basic introduction to X-ray crystallography, Crystal growth, evaluation and mounting, Symmetry and space group determination

Course Outcome(s)

1. Major objective of the course is to provide students with knowledge and awareness of the basic principles and concepts of physics in Life Sciences learning and processes.
2. It aims at developing the basic knowledge and skills needed to succeed in Physical Concepts in Life Sciences.
3. To provide an opportunity for students to develop problem-solving skills using Physics based concepts and formulae.
4. To state the principles and laws of physics dealt with in this course.
5. To state precise definitions of the physical quantities presented in this course including standard unit systems, vectors and basic laws of physics.
6. To display a certain facility in employing mathematical techniques to solve physics problems by using one or others; construction of appropriate mathematical representations of physical situations manipulation of vectors, both graphically and analytically, in two dimensions; set up and solution of algebraic equations and systems of equations; manipulation of trigonometric, logarithmic and exponential functions; construction and interpretation of graphs, including slopes, areas, intercepts and intersection points.

Reference Books:

1. J.D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
2. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
3. Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
5. T.W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
7. E.L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
8. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
9. R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
10. Arun Bahl and B.S. Bahl: Advanced Organic Chemistry, S. Chand
11. K Wilson and J Walker, (1999). Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University Press.

M.Sc. Life Sciences Ist Semester Course Title - Mathematics (Remedial) Course Code - L.Sc. – 1002

Marks - 50

S.No.	Topic
1	Real Number System
2	Elements of Coordinate Geometry and Algebra
3	Relations, Functions. including Periodic Functions. Inverse Functions. Growth Rates and Topics from Differential Calculations such as max/min of functions of one variable differentials and approximations
4	Partial derivatives, max/min of function of more than one variable and method of lease squares
5	Anti-Derivatives, Indefinite integrals and definite integration
6	Logarithms and Exponential Functions
7	Differential Equations and differences equations models in biology and ecology
8	Elements of Probability

Reference Books:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

M.Sc. Life Sciences Ist Semester Course Title - Plant Biology (Remedial) Course Code - L.Sc. - 1003

Course Objective(s)

The learning objectives are

1. Study of structures of plants that enable life function.
2. Green Design: Study of Leaf Structures to Optimize Photosynthesis and Promote Survival.
3. Plant reproduction, their growth & development.
4. Understanding of the Roles of Carbon Dioxide, Sunlight, and Nutrients in Photosynthetic Organisms.
5. Plant environment interactions

Marks - 50

S.No.	Topic
1	Origin of life
2	Formation of Angiosperm, gametes, self-pollination vs. out crossing, mechanisms of pollen dispersal, adaptive traits, fertilization (double fertilization, triple fusion), seed and fruit formation, Embryogenesis, seed dormancy, dispersal of Seed, seed germination
3	Basics of plant development, shoot, leaf, root and floral meristems, transition from vegetative to reproductive stages, growth regulation of plants
4	Plant kingdom-classification, respiration-the role of energy in living system, transport systems in plants water, food substances
5	Maintaining life: food chain, producers and consumers, pyramid of energy, food webs, decomposers, food chains and human, the fuel of life, how plants feed, photosynthesis, chloroplasts, site of photosynthesis, the reaction behind

Course Outcome(s)

After this course, the students would be able to understand How do plants detect, process, and interpret information from the environment. Important processes of plant survival and reproduction. Development and reproduction of plants with overview of different processes. Equip the students with subject domain knowledge and technical skills pertaining to plants in a holistic manner.

Reference Books:

1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
2. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM
3. Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.

M.Sc. Life Sciences Ist Semester Course Title - Animal Biology (Remedial) Course Code - L.Sc. – 1004

Course objective(s)

The aim of the is for each student is

1. To learn life process, origin of life on earth, cell organization, cell physiology, body plans etc of animals
2. To study animal production and management or explore the biological and physical sciences.
3. To better understand animal breeding, behavior, physiology and management among various species, including pets, farm animals and exotic animals.

Marks - 50

S.No.	Topic
1	Nature and Scope of Biology, Understanding of Life
2	Origin of Life. Molecule-to-cell. Prokaryotes and eukaryotes, biomolecules, cell metabolism
3	Organization, unicellularity to multicellularity and its significance
4	Cell Physiology, hormones and cell signaling
5	Cell Division: Amitosis, Mitosis and Meiosis
6	Body Plans: Types and their significance Body symmetry and its Significance
7	Animal Kingdom: Classification of Invertebrate and vertebrates up to class and their general characteristics
8	Tissue. Types, structure and functions
9	Animals Systems: Comparative account of different systems, their basic structure and Functions
10	Digestive System: digestion, absorption, transportation and Assimilation
11	Respiratory System: Breathing, Gas exchange, Gaseous Transportation
12	Circulatory System: Structure and functions of Water and Blood circulatory system, Heart, Blood vessels, Portal and lymphatic systems
13	Movement and Locomotion. Structure and function of Muscle and Bones
14	Excretory System: Structure and functions of different types of excretory organs, Types of excretions, Structure and function of kidney, nephron and micturition
15	Nervous System. Structure and function of ganglion in invertebrates and vertebrates, Brain and its part, spinal cord
16	Sense Organs: Structure and function of compound eye, simple eye and Auditory organs
17	Reproduction· Asexual, Sexual, Primary and Secondary sex organs, Gametogenesis, fertilization and basic embryogenesis

Course Outcome(s)

The student shall be able to

1. Appreciate the cell, tissue strucuture and function in animals including human
2. Explain the cell and its physiology and its all functions
3. Capable to impart various advance aspects of advance animal cell structure and physiology, developmental biology and biotechnology including applied aspects of animal sciences

References

1. Animal Physiology by Hill, Wyse & Anderson (2004)

2. Animal physiology by Randall Burggren & French (2005)
3. Guyton-text book of Medical physiology

M.Sc. Life Sciences Ist Semester Course Title - Chemistry of Macromolecules Course Code - L.Sc. – 1005

Course Objective(s)

1. The course reviews the structure of atom ,which is a necessary prerequisite in understanding the nature of chemical bonding in compounds.
2. It provides basic knowledge about ionic, covalent, metallic bonding & explains that chemical bonding is best regarded as continuum between the three cases.
3. It discusses the periodicity in properties with reference to the s& p block which is necessary in understanding their group chemistry

Marks - 50

S.No.	Topic
1	Energy and its importance for all processes. The relevance of thermodynamics in the study of biological processes Some basic concepts: defining a system, universe, state functions and path functions and their significance for understanding biological processes. The first law of thermodynamics, second law of thermodynamics, Gibbs energy and its relationship with enthalpy and entropy of a system, the equilibrium constant.
2	Understanding different types of chemical equilibria, Ligand binding to macromolecules. The binding constant The binding equation and different ways of analyzing binding data. Ionic product of water
3	pH and Buffer, Acid base equilibria, the Henderson-Hassel Bach equation, and their importance, pKa of amino acids and their relevance Using these concepts in understanding why discontinuous buffer system is used in SDS—PAGE
4	Chemical potential and ionic equilibria, Donnan membrane equilibrium and its significance. Nernst Equation and chemical equilibrium
5	Kinetics: Path dependence of kinetics of chemical processes. Activation energy, transition states and intermediates Rates and rate constants for first order, second order and pseudo first order reactions. Writing rate equations, the differential method and the integration method. Half-life of first and second order reactions and their significance.
6	Physical organic Chemistry. Conjugation, aromaticity and resonance Inductive and field effects Hydrogen bonding and hydrophobicity
7	Some important reaction mechanisms in organic chemistry. SN I , SN2, E1, E2 and electrophilic, addition reactions. free radicals and singlet oxygen production
8	Common reaction mechanisms encountered in biological reactions; peptide bond formation, oligonucleotide and oligosaccharide synthesis, disulphide bonds, group-specific chemical modifications for amino acids.
9	Basic Principles of Bio-Inorganic Chemistry· Coordination bonds and metal-ligand interactions, Metalloproteins and metalloenzymes, Role of metal ions in biological systems.

Course Outcome(s)

1. Solve the conceptual questions using the the quantum mechanical model of the atom, quantum numbers, electronic configuration, angular distribution curves, shapes of s and p and d orbital, periodicity in atomic radii, ionic radii, ionization energy, electron affinity of elements
2. Draw the possible structures and geometry of molecules using radius ratio rules, VSEPR, MO diagrams
3. Understand the concept of lattice energy using BORN LANDE and KAPUSTINKI expression
4. Rationalize the conductivity of metals, semiconductors, insulators based on band theory
5. Application of chemical bonds, inter molecular and intra molecular weak chemical forces and their effect on melting points , boiling points, solubility and energetic of dissolution

Reference Books:

1. Stryer, L. (2015). Biochemistry (8th ed.). New York: Freeman.
2. Lehninger, A. L. (2012). Principles of Biochemistry (6th ed.). New York, NY: Worth.
3. Voet, D., & Voet, J. G. (2016). Biochemistry (5th ed.). Hoboken, NJ: J. Wiley & Sons.
4. Dobson, C. M. (2003). Protein Folding and Misfolding. Nature, 426(6968), 884-890. doi:10.1038/nature02261.
5. Richards, F. M. (1991). The Protein Folding Problem. Scientific American, 264(1), 54-63. doi:10.1038/scientificamerican0191-54

M.Sc. Life Sciences Ist Semester Course Title - Biochemistry – I **Code - L.Sc. – 1006**

Course Objective(s)

1. To provide an advanced understanding of the core principles and topics of the Biochemistry and their experimental basis,
2. To enable the students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.
3. To train the candidates for the emerging field of biochemistry.

Marks : 50

S.No	Topic
1	An overview of Biochemistry, Cellular environment and applicability of basic laws of chemistry and thermodynamics Concept of small and macromolecules. Molecular interactions and its importance in understanding cellular processes.
2	Macromolecules proteins, polysaccharides, lipids. glycoproteins, glycolipids, Lipoproteins, lipopolysaccharides, Protein modifications and their functional implications
3	Primary characterization of proteins, isolation and chromatographic Purification of proteins, ultracentrifugation, sequence determination
4	Structure of amino acids and peptide bonds, Ramachandran Plot. alpha helical and beta-pleated structures, structures of fibroin Proteins like keratin. fibroin, elastin and collagen.
5	Dynamics of protein structure, protein stability, globular proteins and maintenance of specific confirmation, structural motifs commonly found in various proteins and their functional relevance
6	Basic concepts of protein folding, folding pathways role of accessory proteins in protein
7	Structure of hemoglobin, oxygen binding kinetic and its relation to its structure mechanisms of cooperativity in oxygen binding,
8	Monosaccharides and derivatives of sugars, polysaccharides, g]ycosaminoglycan, proteoglycans, protein g]ycosylation and its significance
9	Fatty acids, tri-aryl-glycerol, glycerol phospholipids sphingolipids, Cholesterol lipid bilayers
10	Introduction of Enzymes, Mechanism of Enzymes action, Unit of an Enzymes, Enzymes inhibition, Ribozymes and Abzymes.
11	Nucleic acid, DNA as a genetic material, Primary and Secondary structure of DNA and RNA, Basic Mechanism of DNA replication

Course Outcome(s)

1. Biochemists could become Academicians like Asst. ,Asso., or Professor at colleges or University
2. The students may work as a biochemist for research, institute, consultancy firms, wholesale manufactures diagnostic or forensic laboratories.
3. They can also work as federal agencies such as food and drug administration as well as the national institute of Health.

