JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program: B.Sc.

Proposed Course: Life Sciences

Semester-V

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2020-21

T.Y.B.Sc. Life SciencesSyllabus

Academic year 2020-21

Semester – V			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SLSC501	Genetics & Immunology I	04	04
SLSC502	Developmental Biology & Neurobiology I	04	04
SLSC503	Fermentation technology & Genetic engineering: A Biotechnological Approach I	04	04
SLSC504	Environmental Biotechnology I	04	04
SLSC5PR1	Life Sciences Paper 1 & 2 Practical	04	08
SLSC5PR2	Life Sciences Paper 3 & 2 Practical	04	08

Semester V – Theory

Course Code: SLSC501	**Course Title: Genetics and Immunology – I**	**04 Credits**
Learning Objectives	Upon completion of the course, the student would be able to: 1. Understand the concepts of linkage, recombination and gene mapping in phage and bacteria. 2. Understand organization of genomes 3. Understand denaturation kinetics DNA 4. Differentiate between innate and adaptive immunity, illustrate the cell types and organs involved in the process of the immune response 5. The mechanism of antigen and antibody interactions and diagnostic immunology 6. Understand the Role of Complement pathways 7. Differentiate between humoral and cell mediated immunity 8. describe lymphocyte development and the expression of their receptors	
Course description	This course of Immunology is formulated to provide knowledge of Genetics and Immunology. It involved study of genomes, its molecular aspects, and various types of recombination and mapping in bacteriophages. It also involves study of the immune system, its response and involvement in health and disease. While immunology as a *SCIENCE* has been defined as the "science of self / nonself discrimination", it also includes our innate ability to defend against microorganisms (Innate Immunity); and its ability to recognize and respond to fight the infections through Acquired Immunity. Specific topics being covered include antigens and antibodies, antigen-antibody interactions, antibody structure and formation, Effector responses etc.	
	THEORY	**60 lectures**
Sub-Unit	**Unit – I: The Genetic material**	**15 lectures**
1.	**Discovery of genetic Material:** Griffith's experiment of 1928; Avery, McLeod and McCarty's experiment of 1944; Hershey-Chase's experiment of 1952; and Fraenkel-Conrat and B. Singer's experiment of 1956	**02**
2.	**Molecular aspects:** a) Sequence complexity of DNA - Unique and repetitive sequences of DNA b) Denaturation kinetics and 'CoT' curves c) Satellite DNA	**04**
3.	**Genomes Organization:** a) Organization of Prokaryotic genome b) Organization of Eukaryotic genome (Nucleosome structure and Higher orders of chromosome packing)	**04**

	c) C value paradox	
4.	**Gene regulation in eukaryotes:** a) Chromatic Condensation, modification and remodelling by acetylation and methylation (Heterochromatinization) b) Transcriptional regulation (promoters and enhancers and Transcription initiation complex c) GAL4-UAS system	**05**
Sub-Unit	**Unit – II: Mechanisms of Inheritance and variation in Prokaryotes and Bacteriophages**	**15 lectures**
1.	**Genetic recombination in Bacteriophages: (Theory and numerical problems)** a) Life Cycle of lytic and lysogenic phages b) Complementation in phages (Intra- and Inter-genic) c) Recombination mapping – Two- and three- factor crosses d) Deletion mapping e) Concept of "genes within genes", "alternate splicing" and "terminal redundancy" in phage genomes	**07**
2.	**Genetic recombination in Bacteria: (Theory and numerical problems)** a) Transformation b) Conjugation a) c) Transduction	**08**
Sub-Unit	**Unit – III: Overview and cells and organs of immune system**	**15 lectures**
1.	a) Overview of the Immune system - Innate Vs Adaptive Immunity	**01**
	b) Innate immunity i. Anatomical, Physiological, Phagocytic, Inflammatory barriers ii. Concept of Apoptosis vs Necrosis iii. Concept of PAMP, PRR and TLR	**03**
	c) Cells and organs of the immune system i. Primary and secondary lymphoid organs ii. Cells - structure and functions • Myeloid cells • Lymphoid cells • NK cells	**04**
2.	**Recognition of antigens (**Antigen-antibody interactions) a) Antigen-Specificity, avidity, affinity, immunogenicity b) Antibody-Structure, Functions and variations c) Monoclonal and polyclonal antibodies (Hybridoma Technique) d) Organization and expression of Immunoglobulin genes e) Antigen-antibody interactions –Cross reactivity, Precipitation, Immuno- electrophoresis, Agglutination,	**07**