Reference Books:

1. Stryer, L. (2015). Biochemistry (8th ed.). New York: Freeman.
2. Lehninger, A. L. (2012). Principles of Biochemistry (6th ed.). New York, NY: Worth.

3. Voet, D., & Voet, J. G. (2016). Biochemistry (5th ed.). Hoboken, NJ: J. Wiley & Sons.
4. Dobson, C. M. (2003). Protein Folding and Misfolding. Nature, 426(6968), 884-890. doi:10.1038/nature02261.

M.Sc. Life Sciences I[st] Semester Course Title – Microbiology **Code - L.Sc. – 1007**

Course Objective(s)

The aim of the is for each student

1. To study of bacteria, viruses, fungi, protists, archaea, algae and other microscopic life forms are on us and in us, in the air, soil and water, and in our food.
2. To learn their cultivation and their uses in human welfare
3. Understanding the value of microbes in sustainable development They can keep the planet healthy by recycling waste and supplying nutrients.

Marks : 50

S.No.	Topic
1	History of microbiology. Theory of spontaneous generation Experiments of Pasteur and Tyndall, Koch's Postulates, Isolation of bacteria from natural sample column, Control of Microbial growth methods a sterilization,
2	The Microbial cell: General organization of cell, Prokaryotes Eukaryotes and Archaea, Cell wall organization on Prokaryotes.Eukaryotes and Archaea, Cell surface appendages, Pilli, locomotion by flagella, chemotactic Movement, Peptidoglycan synthesis - inhibitors in different steps.
3	Role of bacteria in human welfare: Biological concepts - Immunization (Pasteur experiment Antibiosis), (penicillin story), Griffith's experiment, A very and McCarty's experiment, Experiment with viruses
4	Growth and nutrition Growth kinetics, Batch an continuous cultures, Nutritional classification of microorganisms, Nutritional uptake by microorganisms (C.N.P.)
5	Changing concepts in microbiology taxonomy, Earlier systems, Molecular taxonomy, Jaccard's similarly coefficients
6	Metabolic Pathways: Metabolic versatility of microbes, Anaerobic Carbon metabolism: Anaerobic respiration, aerobic respiration, Sulphate respiration, Reference to glycolysis, Fermentation diverse fermentation products, Putrefaction, Methane oxidizing and Methanogenic bacteria, Aerobic Carbon, metabolism TCA cycle alternative metabolic pathways, Nitrogen Fixation, synthesis of amino acids, Regulation of `nif, Mycorrhiza.
7	Energy Metabolism: Chemoautotrophs, Hydrogen bacteria, Phototrophic bacteria/Cyanobacteria
8	Microbial Genetics: Modes of genetic exchange in microbes, Transformation, Transduction, Conjugation, Evolutionary Significance, Microbes in Extreme Environment
9	Introduction to Industrial Microbiology: Major industrial products from microbes, Beverages, Antibiotics, Secondary metabolites, Recombinant products.
10	Introduction to Environmental Microbiology. Nature of anthropogenic wastes, Municipal wastes and xenobiotic, Enrichment cultures, Xenobiotic degrading consortia, Bioremediation

Course Outcome(s)

The student will be able to understand

1. Importance of microbes in the environment
2. With this stdy student can opt the various field of microbiology such as Pharmacy, Medicine, clinical research, agriculture, dairy industry, water industry, nanotechnology & chemical technology and they can make careers in research and non-research fields.

References:

1. Microbiology by Michla J. Pelczar, TATA McGRAW-HILL
2. Microbiology by Jackquelyn G.Balck, WIELEY
3. General Microbiology by Roger,John, Mark, and Page by MACMILLAN PRESS LTD

4. Microbiology by Kanika Sharma,

M.Sc. Life Sciences Ist Semester Course Title - Cell Biology – I **Code - L.Sc. – 1008**

Course Objective(s)

1. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells and structure and function of macromolecules, membranes, and organelles
2. To know the levels of organization and related functions in different types of cells and intracellular organization.
3. To understand how these cellular components are used to generate and utilize energy in cells and how cellular metabolism and function completes.
4. To understand the cellular components underlying cellular division and growth.
5. To apply their knowledge of cell biology to understand the cytogenetics and chromosomal constitution.
6. Overall, to get an overview of cell evolution, structure and function of cellular components, and basics of cell analysis tools and techniques.

Marks : 50

S.No.	Topic
1	Introduction to the Cell: The evolution of the cell, From molecules to first cell, From Prokaryotes to eukaryotes, From single cells to multicellular organisms
2	How cells are studied: Microscopy: light microscopy, fluorescence microscopy, Phase contrast microscopy; Electron microscopy, Purification of cells and their parts, Cell separation and culture, flow cytometry, Fractionation of cell contents, Tracing cellular molecular with radioactive isotopes and antibodies
3	The Plasma membrane, Membrane structure· The Lipid bilayer, Membrane proteins, Membrane carbohydrates, Membrane transport of small molecules, Membrane transport of macromolecules and particles; exocytosis and endocytosis
4	The Cell nucleus, Morphology and functional elements of eukaryotic chromosomes, Chromosomal DNA and its packaging and organization The complex global structure of chromosomes and functions implications lampbrush Chromosomes, Polytene chromosomes, heterochromatin, centromeres.
5	Organelles to the eukaryotic cell The lysosomes, The peroxisomes, The Golgi apparatus, The endoplasmic reticulum
6	Protein sorting organelle biogenesis and protein secretion, synthesis and targeting, of mitochondria, chloroplast, peroxisomal proteins, translational modification in the ER. Intracellular traffic, vesicular traffic in the secretary pathway, protein sorting in the Golgi, traffic in the endocvtic pathways exocytosis.
7	The cytoskeleton, the nature of cytoskeleton, Intermediate filaments, Microtubules, Actin filaments, Cilia and centrioles, Organization of the cytoskeleton the fibrous protein of the matrix, Noncollagen component of the extracellular matrix

Course Outcome(s)

1. Students will learn how cellular information is passed on in eukaryotes and prokaryotes, how cells work together in a complex manner in biological system.
2. Students will gain the concept of cellular basic of life as a key mechanism of regulation of genes in the cellular development and cell fate.
3. The students will be able to understand how the cell functions as a unit of life.
3. Candidate shall be able to design and comprehend experimental strategies for analysing the cell and cell functions from a variety of organisms.
4. Students will be skilled in the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes.

Reference Books:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Batlimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.
3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M.Sc. Life Sciences Ist Semester Course Title – Genetics **Code - L.Sc. – 1009**

Course Objective(s)

1. To provides fundamental knowledge of how organisms, populations and species evolve.
2. To provide some of the most incisive analytical approaches that are now being used across the spectrum of the biological disciplines.
3. To impart knowledge about the human chromosome constitution that would help in applying basic principles of chromosome behavior to disease context.
4. Overall, this course will highlight extension of Mendelian Genetics, dosage compensation, evolution of the concept of gene and its amalgamation with molecular biology and study of genetic diseases.

Marks - 50

S.No.	Topic
1	Introduction and scope of Genetics
2	Chromosome Structure: Centromeres, Telomeres.
3	DNA replication· Meselson and Stahl Experiment, Cairns Experiment, OkazakiExperiment, Basic mechanism of DNA replication.
4	Cell division and Cell cycle Mitosis, Meiosis, Chromosomal basis of inheritance
5	Basic Principles of Mendelian Inheritance· Segregation and Independent Assortment, Alleles and Multiple Alleles, Human pedigrees and inheritance
6	Gene Interaction: Sex determination and Sex linked in heritance, Sex determination in humans, Drosophila and other animals, Sex- determination in plants, Sex-linked genes and dosage compensation of X-linked genes. Human genetics: pedigree analysis.
7	Linkage analysis and gene mapping eukaryotes, Coupling and repulsion phases, Crossover and recombination
8	Fine Structure of gene and gene concept: Complementation and recombination,
9	Chloroplast and Mitochondrial in heritance· Yeast, *Chlamydomonas / Neurospora* and higher plants
10	Bacterial Genetics: Transformation, Conjugation, Transduction
11	Mutations, Spontaneous and induced mutations, Chromosomal Mutation and aberrations, Change in chromosome number: polyploidy Evolutionary history of bread wheat, Aneuploids - nullisomics, monosomics, and trisomics, Somatic aneuploids, Changes in chromosome structure, Properties of chromosomes for detection of structural changes, Main type of changes — deletions, duplications, inversions, translocations. Mechanism of chromosome mutations genetic andcytological features of deletions, duplications, inversions and translocations,
12	Mutations, Spontaneous and induced mutations, Chromosomal Mutation and aberrations, Change in chromosome number: polyploidy Evolutionary history of bread wheat, Aneuploids - nullisomics, monosomics, and trisomics, Somatic aneup]oids, Changes in chromosome structure, Properties of chromosomes for detection of structural changes, Main type of changes — deletions, duplications, inversions, translocations. Mechanism of chromosome mutations genetic and cytological features of deletions, duplications, inversions and translocations,
13	Population genetics: application of Mendel's laws to whole population, Calculation of allele frequencies, Hardy-Weinberg principal for. Calculating recessive gene frequency, Calculating frequency of sex-linked alleles

Course Outcome(s)

Genetics course will open up several avenues for students in terms of research and employability.

1. Enable students for extensive use of model organisms, many of which will be used to teach this course.
2. By observing genetic mutations, students can correlate phenotype with genotype, understand genetic interaction and their molecular basis.
3. Students will be able to set hands on genetic crosses to understand recessive and dominant, segregation, pattern of inheritance and finally evaluating statistical significance by counting the progeny as statistical analysis
4. Students will learn how genetic information is passed on in eukaryotes and prokaryotes, how genes work together in a complex manner in biological system and any alteration can lead to major phenotypic change.
5. Students will appreciate the concept of epigenetics as a key mechanism of regulation of gene expression steering development and cell fate that can ultimately be affected in disease condition.

Reference Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

M.Sc. Life Sciences Ist Semester Course Title – Life Sciences Practical's **Code - L.Sc. - 1010**

Marks - 100

S.No.	Topic
1	pH buffers etc
2	Absorption measurements
3	Protein estimations
4	Enzyme kinetics
5	Carbohydrates and lipid analysis
6	Protein purification
7	Chromatography (a) TLC, (b) P C, (c) GLC
8	Microbial diversity
9	Bacterial growth curve/kinetics
10	Bacterial staining and identification
11	Sectioning of tissues (Plant and animal)
12	Staining of different plant cell types
13	Study of different plant groups using permanent slides
14	Radiation induced cell damage
15	Methods for culturing and studying *Drosophila melanogaster*
16	Analysis of mutants for body colour, eye colour, eye shape, wing size, wing shape and wing hair.
17	Induction and detection of sex linked recessive lethal mutation in Drosophila
18	Induction and detection of somatic mutation and mitotic recombination in Drosophila.
19	Mouse bone marrow chromosome preparation.
20	Induction and detection of chromosome mutation in mouse bone Marrow metaphase cells.
21	Isolation of subcellular components: biochemical fractionation
22	Stereo taxing and survival surgery
23	Electrodes and their implantation
24	Poly graphic recording
25	Identification of different areas of the brain and their coordinates

Reference Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Semester – II

M.Sc. Life Sciences IInd Semester Course Title – Cell Biology – II **Code - L.Sc. -2001**

Course Objective(s)

1. To understand the advanced structures and functions of the prokaryotic and eukaryotic cells with special emphasis on cell signalling, cell division, cellular metabolism and cell-cell interaction.
2. To provide knowledge about the complex organization in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types.
3. To create a desire for deeper understanding of advances of cellular biology and to gain knowledge and understanding of this rapidly changing field of modern biology.
4. To describe the levels of organization and related functions in different types of cells and intracellular organization.

Marks - 50

S.No.	Topic
1	**Cell Signaling :** General Principles, G-linked cell surface receptors, Ca^{++} signaling system, Enzyme-linked cell surface receptors, Target cell adaptation/desensitization
2	**The Cell Division Cycle :** General strategy of the cell cycle, Molecular basis of cell cycle control, causes and consequences of failure of control, M-phase, Mitosis, Cytokinesis and Karyokinesis
3	**Energy Conversions : Mitochondrial and chloroplast :** - Mitochondria and chloroplast –fine structure and chemistry -Glycolysis, TCA cycle, Respiratory electron chain and ATP synthesis -Photosynthesis-Pigments, Photosystems, Light reaction, Dark reaction -The evolution of electron transport chain -The genomes of mitochondria and chloroplast -Localization signals and protein imports
4	**Cell Junction, Cell Adhesion and Extra-Cellular Matrix :** Cell Junction, Cell-Cell Adhesions and cell adhesion molecules, The Extra-Cellular Matrix, Extra-cellular matrix receptors of animals
5	**Excitable cells/tissues :** Neuron-structure, types properties, function Transmembrane potential, action potential, conduction of impulse channels – active and passive, voltage and chemical sensitive axoplasmic flow, communication between excited tissues/neurons, cellular and molecular basis of synaptic transmission, neurotransmitters, neurotoxins.

Course Outcome(s)

The students will

1. Be able to understand how the cell functions as a unit of life.
2. gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes.
3. be able to draw parallels between the physiological processes at the cellular and organismic levels.
4. Be able to understand the importance of cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms.

Reference Books:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Batlimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing Inc., New York.

3. Lehninger, Principles of Biochemistry, Fifth Edition.
4. Genetics: Principles and Analysis: Daniel L. Hartl, Elizabeth W. Jones.

M.Sc. Life Sciences IInd Semester Course Title – Biochemistry – II **Code - L.Sc. -2002**

Course Objective(s)

1. This course is aimed on building knowledge of basic principles as well as introducing latest concepts in line with the research developments in biochemical sciences.
2. To provide clear knowledge of basic fundamentals as well as understanding of advanced concepts in human physiology and biochemical processes and integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body;
3. To develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses and research institutes...

Marks - 50

S.No.	Topic
1	Metabolism Basic concepts, Central role of ATP in metabolism, carbon fuel and its oxidation, concept of energy rich compounds and intermediates, Common types of reactions involved in metabolism
2	Glycolysis and gluconeogenesis, Energetics and ATP productions
3	Regulation of glycolysis, glycogen synthase, metabolic flux and its regulation by various metabolic intermediates
4	TCA cycle, its regulation its role in energy generation, its role in generating biosynthetic intermediates, glyoxylate cycle
5	Redox reaction, mitochondrial structure and its role in energy metabolism, electron transport system
6	ATP synthesis and chemo-osmotic hypothesis of ATP generation
7	Pentose phosphate pathway and its importance in biosynthetic reaction
8	Glycogen synthesis, breakdown and its regulation
9	Fatty acid biosynthesis and degradation
10	Synthesis and degradation of steroids
11	Amino acid metabolism, Urea cycle, one carbon reaction, non-protein amino acids amines and their role in cell function
12	Nucleotide biosynthesis and metabolism, salvage pathways, its regulation and diseases
13	Special topics in biochemistry, Mechanisms of hormone action, Role of post-translation modifications in regulation of cell function, Muscle contraction and cell motility

Course Outcome(s)

1. Comprehend and analyze problem based questions.
2. Develop investigative, communicative, analytical and personal skills with respect to the subject.
3. Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body and feedback loops control the same.
4. Synthesize ideas to make connection between knowledge of physiology and real world situations, including healthy life style decisions and homeostatic imbalances i.e. how physiological mechanisms adapt in response to various external and internal stimuli in order to maintain health.
5. Know the role of regulatory systems viz. endocrine and nervous systems and their amalgamation in maintaining various physiological processes.
6. Appreciate the role of enzymes in metabolic pathways. And control of enzyme activity, its mechanism of action and how a drug might inhibit the enzyme.
7. Develop practical learning skills; like qualitative estimation of carbohydrates, chromatography and interpretation of results

Reference Books:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

M.Sc. Life Sciences IInd Semester Course Title – Molecular Biology Code - L.Sc. -2003

Course Objective(s)

The aim of this course is

1. To gain a better picture of the cellular environment with greater understanding of how cellular processes are regulated at the molecular level.
2. Learn the mechanisms and regulation of genome maintenance and gene expression, emphasizing how molecular structure influences function.
3. Understanding the multiple layers of regulation involved in the flow of genetic information.

Marks - 50

S. No.	Topic
1	Macromolecules and Organization : DNA, RNA : Structure, Types, Conformation, Denaturation, Renaturation
2	Chromatin structure, nucleosome
3	Genes and genome organization
4	Transposons and retrotransposons
5	Process DNA Replication – mechanism and enzymes involved, Prokaryotes/eukaryotes
6	RNA world and RNA Replication
7	Mechanism of transcription and enzymes involved, Prokaryotes/eukaryotes
8	RNA processing, capping, polyadenylation, splicing, editing
9	Genetic code and translation
10	Regulation Transcriptional regulation – Prokaryotes/eukaryotes
11	Translational regulation
12	Gene silencing, RNA interference
13	Molecular basis of mutations
14	Repair of DNA damage
15	Recombination of DNA – Site Specific, homologous, transposition
16	Methods used to recombinant DNA research

Course Outcome(s)

The students will be able to understand:

1. how different genomes are packaged and organized
2. various transposable DNA elements and their mechanism of transposition and other DNA recombinations
3. various Molecular Biology processes like replication, transcription, translation in depth
4. control and regulation of various life processes at molecular level
5. understand the possible applications of molecular biology knowledge for recombinant DNA technology

Reference Books:

1. Krebs JE, Goldstein ES and Kilpatrick ST (2014) Lewin's Gene XI, Jones and Barlett Publishers.
2. RF Weaver Molecular Biology, 5th edition (2012) McGraw Hill Higher Education
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M & Losick R (2014) Molecular Biology of the Gene, 7th Edition, Cold Spring Harbor Laboratory Press, New York.
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

M.Sc. Life Sciences II[nd] Semester Course Title – Immunology **Code - L.Sc. -2004**

Course Objective(s)

1. To enable understanding the molecular and cellular basis of the development and function of the immune system
2. To get into the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity,
3. Know the cellular/molecular pathways of humoral/cell-mediated adaptive responses including the role of major his to compatibility complex.
4. Identification of its biological, clinical and therapeutic implications of immunology.

Marks - 50

S. No.	Topic
1	Introduction to Immune System, organs, cells and molecules involved in innate and adaptive immunity, Mechanisms of barrier to entry of microbes/pathogens
2	Haematopoiesis and its regulation : Differentiation of stem cells to different cellular elements in blood, role of cytokines.
3	Introduction to inflammatory reaction chemokines, adhesion molecules, migration of leukocytes to the site of infection, phagocytosis and microbicidal mechanism, Immediate hypersensitivity role of eosinophils and mast cells, Asthma, IgE receptor, prostaglandins and leukotrienes
4	Receptors of innate immunity Toll – like receptors and sensing of PAMPs, signal transduction, opsonization, Fc receptors
5	Antigens, antigenicity and immunogenicity B and T cell epitopes
6	Antibody structure and function (classification of immunoglobulins, immunoglobulin domains concept of variability, isotypes, allotypes and idiotypic markers), Antigen-antibody interactions
7	Immunoglobulin genes, VJ/VDJ rearrangements and genetic mechanisms responsible for antibody diversity, affinity maturation, allelic exclusion Class switching, receptor and soluble forms of immunoglobulin
8	Hybridoma, monoclonal antibodies and antibody engineering
9	Immunological Techniques (antibody generation, detection of molecules using ELISA, RIA, Western blot, immunoprecipitation, flow cytometry, immunofluorescence microscopy etc.)
10	The complement system classical and alternative pathways
11	Major Histocompatibility Complex genetic organization of H2 and HLA complexes. Class I and Class II MHC molecules, structure and function Antigen processing and presentation pathways
12	Differentiation and activation of B cells, BCR and pre BCR, receptor editing, T cell help
13	T cell receptors αβ_ and γδ_T cells, receptor diversity, Activation of T cells APC- T cell interaction, Th1/Th2 cells cytokines. T cell differentiation in thymus, thymic selection and tolerance to self, MHC restriction, super antigens
14	Cell-mediated effect or functions: cytotoxic T cells, Natural Killer Cells, ADCC, NK cell receptors, inverse correlation with target MHC expression, missing self-hypothesis, cytotoxicity reaction
15	Topics like Applications of immunological principles (vaccines and diagnostics) tumour and transplantation Immunology and diseases of relevance to the immune system (autoimmunity and immunodeficiency) etc. would be discussed in context of the basic immunological mechanisms as assignments /tutorials

Course Outcome(s)

1. Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation and memory.
2. Understand the molecular basis of complex, humoral (cytokines, complement) and cellular processes involved in inflammation and immunity, in states of health and disease.
3. Describe basic and state-of-the-art experimental methods and technologies.
4. Integrate knowledge of each subsystem to see their contribution to the functioning of higher- level systems in health and disease including basis of vaccination, autoimmunity, immunodeficiency, hypersensitivity and tolerance.

Reference Books:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication,

Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

M.Sc. Life Sciences IInd Semester Course Title – Biophysics and Structural Biology Code - L.Sc. -2005

Course Objective(s)

1. To get ready contender for position in industry utilizing the logical methods, utilized in R & D, quality control, administrative capacities in pharmaceuticals, chemical companies and food industries.