	Radioimmunoassay	
Sub-Unit	**Unit – IV: Antigen recognition and Effector Mechanisms**	**15 lectures**
1.	**Recognition of antigens(Major Histocompatibility Complex):** a) MHC-I and MHC-II molecules b) MHC allelic polymorphism c) MHC restriction d) d) Antigen processing and presentation-endogenous and exogenous pathways	**05**
2.	**Maturation and activation of Lymphocytes:** a) B- cell maturation, Activation and Differentiation b) T- cell maturation, Activation and Differentiation and T-cell receptor	**04**
3.	**Immune Effector Mechanisms:** a) Cytokines– IL-1, IL-2, IL-4, IFNs and TNFs b) Complement: i) Classical, alternate and lectin pathways and comparison ii) Biological consequences of complement activation iii) Complement fixation tests c) Cell-mediated effector responses: i) Cell-mediated cytotoxicity of T cells ii) Role of TH1, TH2,TH17 and Tc cells	**06**
References	1. Snustad and Simmons. (2006). Principles of Genetics, 4th edn. John Wiley and sons. 2. Peter Russel (2006). I-Genetics; A Molecular approach, 2nd edn. Pearson. 3. Griffiths et al. (2005). Introduction to Genetic Analysis, 8th edn. Freeman and co. 4. Benjamin Lewin. (2008). Genes IX. Jones and Bartlett publishers. 5. S. B. Primrose and R. M. Twyman. (2007). Principles of Gene Manipulation and Genomics, 7th edn. Blackwell publication. 6. W. S. Klug and M. R. Cummings. (2003). Concepts of Genetics, 7th edn. Pearson. 7. W. S. Klug, M. R. Cummings, C. A. Spencer. (2006). Concepts of Genetics, 8th edn. Pearson. 8. Tom Strachan and Andrew Read. (2004). Human Molecular Genetics, 3rd edn. Garland Science pub. 9. R.A.Goldsky, T. J. Kindt, B. A. Osborne, J. Kuby. (2003) Immunology 5th edn. W.H. Freeman. 10. C. A. Janeway, P. Travers, M. Walport, M. Shlomchik. (2005). Immunology: The immune system in health and disease, 6th edn. Garland Science Pub.	

	11. A. K. Abbas, A. H. Litchman. (2000). Cellular and Molecular Immunology, 5th edn. Elsevier publication. 12. Roitt. (2006). Essential Immunology, 11th edn. Blackwell publication. 13. D. Mole, J. Bronstoff, D. Roth, I. Roitt, Mosbey. (2006) Immunology, 7th International edn. Elsevier publication. 14. C. V. Rao. (2002). An Introduction to Immunology. Narossa Publishers.

Course Code: SLSC502	**Course Title: Developmental Biology and Neurobiology – I**	**04 Credits**
Learning Objectives	Upon completion of the course, the student would be able to: 1. Describe model organisms and landmark discoveries in research related to developmental biology 2. Plant developmental biology with Arabidopsis as the model System 3. Events that orchestrate the development from a single cell to a multicellular organism in chick and human 4. Neurological aspects of animal behaviour and imprinting in birds *5.* Parts of the nervous system and their functions *6.* Types of cells involved in the nervous system, resting membrane potential, graded potential, action potential – neuronal communication 7. Neuromuscular junctions, synapses, neurotransmitters	
Course description	This course is based on Developmental Biology and Neurobiology; both these topics form fundamental aspects of Life Sciences. Development is a process by which a single cell (the zygote) gives rise to an entire multicellular organism. It involves cell division, cell signalling, pattern formation, and organogenesis. Developmental details of chick and humans and Arabdopsis (plants) are the most well studied and researched worldwide and thus form the basis for providing a clear understanding of developmental biology. Neurobiology, on the other hand, is the means by which we communicate with the world. The course starts with the role in neurobiology in animal behaviour, followed by a thorough understanding of the parts of the brain, spinal cord and peripheral nervous system. Going into the cellular and molecular level, the types of cells and their functions and biophysics of electrical communication in neurons is described. Besides, how neurons communicate with muscles, types of synapses and types of neurotransmitters is also covered.	
	THEORY	**60 lectures**
Sub-Unit	**Unit – I: Developmental biology – Model organisms**	**15 lectures**
1.	**Basic concepts in development** a) Positional value of cells b) Inductive signals c) Asymmetry in cell division d) Lateral inhibition	**03**
2.	**Model organisms in developmental biology** a) Significance of model organisms b) Dictyostelium: acquisition of multicellularity	**03**