Marks - 50

S. No.	Topic
1	Introduction, Interaction in biology systems
2	Structure of Biomolecules and confirmations of proteins and nucleic acids
3	Secondary, tertiary and quaternary structure of protein
4	Primary and secondary structure of RNA and DNA
5	Method of conformational analysis and prediction of conformation
6	Thermodynamics and kinetics of conformational transition of Proteins
7	Protein folding, techniques for studying Macromolecular structure
8	Ultra centrifugation, Sedimentation velocity and equilibrium – determination of molecular weights
9	Electron microscopy
10	UV Visible Spectroscopy, Fluorescence Spectroscopy
11	Circular Dichroism, Spectroscopy
12	Symmetry, space group crystal lattices, brag's law in real & reciprocal space
13	Nuclear Magnetic Resonance

Course Outcome(s)

1. This filed be a challenging profession that makes significance contributions to any field of science.
2. It is one of the most popular fields of work for chemists.

Reference Books:

1. Principles of physical Biochemistry, van Holde, KE, Johnson, WC, Ho, PS Prentice Hall, Inc., 1998.
2. Proteins, Creighton, TE. ; WH Freeman & Co., 1993
3. Crystallography Made Crystal Clear: A Guide for User"s of Macromolecular Models, Rhodes, G.; Academic Press, 1999
4. Techniques for the Study of Biological Structures and Function, Vol 2, Candor, CR and Schimmel, PR; WH Freeman & Co., 1990
5. Random walks in Biology, Berg, HC; Princeton University Press, 1993

M.Sc. Life Sciences IInd Semester Course Title – Animal Physiology Code - L.Sc. -2006

Course Objective(s)

1. Study of animal physiology for understanding and evaluating underlying biological processes,.
2. To describe the chemistry and physics behind basic body functions, from how molecules behave in cells to how systems of organs work together.
3. Tounderstand what happens in a healthy body in everyday life and what goes wrong when someone gets sick.

Marks : 50

S. No.	Topic
1	Tissue system and their functions, Epithelial tissue, Connective tissue, muscular tissue and Nervous tissue
2	Principles of physiology : relationship between structure and function, Adaptation, Acclimatization, Acclimation, Homeostasis, Feedback-control systems, Conformity and Regulation
3	Methods for exploring physiological mechanisms : Molecular techniques Cellular techniques, Biochemical techniques, Techniques for studying behaviour
4	Molecule, Energy and Biosynthesis- Types, Interactions and function
5	Comparative account of the nervous system in invertebrates and vertebrates
6	Endocrine system Glands and Hormones Secretory mechanisms, Endocrine and Neuro-endocrine systems, Cellular mechanism of hormone action, Physiological effects of hormones
7	Muscle and animal movement : Electrophysiology and biochemistry of contraction in skeletal cardiac and visceral muscles
8	Circulatory systems : general plan, electrical and mechanical Properties of myogenic and neurogenic hearts. Heart cycle including electrocardiogram, Hemodynamic, Cardiovascular response to extreme conditions like exercise, diving and haemorrhage Neural control of cardiovascular system Immune responses
9	Respiratory system : respiratory pigments, transport of gases in blood, regulation of body pH, respiratory response to extreme conditions like hypoxia, diving and exercise. Physiology of (mammals) and neural control of breathing
10	Excretory system : Osmoregulation, osmoregulators, Conformers, Obligatory exchanges of ions and water Osmoregulation in water and terrestrial environment. Physiology of mammalian and non – mammalian kidneys
11	Digestive system : Acquisition of Energy, Types of feeding, Digestion (motility and Secretions), Metabolism and absorption, Physiology of gastrointestinal system (mammals) including neural and hormonal regulatory mechanisms
12	Energetics of metabolism expenditure : Body size and metabolic rate, Energetics of locomotion, body rhythms and energetic, energetic of reproduction
13	Thermoregulation Temperature dependence of metabolic rate, determinants of body heat and temperature thermal biology of ectotherms, heterotherms and endotherms
14	Reproductive system, Asexual and sexual reproductive system, Gonads, gamets, Gametogenesis and hormonal control, Fertilization, Capacitation

Course Outcome(s)

1. To investigate the biological processes that occur for animal life to exist
2. These processes can be studied at various levels of organization from membranes through to organelles, cells, organs, organ systems, and to the whole animal.
3. A branch of biology, its focus is in how organisms, organ systems, organs, cells, and biomolecules carry out the chemical or physical functions that exist in a living system.

References:

1. ESSENTIAL OF ANIMAL PHYSIOLOGY BY S.C. RASTOGI,

2. ANIMAL PHYSIOLOGY AND RELATED BIOCHEMISTRY BY H.R.SINGH,
3. ANIMAL PHYSIOLOGY BY GOYALAND SHASTRY,
4. DR.P.B.REDDY'S, TEXTBOOK OF MEDICAL PHYSIOLOGY BY GUYTON AND HALL,

Semester - II Course - M.Sc. Life Sciences Course Title – Plant Physiology Code - L.Sc. -2007

Course Objective(s)

The learning objectives are

1. To educate student about the mechanism and physiology of processes of life in plants.
2. To focus on the plant nutrient uptake and translocation, plant environment continuum, photosynthesis, respiration and nitrogen metabolism.
3. To educate student about the various metabolic pathways leading to the formation of significant molecules and their catabolism. It focuses upon the vital role of each of these molecules in plants.

Marks - 50

S. No.	Topic
1.	Water relations : Properties of water, Properties of solutions, cell water potential, soil - plant – atmosphere continuum
2	Photosynthesis : Light absorption, emission, energy transfer, Z- scheme of photosynthesis, electron transfer, photo-phosphorylation, CO_2 fixation, C_3, C_4, CAM plants, Environment and its impact on photosynthesis
3	Respiration : Complex – I, complex – II, complex- III, complex- IV, Structure and function, Oxidative phosphorylation, Cyanide-resistant respiration
4	Photo - morphogenesis : Phytochromes, Cryptochromes, photo-morphogenesis
5	Transport processes in plant Active and passive transport system, ion channels, driving forces and flow, transport of nutrients across the primary root, transport through sieve element, transport of metabolites from the source to the sink, genetic regulation of transport systems in response to nutrients availability and growth status
6	Mineral nutrition and assimilations of inorganic nutrients : Plant – mycorrhiza association, nitrogen metabolism, sulfur metabolism, phosphate metabolism, calcium, metabolism, assimilation, cations, chloride dynamics
7	Lipid metabolism in plants : Fatty acid biosynthesis, membrane lipid biosynthesis, lipid desaturation, triacylglycerols, complex lipids, cell wall lipids, alkaloids, ceramides
8	Plant Hormones Introduction and concept types of growth regulators, Auxin : the master growth hormone, Avena coleoptiles bioassay, discovery of auxin, distribution in plants, roles, how auxin works ? Auxin mutants, auxin perception, auxin binding proteins, signal transduction, auxin-responsive genes/promoters/factors. Model for gene regulation, de – repression of early auxin genes Acid theory. Polar auxin transport – a chemiosmotic model, commercial uses of auxin
9	Gibberellins: Foolish seedling disease, functions of GAs, location, free vs. Conjugated Gas. How GA works ? signal transduction and mechanism of action of GAs taking alpha-amylase as an example, commercial applications
10	Cytokinins : location, functions and mechanism of action, Commercial applications
11	Ethylene ; discovery, locations and functions, mutants, mechanism of actions applications
12	Abscisic acid : a natural stress hormone, discovery, location function mutants – VPI, ABA and ABI, mechanism of action
13	Programmed cell death : hypersensitive response, functions, relevance with diseases, apoptosis, Caspases, Importance of PCD in plant development, role of PCD, model of PCD

Course Outcome(s) After this course, the students would be able

1. to underst the various physiological life processes in the plants.
2. To gain insights about the various uptake and transport mechanisms in plants and understand the various processes.
3. To understand the role of various hormones, signalling compounds, channel or transport proteins involved in nutrient

uptake in plants.

4. To enrich themselves with the phenomenon of metabolism of primary and secondary metabolites and their role in plants.

References:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

M.Sc. Life Sciences IInd Semester Course Title – Life Sciences Practicals - II Code - L.Sc. -2008

Marks - 100

S. No.	Topic
1	Building of a model of B-DNA
2	Preparation of competent E coli cells
3	Transformation of competent E coli cells with plasmid DNA
4	Isolation of plasmid DNA and agarose gel electrophoresis of DNA
5	Restriction enzyme digestion of DNA
6	Polymerase Chain Reaction (PCR) of DNA
7	Expression of foreign protein in E coli
8	Lytic growth of bacteriophage lambda
9	Plant tissue culture I
10	Plant tissue culture II
11	Plant tissue culture III
12	Basic techniques in animal tissue culture
13	Immunology experiment I
14	Immunology experiment II
15	Immunology experiment III
16	Microbe symbiosis experiment
17	Infectious organisms : demonstrations (Microscopic) Candida, Leishmania, Plasmodium, Entamoeba
18	Plant physiology I
19	Plant physiology II
20	Plant physiology III
21	Plant physiology IV
22	Electrophysiological recordings : action potential, EEG, etc.

M.Sc. Life Sciences Semester — III

M.Sc. Life Sciences III[rd] Semester Course Title – Animal Developmental Biology Code - L.Sc. -3001

Course Objective(s)

The aim of the is for each student

1. To develop knowledge of the principle of animal developmental biology with latest concepts with research development in different animals.
2. To understand the principle of developmental biology with basics of cell signaling
3. To learn the phenomena of experimental developmental biology
4. Finally with this study students will know about the applications of developmental biology which beneficial in birth control, genetic disorder, cell diseases and their remediation.

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Marks : 50

S. No.	Topic
1	Principles of Developmental Biology Questions and approaches in developmental biology, Evolution of developmental patterns, Principles of experimental embryology, Genomic
2	Signaling cascades involved in the control of developmental programme with specific examples
3	Early embryonic development Cleavage -Types and mechanism, Gastrulation - movements involved, Cell specification with respect to amphibian, chick
4	Phenomenon of the Organizer with respect to amphibians: Progressive determination, Regional
5	Pattern formation. French flag model, Polar coordinate model
6	Regeneration: Epimorphic e_g salamander limbs, Morphalactic e g Hydra. Compensatory e.g mammalian liver
7	Tetrapod limb development, Axes formation, Coordination of the three axes
8	*Dictvostelium discoideurn* as a model organism Life cycle, Pattern formation, cAMP signaling during development
9	*C. elegansas* as a model system: Invariant cell lineage, Vulva! development, sex determination
10	*Drosophila* as a model system: Anterior/posterior, Dorsal/ventral polarity development
11	Applications of Developmental Biology
12	Programmed cell death apoptosis, autophagy and necrosis

Course Outcome(s)

The students shall be capable to understand

1. how an organism develops
2. how a single cell becomes an organized grouping of cells.
3. all aspects of plant and animal development, including stem cell biology and regeneration.

Reference Books:

1. Biologia Del Desarrollo/ Developmental Biology by Scott F. Gilbert,
2. Chordate embryology By Verma and Agarwal,
3. Cell and developmental biology by Shastry, Tomar and Singh,
4. Elements of Developmental biology by P.C.Jain

M.Sc. Life Sciences IIIrd Semester Course Title – Plant Developmental Biology Code - L.Sc. -3002

Course Objective(s)

This course aims at making the students

1. Acquainted with the fundamentals and present understanding of the mechanisms associated with development, differentiation and structure of various plant organs, the metabolic and physiological changes occurring in them
2. Learn the analysis of mutants that have helped establish roles of various genes in promoting, regulating or suppression the function.

Marks - 50

S. No.	Topic
1	Model plants for developmental biology· Introduction of model plants used for development studies in plant system, advantages of each system with special emphasis on model plant Arabidopsis
2	Terms and tools Cell division, planes, cell autonomy, cell polarity, radial/bilateral symmetry, pattern formation, abaxial-adaxial identity, cell lineage vs cell position, meristem, determinant vs indeterminant meristem, cell ablation technique, temporal and spatial expression of genes, in situ hybridization, interacting genes and their position in respect to signaling pathway, targeted mutagenesis in plants, mutant generation and identification of the gene
3	Reproduction Male and female gametophyte development, genetic and hormonal regulation of reproduction, pollination and fertilization
4	Seed formation and germination: Seed formation, cotyledon, endosperm and seed coat development. Seed dormancy and germination, seedling development, genetic regulation of vernalization
5	Embryogenesis Basic layout of dicot and monocot embryos, stages of embryo development, embryonic axis, cell division and pattern formation in embryo, genetic and hormonal regulation of embryo development, cell polarity in embryo
6	Shoot development: Structure and function of shoot apical meristem (SAM), initiation and maintenance of SAM, regulation of meristem size, antagonism between SAM and lateral organs, genetic regulations, axial bud formation, shoot branching
7	Leaf development Emergence of leaf primordium from SAM, abaxial and adaxial identity of leaf cells, leaf margin, trichome, epidermis and stomata development, vascular differentiation
8	Root development: Root apical meristem structure and function, lateral root development, lateral and adventitious root development, root hair development, hormonal regulations in root development
9	Flower development: Transition from vegetative to reproductive stage, inflorescence meristem, floral whorls specification, ABC model and beyond, whorl boundary specification, asymmetric flower development, structure and development of monocot flowers
10	Use of in vitro system for studying development

Course Outcome(s)

After this course, student will develop the

1. Understanding of growth, development and reproduction in plants as well as understand the physiological and metabolic changes happening along with the environmental impact.
2. Will enable students to understand various commercialised applications for improving many aspects of plants.

References:

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.

3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, NY, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA

M.Sc. Life Sciences IIIrd Semester Course Title – Computational Biology & Bioinformatics Code - L.Sc. -3003

Course Objective(s)

1. To impart knowledge to students on the most import skill which is required in this era for any scientific worker.
2. To cover the era of computerized biology information, review of relevant definitions in molecular biology, overview of challenges of molecular biology and genomics and proteomics.
3. To familiarize students with basics of computer system, hardware, software, and networking.
4. To provide students with the structural and functional details of biomolecules especially proteins and nucleic acids.
5. To get the confidence to use computer programs for the daily design of experiments, data collection, and analysis of results. The mandatory hands-on exercises on the computer applications.

Marks - 50

S. No.	Topic
1	**Introduction to Bioinformatics and Computational** Biology with historical background, major developments, Operating systems, Linux commands, File transfer protocols ftp and telnet, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL), Data types. scalars and collections, operators. Program control flow constructs, Library Functions String specific functions, User defined functions, File handling
2	Biological databases, Biological sequences, Genome specific databases, data query and data mining, Boolean operators; Problems and Applications to biological problems
3	Nucleic acid sequence analysis, alignment, similarity searches including remote similarity searches, secondary structure elements, motifs, Sequence Analysis, Pair-wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms
4	Protein sequence analysis; alignment, similarly searches including remote similarity searches, secondary structure elements, motifs, Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction,Peptide mass fingerprinting
5	Genomics and annotation, Applications of informatics techniques in genomics and proteomics: Assembling the genome_STS content mapping for clone contigs
6	RNA, secondary structure, small non-coding RNAs
7	Evolutionary analysis; use of the PHYLIP package, tree construction, Introduction to phylogenetics, Distance based trees, UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping

Course Outcome(s)

1. This paper will lead to make students understand about the fundamentals of computer systems, hardware and software which will be utilized in learning the advances of the course.
2. The course will make students advanced in understanding the molecular interactions inside cell especially the structural details of protein and nucleic acids.
3. Students will specifically gain knowledge about the genomic and proteomic tools and techniques for understanding intermolecular interactions.
4. Students will be able to develop training in the field of Bioinformatics with specific emphasis for fulfilling expectations of Pharmacy,Chemical and Biotech industry.

Reference Books:

1. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, NY, USA.

2. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, US.
3. P. K. Sinha, P. Sinha. Foundation of Computing. BPB Publications.
4. S. Harisha. Fundamentals of Bioinformatics. I.K. International Publications, New Delhi.
5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi.
6. M. Campbell & L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, CSHL Press.

Optional (Any Four)

M.Sc. Life Sciences IIIrd Semester Course Title – Biostatistics **Code - L.Sc. -3004**

Marks - 75

S. No.	Topic
1	Introduction. Applications of statistics in biology, definitions (populations, samples), Introduction to probability theory, Basic concepts, definitions to understand probability and sampling; Defining sample space, computing probability
2	Random variables and probability distributions Discrete random variables, Bernoulli random variable, binomial distribution, Poisson distribution with examples, Continuous random variables, Normal random variable, other continuous distributions. Central limit theorem
3	Summary statistics measures of location and spread Measures of location Arithmetic and other means, median, mode; when to use each measure of location, Measures of spread Variance and Standard Deviation, Standard Error, Skewness, Kurtosis, Quantiles, Outliers
4	Framework for statistical analyses Framing hypothesis, The scientific method; deduction **and** induction; The Hypothetico-deductive method, Testing hypothesis, Significance and p-values; Type **I** and Type II errors, Introduction to frameworks for statistical analyses, Brief introduction to three main frameworks. Monte-carlo analysis, Parametric analysis, Bayesian analysis
5	Study design Experiments & Replication: Addressing spatio-temporal variation: treatments vs. gradients, testing hypothesis, experiments - natural vs manipulative; replicates, sample size, independence, Experimental Design, Regression design (for continuous predictors, gradients, randomization); ANOVA designs (Randomized block designs, Nested designs, Multi-factor designs)
6	Data Analyses Computing sums of squares, standard error of differences between means, T-test, Regression, Fitting data to a linear model, Variances and co-variances; least-square parametric estimates, Hypothesis test with regression; Assumptions, Analyses of variance, ANOVA and Partitioning of Sum of Squares, Assumptions, Hypothesis tests with ANOVA, Constructing F-Ratios; ANOVA tables, Analyses of categorical data, Two-way contingency tables; Chi- square and G-Test

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic Geometry, 9th Edn, ISE Reprint, AddisonWesley, 1998.
2. E. Kreyszig, Advanced engineering mathematics, 8th Edition, John Wiley, 1999.
3. W.E. Boyce and R. DiPrima, Elementary Differential Equations, 8th Edition, John Wiley, 2005.

M.Sc. Life Sciences IIIrd Semester Course Title – Molecular Genetics & Genetic Engineering Code - L.Sc. -3005

Course Objective(s)

1. To demonstrate the innovative utilization of manipulating enzymes, various cloning and expression vectors and analysis of genomic sequences.
2. To interpret the applications of genetic engineering in biotechnological research.
3. To educate the students in strategizing research methodologies employing recombinant DNA techniques.

Marks - 75

S. No.	Topic
1	Gene· Concept, Structure and Organization
2	Transcriptional control regions of eukaryotic and prokaryotic genes
3	Restriction and Modifying enzymes
4	Cloning Vectors - Plasmids, phage vectors, yeast vectors, artificial chromosomes
5	cDNA synthesis and construction of cDNA libraries
6	Genomic libraries and their construction
7	Identification and analysis of recombinant DNA clones
8	DNA sequencing methods
9	Genome Sequencing and Analysis
10	Methods to study gene expression
11	**PCR** and its application
12	Generation of mutation and mutants. Random mutations, Targeted mutations
13	RNA interference and gene silencing, gene knockouts
14	Transgenic systems, genome editing

Course Outcome(s)

The students shall

1. Recall the principles of genetic engineering and the vectors used in cloning, methods of introduction of gene and expression
2. Appreciate the different cloning strategies and their expression
3. Know about implementation of genetic engineering for different purposes
4. Investigate the different strategies of recombinant DNA technology and resolve the problems encountered

Reference Books:

1. Krebs JE, Goldstein ES and Kilpatrick ST (2014) Lewin's Gene XI, Jones and Barlett Publishers.
2. RF Weaver Molecular Biology, 5th edition (2012) McGraw Hill Higher Education
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M & Losick R (2014) Molecular Biology of the Gene, 7th Edition, Cold Spring Harbor Laboratory Press, New York.
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

M.Sc. Life Sciences IIIrd Semester Course Title – Molecular Cancer Biology Code - L.Sc. -3006

Course Objective(s)

1. To provide basic knowledge of cancer genomics;
2. To become familiar with relevant technologies, public databases and informatics methods that is used to determine driver mutations and oncogenic pathways
3. To provide the rationale for personalized cancer treatment;
4. To provide basic information regarding underlying biology of common cancers.

Marks - 75

S. No.	Topic
1	Introduction to cancer, cancer incidence and mortality; origin of neoplastic cells; cancer as cellular disease; tumor cell growth kinetics
2	Oncogenes and tumor suppressor genes
3	Environmental carcinogens; carcinogen metabolism
4	Chemical carcinogenesis; initiation, promotion and progression
5	Mechanism of ultraviolet radiation carcinogenesis (melanoma and non-melanoma skin cancer)
6	Animal models of cancer research; a thymus nude mice model; syngeneic mouse model, transgenic mouse model etc.
7	Heredity and cancer; genetic basis of carcinogenesis (e.g. APC mutation and colon cancer)
8	Viral carcinogenesis mechanism
9	immunological aspects of cancer; leukemia
10	Deregulated cell cycle progression in cancer
11	Aberrant cell signaling in cancer
12	Anti-apoptotic mechanisms for the survival of cancer cells
13	Tumor angiogenesis and its molecular mechanisms
14	Mechanisms of cancer invasion and metastasis
15	Cancer therapeutics: surgery, radiation and chemotherapy
16	Chemoprevention of cancer

Course Outcome(s)

1. Understanding genomic basis of cancer
2. Explaining key technologies and interact with public databases;
3. Understanding biology of various cancers and role of environment in carcinogenesis.

Reference Books:

Graham Dellaire, Jason N. Berman and Robert J. Arceci, (2013), Cancer Genomics: from Bench to Personalized Medicine, 1st Edition; Academic Press.

M.Sc. Life Sciences IIIrd Semester Course Title – Virology **Code - L.Sc. -3007**

Course Objective(s)

1. To impart knowledge to students about different microbes living in specific niche especially the viruses.
2. To give an overview of the important virus families, their replication strategies and mechanisms for development of viral infectious diseases.
3. To learn taxonomy, replication strategies, pathogenicity and transmission of viruses and, diagnosis, prevention and treatment of viral diseases.
4. To emphasise on common human viral infections and virus-host interactions as a key to understanding the diversity of viruses and viral diseases.
5. To cover topics on antiviral immunity and viral evasion and vaccine development.