	c) Zebra fish: in situ hybridization d) Chick and amphibians: fate maps and chimeras	
3.	**Plant development: DicotyledonsArabidopsis as the model System** a) Life cycle of Arabidopsis – sporophytic and gametophytic generation b) Fertilization and embryo development, Formation of meristems (root and shoot), c) Formation of different organs – leaf, flower, androecium [including development of anthers, pollen grain, pollen tube etc.] and gynoecium [development of pistil - up to formation of embryo sac] d) Double fertilization, seed formation. [Eventual formation of fruit], e) Role of Homeotic genes specifying parts of a flower f) Plant genome project (Arabidopsis and rice)	**09**
Sub-Unit	**Unit – II: Animal Development**	**15 lectures**
1.	**Sexual Reproduction** a) Sex determination, dosage compensation b) Fertilization, acrosome reaction, prevention of polyspermy, cortical reaction	**03**
1.	**Chick development**- Introduction, cleavage, morula and blastula, gastrulation, neurulation, organogenesis, axis specification and avian organizer.	**06**
2.	**Human development** – Introduction, cleavage, morula and blastula, gastrulation, neurulation, organogenesis	**06**
Sub-Unit	**Unit – III: Introduction to behaviour and the nervous system:**	**15 lectures**
1.	**Overview of animal behaviour** a) Innate behaviour and Learned behaviour (example: Aplysia) b) Imprinting in birds, Behavioural defects – e.g. Bird songs of isolated, caged birds.)	**03**
2.	**General organization of the nervous system** Vertebrate nervous system: a) Central Nervous System - cerebral hemispheres, cerebellum, diencephalon, medulla, pons, midbrain and spinal cord b) Peripheral Nervous system - (autonomous, somatic, cranial, spinal, plexii) c) Meninges and CSF, blood brain barrier d) Limbic System (emotions and memory) e) Hypothalamo – Hypophysial Axis	**12**

Subunit	Unit IV: Cellular organization of the nervous system	15 lectures
1.	a) Types of cells: Neuronal, Glial cells, Ependymal cells b) Chemical Basis of Neural transmission- Introduction Ionic basis of resting membrane potential: Donann's equilibrium experiments, Nernst's potential, Goldman's equation, Sodium –Potassium pump. c) Action Potential & propagation– Hodgkin and Huxley's model, voltage clamp experiment and the derivation and propagation of Action Potential, Graded potential d) Synaptic potential and synaptic integration [Electrical and Chemical Synaptic Potential] Excitatory Post Synaptic Potential (EPSP), Inhibitory Post Synaptic Potential (IPSP) e) Neuro – muscular junctions f) Synapse: Structure, Types – chemical and electrical	**09**
2.	**Neurotransmitters** i. Introduction, Biosynthesis, physiological role, pharmacological ii. significance, (examples of one agonist and one antagonist for each iii. neurotransmitter mentioned below. iv. Acetylcholine (Nicotinic and muscarinic receptors). v. Dopamine (D1 and D2 receptors). vi. GABA and Glutamate vii. Neuropeptide (Endorphin and Enkephalin).	**06**
References	1. Wolpert L., Tickle C., and Arias AA. (2015) Principles of Development, Oxford University Press. 2. Gilbert SF., Barresi M.J.F. (2016) Developmental Biology, Sinauer Associates, Oxford University Press. 3. R.M.Twyman. (2000) BIOS Instant Notes in Developmental Biology, Taylor & Francis. 4. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D, Darnell J. Molecular Cell Biology. (2000) Molecular Cell Biology, W.H. Freeman. 5. Purves P., Augustine G., Fitzpatrick D., Hall WC., LaMantia AS., White LE. (2011) Neuroscience, Sinauer Associates, Inc. 6. Tortora GJ., Derrickson B. (2013) Principles of Anatomy and Physiology, John Wiley & Sons Inc 7. Longstaff A. (2011) BIOS Instant Notes in Neuroscience, Taylor & Francis 8. Smith C.U.M. (2002) Elements Of Molecular Neurobiology, Wiley	