Marks - 75

S. No.	Topic
1	Origins of virology, viruses as a living system etc
2	Classification of viruses
3	Organization of viruses Protein structure and assembly, nucleic acid packaging, geometrical aspects, icosahedral and helical symmetry
4	Virus attachment and entry in to host cells
5	Cellular and molecular biology of Host virus interaction
6	Genome replication and mRNA production by RNA viruses
7	Reverse transcription and integration in to the host genome (retroviruses)
8	DNA virus replication strategies
9	Unique features of viral gene expression
10	Translational control of viral gene expression
11	Viral pathogenesis and cell transformation by viruses
12	Viral Genetics, Viral vaccines, Antiviral chemotherapy, Persistence of viruses
13	Hepadnaviruses, HIV, Polyomaviruses (SV40), Baculovirus, Topsoviruses, Potyviruses
14	Virus evolution
15	Viral vectors and gene therapy

Course Outcome(s)

The course will provide students

1. The knowledge about the elements of the viral life cycle.
2. Explain the rationale behind the Baltimore classification system of viruses and present example viruses for each Baltimore group.
3. Explain viral replication strategies; and compare and contrast replication mechanisms used by viruses relevant for human disease.
4. Will learn about the host antiviral immune mechanisms at a cellular and molecular level and will able to describe viral strategies to evade host immune and cellular factors.
5. Will learn about the vaccine strategies and mechanisms of antiviral drugs.

Reference Books:

1. Flint S.J., Enquist L.W., Racaniello V.R., Skalka A.M. “Principles of Virology”, ASM Press.

2. David M. Knipe, Peter M. Howley, Diane E Griffin, Robert A Lamb, Malcolm A Martin, Bernard Roizman and Stephen E, "Fields Virology", Lippincott Williams & Wilkins.
3. Basic Virology" Edward K. Wagner, Martínez J. Hewlett, David C. Bloom, David Camerini., Wiley-Blackwell.
4. "Understanding viruses" Teri Shors. Burlington: Jones & Bartlett Learning, cop.

M.Sc. Life Sciences IIIrd Semester Course Title – Advanced Microbial Physiology Code - L.Sc. -3008

Marks - 75

S. No.	Topic
1	Host Microbe Interaction· Biochemical. Physiological. Genetic aspects of symbionts, Physiology and Molecular Biology of Symbiosis Molecular taxonomy of microorganisms
2	Advanced Bacterial Metabolism: Recent Advances in bacterial metabolism will be covered with emphasis on unusual bacterial pathways
3	Stressors, Stress reactions and Survival of bacteria. Prokaryotic responses to Environmental stress: Heat shock and molecular chaperones. Oxidative stress Hydrostatic stress. Osmotic shock Cross responses to stress factors
4	Quorum sensing in Bacteria Gram negative bacteria: LUXA/LUXB -Type: Gram Positive bacteria: Peptide mediated Quorum sensing
5	Signal Transduction Mechanisms in bacteria with special emphasis on Caulobacter development and cell cycle control
6	Interactions between Humans and microorganisms. Non-specific and specific defense mechanisms. Mechanisms of pathogenesis host factors influencing resistance to infection
7	Physiology of growth: Growth kinetics. Regulation. Effect of Environmental factors on growth e.g., pH, Temperature, Oxygen, Nutrient limitations etc
8	Physiology and vaccine development: Use of proteomics and genomics and physiology for the development of vaccine of specific microorganisms
9	Environmental Microbiology Microbial degradation of xenobiotics , Catabolic genes and their regulation Biomaterials Isolation Production Characterization and its use
10	Industrial Microbiology The application of fundamental principles of microbiology to industrial Fermentations and processing. Antibiotics production etc.

Reference Books:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

M.Sc. Life Sciences IIIrd Semester Course Title – Neurophysiology **Code - L.Sc. -3009**

Course Objective(s)

1. To provide the student with neuro-physiological principles, concepts and mechanisms useful for understanding the nervous system and its aberrations in pathologies that impact upon the functioning of the individual.
2. To understand the function of major brain structures and will have learned signs and symptoms of some important neurological disease processes that illustrate principles of brain function

Marks - 75

S. No.	Topic
1	Neuron, glia, structure and function general, ionic distribution, transmembrane potential, membrane, lipids, myelination, channels, receptor, action potential generation, propagation, synapse, neurotransmitter release, axoplasmic transport
2	Neurotransmitter synthesis and its regulation, receptor type, properties, second messengers
3	Coding of information, sensation, adaptation, denervation, hypersensitivity, sensitization
4	Reflex, properties, types, myotatic reflex, conditioned and unconditioned reflex, learning, motor control and decerebrate rigidity, injury to brain
5	Development and evolution of brain, organization of nervous system anatomy, cyto-architecture; brainstem, cerebrum, cerebellum, reticular formation, cortex; spinal cord, vertebral column, CSF, blood brain barrier, touch. pain. heat. itch etc
6	Methods to study, sympathetic and parasympathetic nervous system; ascending and descending tracts
7	Gross to cellular study stimulation lesion, unit studies, anatomical, histological, biochemical, micro-dialysis, micro-iontophoresis, molecular studies, in vivo and in vitro cell culture studies

Course Outcome(s)

The students will be able to

1. Describe neuro physiological concepts, principles and mechanisms underlying normal functioning and explain their relationships to normal and pathological functioning of the individual
2. Identify key components of the etiology, the epidemiology and the clinical characteristics of common neurological conditions associated with malfunctioning of brain structures and appreciate factors leading to a differential diagnosis
3. Identify key components of the medical treatment, surgical interventions and rehabilitation associated with common neurological conditions and understand the impact of such treatment on the functional outcome of clients

Reference Books:

1. Principles of Neural Science by Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell
2. Fundamental Neuroscience by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell
3. From Neuron to Brain by John G. Nicholls, A. Robert Martin, Bruce G. Wallace, Paul A. Fuchs.
4. Development of the Nervous system by Dan H. Sans, Thomas A. Reh, William A. Harris
5. The Central Nervous System: Structure and function by Per Brodal
6. Textbook of Medical Physiology by A C Guyton.

M.Sc. Life Sciences IIIrd Semester Course Title – Enzymology and Enzyme Technology Code - L.Sc. -3010

Marks - 75

S. No.	Topic
1	**Structure and Function of Enzymes:** A Brief history of enzymology, relationship of enzymology with other sciences Structure of enzymes, Monomeric and oligomeric enzymes, cofactors, metal ions and coenzymes, enzymes, abzymes, ribozymes. Hypotheses of enzyme substrate interaction Active sites of enzymes, specificity of enzyme action, Types of specificity E C. Classification of enzymes. oxidoreductases, transferases, hydrolases, lyases, Isomerases, ligases, Multifunctional enzymes. K cat, Enzyme unit, specific activity, unit of enzyme activity Solution of practical problems
2	**Principles of Enzyme Kinetics :-** Basic principles of chemical catalysis covalent catalysis, General Acid Base catalysis, metal ion catalysis Co-ordinated catalysis
3	**The Steady-State Kinetics of an enzyme catalyzed reaction:** Michaelis and Menten, van Styke Cullen, Brigs, Haldane works, the main principle of steady state **The Kinetic of single substrate enzyme reactions: The** initial reaction state and substrate concentration relationship, Deviation of steady state rate equation. The method of king and Altman. Kinetics of two substrate enzyme reaction kinetics of allosteric enzymes. Enzyme inhibition reversible and irreversible inhibitions Competitive noncompetitive uncompetitive and mixed enzyme inhibition. **Regulation of enzyme activity:** Partial proteolysis covalent modification, allosteric regulation, The dependence of enzyme activity on temperature and pH.
4	**Application of Enzymology :** Enzyme extraction and purification alternative enzymes , enzyme engineering and modeling, Enzymes in industry and medicine, Enzyme immobilization-techniques and applications

Reference Books:

1. Stryer, L. (2015). Biochemistry (8th ed.). New York: Freeman.
2. Lehninger, A. L. (2012). Principles of Biochemistry (6th ed.). New York, NY: Worth.
3. Voet, D., & Voet, J. G. (2016). Biochemistry (5th ed.). Hoboken, NJ: J. Wiley & Sons.
4. Dobson, C. M. (2003). Protein Folding and Misfolding. Nature, 426(6968), 884-890. doi:10.1038/nature02261.
5. Richards, F. M. (1991). The Protein Folding Problem. Scientific American, 264(1), 54-63. doi:10.1038/scientificamerican0191-54**.**

M.Sc. Life Sciences IIIrd Semester Course Title – Pluripotent Stem Cells & Reproduction Code - L.Sc. -3011

Course Objective(s)

This course aims

1. To acquaint with the properties and understanding of stem cells. Role and niche of stem cells in various systems and control mechanisms.
2. To learn derivatization, trans differentiation, induced pluripotency and different in vitro technologies for better control on stem cells.

Marks - 75

S. No.	Topic
1	Introduction Stem Cells, embryonic stem cells in vitro fertilization and pre-implantation genetic diagnosis, adult stem cells, homeostasis and regenerative medicine, the microenvironment, its role in cell fate decisions and cancer, the immune system and the hematopoietic stem cell lineage tree, developing induced pluripotent stem cells
2	Pluripotent stem cells, types - totipotent, multipotent, oligopotent and unipotent
3	Stem Cell Engineering· Principle and applications, embryonic stem cells, deviation and culture of ES cells, genetic engineering and reprogramming of stem cells, iPS cells
4	Stem cell niches and overview of cell signaling, stem education, Trans-differentiation, Growth Factors and Paracrine mechanism and action of stem cells, and trans-differentiation of stem cells, regulation of stem cell niche in different adult tissues, charaterizaion and use of specific adult stem cells, development of instructive biomaterials, commercialization of stem cell based therapies
5	Molecular facets of pluripotency, mechanism of self renewal and differentiation, ES cell cycle control, Somatic cell nuclear transfer technology, Induced pluripotent stem cells, Stem cell origin of cancer. Cancer stem cells,Pathways involved in stem cells and cancer stem cells
6	Bone marrow microenvironment, Hematopoietic stem cell mobilization and differentiation, mesenchymal stem cells and their properties, Hematopoietic and mesenchymal stem cells: Isoaltion, ex vivo expansion, characterization, transcription regulation and differentiation, Side population phenotypes, endothelial progenitor cells, Multipotent adult progenitor cells, Differentiation of stem cells in-vivo and ex-vivo, Differentiation of mesenchymal stem cells into osteoblast, adipocyte, chondrocyte lineages, Transdifferentiation of mesenchymal stem cell into various lineages, differentiation into endothelial cells and stem cell mediated angiogenesis
7	Stem cells in treating various diseases, Mechanism of treatment and their regenerative ability, Pre-clinical and clinical applications of stem cells, chemokine reactions, cause of success and failure in treatment, stem cells and tissue engineering: Its applications Politics, religion and moral/ ethical issues

Course Outcome(s)

After this course, student will

1. Develop the understanding of stem cells, types of stem cells, describe the medical uses for stem cells.
2. Learn the properties that defines a stem cell? Different types of stem cells, usage of stem cells to understand and treat diseases. Methods of production and maintenance of stem cells with biological niche.

Reference Books:

1. Knoepfler, Stem Cells: An Insider's Guide, World Scientific Publishing Company
2. Harris J. Quigley M. Chan S., Stem Cells: New Frontiers in Science & Ethics, World Scientific Publishing Co Pte Ltd

M.Sc. Life Sciences IIIrd Semester Course Title – Ecology and Biodiversity **Code - L.Sc. -3012**

Course Objective(s)

Students will learn

1. Ecology with its levels of ecological research
2. To recognize the value and interaction in between abiotic and biotic components the relationship between abiotic and biotic components of the environment
3. To elaborate the conservation of biological diversity; the sustainable use of the components of biological diversity.

Marks : - 75

S. No.	Topic
1	General Ecology **and** Ecological considerations
2	Ecology of individual organisms, population ecology, community ecology, ecosystem ecology
3	Bio-diversity, spatial and temporal dimension,
4	Bio-diversity and Population Biology,
5	Theoretical aspects **of** Genetic Issues at population level
6	Fragmentation of Habitat: Consequences for Ecology and Biodiversity
7	Eco-functions of Biodiversity at Community/Eco-system/Landscape Level
8	Inventorying & monitoring of Biodiversity.
9	Conservation of Biodiversity, Problems in Protected Areas
10	Problems of Rehabilitation of Degraded Ecosystems
11	Problems and Principles of In situ and Lx Situ Biodiversity conservation.
12	Biodiversity anti agriculture/Fisheries Development.
13	Biodiversity and Industrial Development
14	Biodiversity conservational Practices and Ethnic Cultures
15	Biodiversity and Global natural and cultural changes.

Course Outcome(s)

1. Capacity for scientific studies by human beings in search of social and economic benefits.
2. Apply the knowledge for Genetic biodiversity (study at gene level). Species biodiversity (study of varieties of species in nature)
3. Manage wildlife, ecosystem, water conservation and sustainable development.

Reference Books:

1. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Pandit, M.K. & Grumbine R.E. 2012. Ongoing and proposed hydropower development in the Himalaya and its impact on terrestrial biodiversity. Conservation Biology 26:1061-1071.
4. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.
5. Basic Ecology By E.P. Odum,
6. Environmental Biology By P.D. Sharma,

7. Environmental Biology And Toxicology By P.D.Sharma,
8. Ecology And Environmental Science By Singh And Kumar

M.Sc. Life Sciences Semester — IV

Optional Courses (any three)

M.Sc. Life Sciences IVth Semester Course Title – Neural And Behavioural Biology Code - L.Sc. - 4001

Marks - 75

S. No.	Topic
1	Special senses, Vision optics, anatomy, transduction of light to electrical energy, Neurophysiology of vision, accommodation, errors, of vision, color vision, visual acquity, visual perception
2	Hearing anatomy, neurophysiology of hearing
3	Neural regulation of body temperature, cardiovascular function, respiration, Neuroendocrine regulation, basis of neuroimmune control, interleukin, etc
4	States of consciousness—sleep-wakefulness behavior, identification, classification of sleep-wakefulness, EEG, EOG, EMG, Neural and neuro-chemical regulation of sleep-wakefulness, effects of sleep loss, functions of sleep, relation of sleep-wakefulness with other functions, biorhythm, clock/per gene regulation
5	Feeding, social, colony formation, hibernating, migratory behaviors
6	Aggression, fight and flight behaviors, stress and adaptation - neural Control
7	Neurogenetics, Narcolepsy, Down's syndrome
8	Ageing, factors affecting, Depression, Schizophrenia, epilepsy, Parkinson's Alzheimer, Neural Modeling/ artificial intelligence/ neural network

Reference Books:

1. Principles of Neural Science by Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell
2. Fundamental Neuroscience by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell
3. From Neuron to Brain by John G. Nicholls, A. Robert Martin, Bruce G. Wallace, Paul A. Fuchs.
4. Development of the Nervous system by Dan H. Sans, Thomas A. Reh, William A. Harris
5. The Central Nervous System: Structure and function by Per Brodal
6. Textbook of Medical Physiology by A C Guyton.

M.Sc. Life Sciences IVth Semester Course Title – Plant Biotechnology Code - L.Sc. – 4002

Course Objective(s)

1. To make students understand about the basics of plant science
2 .To equip students with culture techniques and scope of plant biotechnology
3. To provide knowledge on genetic engineering in the improvement of plants for human welfare

Marks - 75

S. No.	Topic
1	Plant Tissue Culture Historical perspective, Totipotency, isolation, maintenance and cultivation of cell cultures, Organogenesis, Somatic embryogenesis, Regulation and applications, Artificial seed production
2	Micropropagation, meristem and shoot tip culture, Production of virus-free plants
3	Somaclonal variation, induction and selection of mutants, disease-, herbicide- and stress tolerant mutants
4	In vitro pollination and fertilization, Embryo culture, and their applications in plant breeding.
5	Haploid production, Androgenesis and gynogenesis, and its applications in genetics and plant breeding
6	Protoplast Culture and Somatic Hybridization, Protoplast isolation, Culture and usage, Somatic hybridization — methods, selection and characterization, and application; Cybrids and somatic cell genetics.
7	Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds, strategies for enhancing secondary metabolite production from cultured cells.
8	Germplasm conservation and cryopreservation.
9	Agrobiology: Agrobacterium-plant interaction, Virulence; Ti and Ri Plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid. Genetic Transformation, Agrobacteriummediated gene delivery; Co-integrate and binary vectors and their utility; Direct gene transfer- PEG-mediated, electroporation, particle bombardment and alternative methods
10	Screenable/Scorable and Selectable markers, Characterization of transgenics; Chloroplast transformation; Marker-free methodologies, Gene targeting.
11	Molecular Mapping & Marker Assisted Selection (MAS), Quantitative and qualitative traits, MAS for genes of agronomic importance, Molecular polymorphism, RELP, RAPD, STS, AFLP, SNP markers, Construction of genetic and physical map; Gene mapping; QTL mapping
12	Strategies for introducing Biotic and Abiotic Stress Resistance/Tolerance Bacterial resistance; Viral resistance; Fungal resistance, Insects and pathogens resistance; Herbicide resistance, Drought, salinity, thermal stress, flooding and submergence tolerance, Terminator seeds
13	Plants / Plant cells as Biofactories, Concept of biofactories; Fermentation and production of industrial and pharmaceutical biomolecules

Course Outcome(s)

The students shall be able to:

1. demonstrate knowledge for in-depth analytical and critical thinking to identify, formulate and solve the issues related to Biotechnology Industry, Pharma industry, Medical or hospital related organizations, Regulatory Agencies, & Academia.
2. appreciate and execute their professional roles in society as biotechnology professionals, employers and employees in various industries, regulators, researchers, educators and managers
3. establish different types of plant cultures.
4. apply the technical skills learnt to establish nurseries for horticultural and agricultural crops.
5. compare the pros and cons of transgenic plants on environment
6. explain the concepts of intellectual property management and handling of GMOs.

Reference Books:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.

3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

M.Sc. Life Sciences IVth Semester Course Title – Molecular Parasitology Code - L.Sc. – 4003

Course Objective(s)

The course

1. Will provide general concepts of parasitology, knowledge of some parasitic diseases that could be transmitted between animal and man.
2. Will provides a knowledge about how to protect man and domestic animals from parasites, the different biological interrelationship and the host parasite relationship, during the course students studies parasitic and their relation to their host environment.

Marks - 75

S. No.	Topic
1	Introduction to Protozoan parasites *Entamoeba histolynca* and other amitochondriates; Kinetoplastids including Leishmania and Trypanosomes, Apicomplexans e.g. Plasmodium, *Toxoplasma gond",* Helminthes and nematodes
2	Peculiar organelles of Protozoa cytoskeleton, mitotic spindle, glycosomes, hydrogenosomes
3	Chemotherapeutic targets in protozoan parasites Properties of an effective drug, Classes of drugs, Mechanism of action of drugs
4	Drug Resistance and mechanism in protozoan parasites
5	Host-parasite interactions and Antigenic variation and host evasion
6	Virulence factor in protozoan parasite
7	Genomic organization, transcription, splicing and gene regulation in parasites. Chromosomal, Extra chromosomal
8	Functional genomics of parasites
9	Novel molecular mechanisms in parasites, Replication of kDNA and RNA editing
10	Diagnostic s
11	Immuno-pathogenic mechanism- Innate immunity, functions of complements, receptors for innate immunity, toll like receptors, Adaptive immunity, role of cytokines etc
12	Vaccine targets

Course Outcome(s)

1. Knowledge to identify parasitism, parasites and their examples.
2. Describe disease of mode of diagnosis, control of parasites infections, understanding parasites host relationship student become right use of microscopes, using computer and internet, conducting documentary
3. About some parasites throw out the kingdom.
4. Helpful to develop the ability to work as a member of team to conduct a specific project

Reference Books:

1. KC Carroll, SA Morse, T Mietzner, S Miller. (2016), Jawetz, Melnick and Adelbergs's Medical Microbiology, 27th edition, McGraw Hill.
2. J Owen, J Punt and Sharon Stranford; (2012), Kuby Immunology, 7th edition W.H. Freeman and Co.
3. IT Kudva, NA. Cornick, PJ Plummer, Q Zhang, TL Nicholson, JP Bannantine and BH Bellaire. (2016), Virulence Mechanisms of Bacterial Pathogens, 5th edition, ASM Press.
4. V Kumar, AK. Abbas and JC Aster, (2015), Robbins & Cotran Pathologic Basis of Disease, 9th Edition, Elsevier.
5. K Murphy and K Weaver, (2016), Janeway's Immunobiology, 9th Edition, Garland Science.
6. AK Abbas, (2015), Cellular and Molecular Immunology, 8th Edition, Elsevier.