Course Code: SLSC503	**Course Title:Fermentation technology & Genetic engineering: A Biotechnological approach I**	**04 Credits**
Learning Objectives	Upon successful completion of this course, the student will be able to: 1. Understand the various concepts of fermentation (aerobic, anaerobic, batch vs continuous); 2. Design a simple containment system (Bioreactor / fermentor). 3. Isolate and screen microorganism with potential to produce particular metabolite. 4. Enhance the efficiency of microorganisms to produce particular metabolite and produce the same at large scale. 5. Produce beer, wine, vinegar, cheese, yoghurt etc resulting from alcoholic and acidic fermentation. 6. Understand the Principles of instrumentation 7. Describe the use of restriction endonucleases in gene cloning. 8. Describe the different vectors (prokaryotic) that can be used in gene cloning experiments. 9. Describe the essential steps involved in gene cloning with relevant examples. 10. Describe the various strategies of cloning, screening and selection methods.	
Course description	This course is aimed at introducing the students to the basic concepts of Fermentation technology and Genetic Engineering. Fermentation technology includes isolation techniques used in biotechnological processes, bioreactors, and other membrane separation techniques, finalization (strain improvement) and stabilization of the product. The microbial biomass-disintegration, stabilization, purification techniques for the isolation of metabolites and cellular components. Production of beer, wine, vinegar etc through fermentation processes. Genetic engineering includes the principles of gene cloning, molecular cloning methods, vectors used for cloning in prokaryotes and various recombinant screening techniques.	
	THEORY	**60 lectures**
Sub-Unit	**Unit – I: Fermentation technology – Principles**	**15 lectures**
1.	History and development of Food & Fermentation Technology	**01**
2.	Fermentation technology & Instrumentation	**01**
3.	a) Principles of microbial growth, b) Screening (primary & secondary) c) Strain improvement (mutation & selection using auxotrophy& analogue resistance	**04**

4.	The Bioreactor / Fermenter & accessories (Stirred tank & Airlift)	**02**
5.	Media design for fermentation (include molasses, corn steep liquor)	**02**
6.	Downstream processing (use ex of Penicillin and an enzyme for cell disruption)	**01**
7.	Instrumentation: Principles and technique of Centrifugation, Spectrophotometry & Chromatography	**04**
Sub-Unit	**Unit – II: Fermentation technology - Food and Beverage Production**	**15 lectures**
1.	Batch v/s Continuous fermentation	**02**
2.	Technological aspects of industrial production of: a) Cheese b) Beer c) Vinegar d) Single Cell Protein e) Mushroom f) Yoghurt g) Wine	**11**
3.	Food quality assurance: Regulatory & social aspects of food biotechnology	**02**
Sub-Unit	**Unit – III: Principles of Gene Cloning**	**15 lectures**
1.	Introduction to the history of Gene cloning	**01**
2.	Molecular cloning methods: a) Cutting DNA molecules: a) Restriction enzymes (Discovery, Nomenclature, Type I, II ,III, patterns of DNA cutting), Restriction Mapping, b) Use of Alkaline Phosphatase c) Joining DNA molecules: d) DNA ligases, Homopolymer tailing, Linker and Adaptors	**07**
3.	Vectors: The cloning vehicles in prokaryotes a) Plasmid vectors i. pBR322 (structure, origin, use – expression of Insulin and Somatostatin gene in *E.coli*) ii. ii) pUC (structure, origin, use) b) Cosmids c) c) Phage vectors – Lambda and M13	**07**

Sub-Unit	Unit – IV: Cloning and Screening Techniques	15 lectures
1.	**Cloning of genes**: a. Genomic Libraries b. cDNA Libraries c. PCR cloning d. Positioning cloning	**05**
2.	**a) PCR:** Polymerase chain reaction i. Method ii. Limitations and applications iii. Types of Primers – Universal, Nested, Poison primers iv. Types – Q-PCR, RT-PCR **b) Chromosome walking and Chromosome jumping**	**05**
3.	**Screening and selection of the desired clone:** a) a)Immunological method b) Nucleic acid hybridization method c) Transformant Screening by Gene Inactivation method d) d) HRT and HART	**05**
References	1. Michael L Shuler and FikretKargi. (2008). Bioprocess Engineering*:* Basic Concepts., Prentice-Hall of India Pvt Ltd. 2. Stanbury P.F.,Whitaker A. and Hall S.J. (2007). Principles of Fermentation Technology. Elsevier India Pvt Ltd. 3. Prescott And Dunn. (2004). Industrial Microbiology. Chapman & Hall. 4. Casida, L.E. (2003) Industrial Microbiology. New Age International (P) Ltd. 5. S.B. Primrose and Twyman. (2006). Principles of gene manipulation, 7th Ed. Blackwell. 6. R.W. Old and S.B. Primrose. (2004). Principles of gene manipulation, 6th edition, Blackwell. 7. Watson. (20010), Recombinant DNA, 3rd ed. ASM Press. 8. T.A. Brown. (2009). Gene cloning and DNA analysis, 2nd ed. Wiley-Blackwell. 9. B. Glick et al. (2010). Molecular Biotechnology- Principles and application of recombinant DNA, 4th ed. ASM Press. 10. 10. D. Clark, N. Pazdernik. (2009) Biotechnology- Applying the genetics to revolution. Academic Press.	

Course Code: SLSC504	Course Title: Environmental Biotechnology I	04 Credits
Learning Objectives	**Upon completion of the course, the student would be able to:** 1. Articulate the interdisciplinary context of environmental issues. 2. Prepare for career success in natural resources and its conservation, public health, environmental monitoring and remediation, industrial environmental management 3. Develop a sense of community responsibility by becoming aware of scientific issues in the larger social context. 4. Well-grounded in laws and regulations of Indian constitution for the safeguard of Environment 5. Develop standards of professional behaviour that include rules of ethics and etiquette. 6. Articulate a comprehensive world view that integrates diverse approaches to sustainability. 7. Understand the basic theoretical concepts and methodologies of both the physical and social sciences. 8. Learn how to solve large-scale problems using a multitude of tools and approaches. 9. Understand the basic sustainability concepts of homeostasis, carrying-capacity, recycling 10. Formulate an action plan for sustainable alternatives that integrate science, humanist, and social perspectives.	
Course Description	Environmental biotechnology is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment. The students will be Introduced to Fundamentals of environmental science, Sustainable development of the Biosphere and use of Natural resources, Biodiversity and wildlife management and its conservation, Pesticides and Toxicology Management and get aware on environmental legal provisions.	

	THEORY	60 lectures
Sub-Unit	**Unit – I: Introduction to Fundamentals of environmental science**	**15 lectures**
1	**Environmental Science:** **a) Humans and Sustainability:** i) Principles of Sustainability, Key Components ii) How humans affect their environment: Cultural Revolution; Hunter gatherer population, Agricultural revolution, Industrial–Medical Revolution,Information and Globalization Revolution. **b) Ecosystem and Human needs:** i) Resource depletion and pollution ii) Dwindling Biodiversity iii) Environmental problems and their solutions iv) Ecological footprints v) Environmental worldviews	**07**
2	**Population and consumption Dynamics:** **a) Energy and food production** i) Green revolution ii) Blue revolution iii) Food security and Nutrition **b) Ecological costs of food production.** i) Industrialized Food Production and Environmental problems, Politics and economics of Hunger. ii) GM foods and their environmental concerns e.g. *Bt*Brinjal iii) International Treaty on Plant Genetic Resources for food and Agriculture (ITGR) iv) Intellectual Property Rights (IPR) v) Biopiracy (e.g., Neem/Basmati) vi) Seed Bank **g) Human impact on climate:** i) Ozone layer and depletion ii) Greenhouse effect and global warming iii) Carbon footprints	**08**
Sub-Unit	**Unit – II: Biodiversity and its Conservation:**	**15 lectures**
1	a) **Biomes of the world:** climate, vegetation and Geographical distribution pattern. b) **Biological diversity of India:** Indian Bio-geographic Zones, climate and its impact on biodiversity.	**04**
2	**a) Indian flora and fauna:** Indian forest and vegetation types: diversity of flora and fauna i) Endangered, Endemic and Extinct Species of India ii) Threatened species categories of IUCN	**08**