7. Ananthanarayan and Paniker, Textbook of Microbiology, 8th Edition.
8. Baveja CP, Textbook of Microbiology.

M.Sc. Life Sciences IVth Semester Course Title – Radiation Biology Code - L.Sc. – 4004

Marks - 75

S. No.	Topic
1	interaction of radiation with matter. Different types of radiation. Ionization and excitation. Linear energy transfer, Direct and indirect effects of radiation, Radiation chemistry of water
2	Biological effects of radiations· Whole body irradiation and sensitivity of tissue, Units of radiation measurement, Radiation levels and limits
3	Cell Survival curves reproductive integrity, mechanism of cell killing, survival curves in mammalian cells
4	Radio-sensitivity and cell cycle: Variation of sensitivity with cell age, effect of X-rays and high LET radiations, possible implications in radiotherapy
5	Heritable effects of radiations Chromosomal and chromatid aberrations, point mutations Mendelian, chromosomal and multi- factorial diseases, genetic risk assessment, doubling dose, mutation component
6	Modification of radiation induced damage, Radiosensitizers, Radio-protectors, Normal tissue radioprotection, Mechanisms of action, sulfhydryl compounds, WR series, dose reduction factor (DRF)
7	Non-targeted effects of radiations. Bystanders effects, chromosomal instability, adaptive response
8	Mechanisms for the repair of DNA, Repair of DNA breaks, Repair of base damage photo reactivation, excision repair, post-replication recovery, Base excision repair, nucleotide excision repair (NER), transcription coupled repair (TCR) and bulk DNA repair
9	Radiation induced signaling pathways: Radiation induced gene expression, Signaling abnormalities in cancer. Effects of signaling abnormalities on radiation responses
10	Radiation carcmogenesis Initiation, promotion, progression, Dose response for radiation induced cancers, Importance of age at exposure and time since exposure, Second tumors in radiation therapy patients

Reference Books:

1. Kenneth Chadwick (2020) Understanding Radiation Biology: From DNA Damage to Cancer and Radiation Risk.
2. C.S. Sureka, Christina Armpilia (2017) Radiation Biology for Medical Physicists
3. John T. Lett & Howard Adler (2013) Advances in Radiation Biology: Kindle Edition, Academic Press

M.Sc. Life Sciences IVth Semester Title – Redox Biology **Code - L.Sc. – 4005**

Course Objective(s)

This course aims at making the students

1. Acquainted with the components of redox reactions.
2. Learn about the basics of redox biology, the importance of the response in photosynthesis, and mitochondrial oxidative phosphorylations.
3. Understand Biological Systems Relevant for Redox Signaling and Control Cellular generation of Oxidants: Relation to Oxidative Stress
4. Aware of the Chemical Basis of Biological Redox Control Protein Glutathiolation Structure and Function of the Human Peroxiredoxin-Based Antioxidant System: the Interplay between Peroxiredoxins, Thioredoxins, Thioredoxin Reductases, Sulfiredoxins and Sestrins,
5. Hydrogen Peroxide and Cysteine Protein Signaling Pathways Protein Tyrosine Phosphatases as Mediators of Redox Signaling Oxidative Stress and Apoptosis Redox Regulation of Apoptosis in Immune Cells Redox Control in Human Disease with a Special Emphasis on the Peroxiredoxin-Based Antioxidant System Free Radicals and Mammalian Aging.

Marks - 75

S. No.	Topic
1	Redox Biology, a historical perspective and contemporary concepts
2	Redox metabolism and cellular processes Photosynthesis and Oxidative Phosphorylation
3	Organelle specific pro-oxidant enzymes and their functions
4	Antioxidant systems and redox buffers
5	In vivo and in vitro detection of reactive oxygen species and free radicals
6	Redox signaling in normal physiological processes Protein thiols, their oxidative and nitrosative modifications and cellular functions, Hydrogen peroxide and cell signaling, S- expression, Redox status and epigenetic regulation, Redox regulation of cell-cell
7	Emerging concept of redox homeostasis, oxidative stress and human diseases
8	Robustness and pitfall of the "Free Radical theory of Aging"
9	Role of nitric oxide and per oxynitrite in human health and diseases

Course Outcome(s)

After this course, student will

1. Understand of advances in systems biology that have led to the realization that redox reactions play an important role in many diseases.
2. Understand the basic principles focusing on various aspects of five primary areas of redox biochemistry: Antioxidant molecules and redox cofactors; Antioxidant enzymes; Redox regulation of physiological processes; Pathological processes related to redox.
3. Understand redox enzymology, mycobacterial drug targets, immunology, neurophysiology and oxygen sensing, and will understand the role of redox biochemistry in medicine.
4. Understand the important aspects of Hydrogen peroxide as major redox metabolite operative in redox sensing, signaling and redox regulation.

Reference Books:

1. Redox Signaling and Regulation in Biology and Medicine by Claus Jacob (Editor), Paul G. Winyard (Editor) Wiley-VCH; 1st edition (22 April 2009)
2. Redox Biochemistry 1st Edition by Ruma Banerjee (Editor), Donald Becker (Co-editor), Martin Dickman (Co-editor), Vadim Gladyshev (Co-editor), Stephen Ragsdale (Co-editor) Publisher : **Wiley; 1st edition (December 17, 2007)**

M.Sc. Life Sciences IVth Semester Course Title – Microbial Biotechnology Code - L.Sc. – 4006

Course Objective(s)

1. Production of a range of value-added products though microbes through different technology
2. Preservation of food
3. Target the selection and manipulation of micro-organisms with the Objective of improving process control, product quality, safety, consistency and yield.
4. To learn how students can enhance properties of the food such as taste ,aroma ,shelf-life, texture and nutritional value of foods.

Marks : 75

S. No.	Topic
1	Microbial biotechnology Scope, techniques, microbes as moving factories for macromolecules
2	Isolation, identification and selection of microbial strains
3	Determination of optimal nutrition requirements (Classical and modern approaches)
4	Strain improvement to increase product formation.
5	Maintenance and preservation of microbial cultures
6	Aerobic carbon utilization of renewable and non-renewable substrates; Anaerobic carbon utilization Waste management - treatment of solid and liquid waste Bioremediation of xenophobic pollutants
7	Production of proteins in yeast, SCP production
8	Production of recombinant and synthetic vaccines
9	Production of enzymes, vitamins, and amino acids from microorganisms
10	Microbial biomass and fuel production, algal biomass
11	Microbial production polysaccharides, and organic acids, solvents, Biosurfactants, Biodegradable plastics

Course Outcome(s)

Students

1. Shall learn advances in food safety, food security, value-added products, human nutrition and functional foods, plant and animal protection, and overall fundamental research in the agricultural sciences
2. Shall contribute/serve in disease prevention and therapy, diagnostics, agriculture and horticulture, food provision.
3. Could serve as human resource for the production of proteins and enzymes, medicinal, polymers, enzyme inhibitors, surfactants, bioherbicides, biopesticides, and many more agricultural and industrial industries.

Reference Books:

1. MICROBIOLOGY BY MICHAL J, PELCZAR
2. MICROBIOLOGY BY PD SHARMA
3. MICROBIOLOGY BY JACQUELYN G. BLACK
4. MICROBIOLOGY BY KANIKA SHARMA,

M.Sc. Life Sciences IVth Semester Course Title – Nanobiotechnology Code - L.Sc. – 4007

Course Objective(s)

1. To provide the foundational knowledge of the Nanoscience and related fields.
2. To acquire an understanding the Nanoscience and Applications
3. To understand in broad outline of Nanoscience and Nanotechnology.
4. To emphasize on the biotechnological applications of the nanomaterials especially their design and application in drug delivery.
5. To address the industrial needs through interdisciplinary training that bridges gap and meets the demand f pharmaceutical and chemical industry.

Marks - 75

S. No.	Topic
1	Properties and characterization of Nanomaterials, Bionanomachines and their basics
2	Nanomaterials and bio system interaction, Synthesis of biomolecules and interphase systems, Prtein and DNA based nanostructures, roteins as transducers and amplifiers of biomolecular recognition events, Nanobioelectronic devices and polymer nanocontainers, Microbial production of nanoparticles, Hybrid conjugates of gold nanoparticles, Use of DNA molecules in nanomachines and compuring
3	Bio Medical nanotechnology (Diagnostic. Delivery, and therapeutics), Nanotoxicology
4	Functional principles of nanobiotechnology: Information driven nano assembly, energetic, role of enzymes in chemical transformation, allosteric motion and covalent modification in protein activity regulation, structure and functions of biomaterials
5	Bio Nano machines and their basics Negligible gravity and inertia, atomic granulity, thermal motion, water environment and their importance in bio nano machines, The role of proteins —amino acids — nucleic acids — lipid an d polysaccharides in modern biomaterials. Overview of
6	Bio molecular Motors ATP synthetase and flagellar motors, Traffic across membranes potassium channels. ABC Transporters and Bacteriorhodopsin, Biomolecular sensing, self-replication machine — phase, Bio nanotechnology, protein folding, self-assembly, self-organization, molecular recognition and flexibility of biomaterials
7	Role of nanotechnology in biological therapies, application in cancer therapy and nanomedicine . Introduction and rationale for nanotechnology in cancer therapy - passive targeting of solid tumours, pathophysiological principles and physiochemical aspects of delivery system - active targeting strategies in cancer with a focus on potencial nanotechnology application multifunctional nanoparticles for cancer therapy

Course Outcome(s)

After completing this course students will be able

1. To explain about the background on nanoscience and its applications.
2. To understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment.
3. To apply their learned knowledge to develop Nanomaterial's.
4. To apply Nanotechnology and may apply their skills in research laboratories and pharmaceutical industries.

Reference Books:

1. Guozhong Cao. Ed Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Series in Nanoscience and Nanotechnology

2. Introductory Nanoscience: Physical and Chemical Concepts": Masaru, Kuno, Garland Science.
3. Bharat Bhushan, Handbook of Nanotechnology, Springer.
4. Hari Singh Nalwa, Handbook Of Nanostructured Biomaterials And Their Applications In Nanobiotechnology, Journal of Nanoscience and Nanotechnology.

Semester - IV Course - M.Sc. Life Sciences Course Title – Hormone Action & Metabolic disorder Code - L.Sc. - 4008

Course Objective(s)

This course aims

1. To study endocrine system in terms of structure, function & its role in regulating metabolism, growth, reproduction in different organisms with reference to disorders resulting from dysfunction
2. Give vast amounts of information and knowledge regarding the metabolism and endocrinology

Marks : 75

S. No.	Topic
1	Characteristics of hormone system, Classification.
2	Molecular basis of hormone action, hormone receptors, cAMP, protein kinase other intracellular messenger like Ca^{++} and phosphoinositides.
3	GTP binding proteins, phospholipase, inositol triphosphate and diacyl glycerol.
4	Assay of hormones.
5	Mechanism of action of insulin receptors and tyrosine kinase growth factors.
6	Diabetes regulation of insulin/glucagon and its significance.
7	Hormonal regulation of carbohydrate, fat and protein metabolism.
8	The hypothalamus and pituitary, over and under secretion of pituitary hormones.
9	Hormones and cancer.
10	Thyroid hormone — Mechanisms of action and pathophysiology.
11	Hormones regulating calcium metabolism, calcium as a second messenger, calmodulin.
12	Classification and mechanism of action of catecholamines, neurohormones and substance P. Biomedical importance.
13	Hormones of the gonads, testosterone and estrogens mechanism of action and pathophysiology.
14	Gastrointestinal and neural hormone like secretion like secretion, substance P, neurotensin their mechanism of action.

Course Outcome(s)

1. Understanding the common endocrine disorders , metabolic regulations, their management
2. Describing new advances in medicine for treating the hormonal imbalance at different levels
3. Studying thoroughly the genetic and psychiatric abnormalities associated with metabolic changes
4. To study the chemical nature of hormones and its quantitative action in relation to different disorders
5. Analyzing the role of hormones as a regulatory factor in the living system, the neurotransmitters and their relation with some diseases and drug addiction

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John Wiley & Sons,Inc.

Course Title - Seminar	
Semester - IV Course - M.Sc. Life Sciences Code — L.Sc. — 4009	**Marks: 25**
Course Title - Dissertation	
Semester - IV Course - M.Sc. Life Sciences Course Code — L.Sc. — 4010	**Marks: 200**