	iii) Threatened species of plants and animals in India and their reasons iv) Red data books **b) Wildlife management and conservation:** i) Goals and Strategies ii) Human land-use and wildlife management iii) Impact of Ecotourism; role of local communities in wildlife management initiatives **c) Environmental biotechnology:** Role of biotechnology in conservation of species, in-situ and ex-situ conservation	
3	**a)Marine life:** i) Open sea and coastal sea productivity and conservation issue ii) Biodiversity conservation: Global agreements and national concerns iii) RAMSAR sites	**03**
Sub-Unit	**Unit – III: Pesticides and Toxicology Management:**	**15 lectures**
1	**Pest and pesticides:** **a) Basic introduction to Pests,Pesticides and Environment** i) Pesticide toxicity ii) Bioaccumulation and Biomagnification iii) Persistence, resistance and pollution **b) New methods of pest control:** i) Integrated pest management ii) Biological pest control by predators, parasites, and pathogens iii) Genetically Engineering and pest control **c) Bioremediation and Phytoremediation of Pesticide** **d) Pesticide regulation and Endosulphan issue**	**08**
2	**Toxicology Management**. **a) Basic concepts, toxicity and its impacts** i) Industrial toxicants and hazardous materials ii) Toxic and hazardous waste management iii) Measurement of toxicity, TLM and lethality studies, iv) Physiological and metabolic effects on flora and fauna. **b) Limitation of Toxicological studies:** Comparison of animal toxicological models and Toxicity in Humans. **c) Human clinical trials:** Concept of Clinical trial phases - I, II, III and IV. **d) Ethical issues of clinical trials:** e.g. Thalidomide, Human Papillomavirus vaccine trials.	**07**

Sub-Unit	Unit – IV:	15 lectures
1	**a) Sustainable Development** i) Sustainable Development: As defined by United Nations World Commission on Environment and Development. ii) Ecological and economic growth factor for sustainable development, integrating environmental concerns in economic decision iii) Costs benefit analysis iv) Role of International Environmental Organizations in sustainable economic development.	**06**
2	**a) Awareness of citizen on environmental legal provisions:** i) Constitutional Provisions for environment ii) Legislative power relating to environmental law iii) General laws relating to environment	**06**
3	**a) Entrepreneurship Skill Development** i) General concept and Key features of an entrepreneur ii) Factors affecting entrepreneurship development iii) Risks and benefits iv) Historic background	**03**
References	1. Living in the Environment (17th Edition) by G. Tyler Miller & Scott Spoolman (2015) 2. Entrepreneurial And Innovative Management by Buame, S, (2000) 3. The Entrepreneur, Entrepreneurship and Development Principles, Programmes and Policies VOLUME 1 by Vasant desai 4. Misra and Pandey (2011), "Essential environmental studies", Ane Books 5. Martens (1998),"Health and climate change ", Earth Scan 6. Saxena (1998), "Environmental Analysis of soil and air", Agrobotanica 7. Chakraborti (2005),"Energy efficient and environment friendly technologies for rural development " ,Allied Publishers 8. Dash M C (2004) "Ecology, chemistry and Management of environmental Pollution ",Mac Millan India 9. Nayak ,Amar(2006) "Sustainable sewage water Management ",Mc Millan India 10. Dolder, Willi (2009), "Endangered animals, Parragon 11. Gupta P K (2000)," Methods in environmental Analysis", Agrobio (India) 12. Fumento, Michael (2003),"Bioevolution : How biotechnology is changing our world" , California encounter Books 13. Kapur (2010) "Vulnerable India ", SAGE 14. Jacob, Miriam(2004)," Silent Invaders" , Orient Longman 15. Mc Cafferty (1998),"Aquatic Entomology ", Jones and Barlett 16. Subramanyam (2006),"Ecology" , 2nd ed.Narosa 17. Dilip Kumar, Rajvaidya (2004)," Environmental Biotechnology ", APH 18. Sharma and Khan (2004)," Ozone Depletion and Environmental Impacts" ,Pointer publishers	

Semester V – Practical

Course Code SLSC5PR1	Course Title: Life Sciences Paper 1 & 2 Practical	04 Credits
PRACTICAL – I	**Genetics**	
1.	Extraction of chromosomal DNA from chicken liver	
2.	Streak plate isolation of saliva on two different media	
3.	Viable count for enumeration of bacteria by – Bulk seed method	
4.	Viable count for enumeration of bacteria by – Surface spread method	
5.	Study of wild-type and mutant *Drosophila* from slides / photographs	
6.	Study of UV-Visible Spectrophotometer	
7.	Polymerase Chain Reaction	
	Immunology	
8.	Study of ABO and Rh Blood grouping systems	
9.	Isoamagglutination Titre	
10.	Coomb's Test	
11.	Quantitative Widal Test	
12.	Study of lymphoid organs of rat (photograph)	
13.	Study of Thymus, Spleen, and Lymph node (tissue sections)	
14.	Observation of Blast cells in bone marrow of any mammal (slides/photograph)	

PRACTICAL – II	Developmental Biology	
1.	Study of developmental stages of chick embryo	
2.	Cytochrome C- oxidase activity in a developing chick embryo	
3.	Programmed cell death in limb bud using Janus Green B stain (in chick embryo)	
4.	Alizarin stain to study limb development in chick embryo/ Regeneration of cartilage / bone	
5.	Acid and alkaline Phosphatase in Chick embryo	
6.	Effect of temperature on cell viability in pollen grains/yeast using Trypan blue/ acetocarmine	
7.	Root and shoot development in sections of a 2 day old plant embryo	
	Neurobiology	
8.	Dissection & display of Nervous system in invertebrates – earthworm	
9.	Dissection & display of Nervous system in vertebrates – chick brain	
10.	Study of Permanent slides/photographs - Medullary nerve fibre, TS of Spinal cord, Mammalian retina, Electron micrographs of neural tissue	
11.	Study of the Nervous system of Sepia with special reference to Giant axon and stellate ganglia	

Course Code SLSC5PR2	Course Title: Life Sciences Paper 3 & 4 Practical	04 Credits
PRACTICAL – III	**FERMENTATION TECHNOLOGY & GENETIC ENGINEERING: A BIOTECHNOLOGICAL APPROACH**	
1.	Extraction of enzyme: (Amylase from sweet-potato / salivary amylase / egg white lysozyme or any other convenient enzyme)	
2.	Purification of enzyme: Above enzyme extract used for purifying by salting-out method	
3.	Determination of - i) enzyme activity ii) specific activity.	
4.	Determination of the effect of pH and Temperature on Enzyme activity (Amylase / any other convenient enzyme).	
5.	Determination of the K_m of amylase/any other convenient enzyme.	
6.	Immobilization of Enzyme (Amylase/any other convenient enzyme) using hen egg-white / alginate method and assay its activity.	
7.	Polyacrylamide Gel Electrophoresis of *E. coli* extract / Serum proteins / Saliva / Egg white any other suitable sample.	
PRACTICAL – IV	**Environmental Sciences**	
1.	A visit to aquatic ecosystem and methods for water and plankton collection/ Plankton identification and quantification from river / lake water samples	
2.	Vegetation studies by line, quadrates and belt transect methods and their analysis.	
3.	Preparation of media for microbial culture, Isolation and culturing of microbes from Soil / water samples (Fungal /Bacterial organism)**.**	
4.	Study of fecundity from the given sample of freshwater/marine fish	
5.	Isolation and culturing of Rhizobium from the given sample**.**	
6.	Analysis of soils for pH, moisture, soil types.	
7.	Water analysis for physicochemical characteristics: (any three) Salinity/Acidity/Alkalinity/BOD/DO/COD/Copper	
8.	Calculating carbon foot print	

Evaluation Scheme

[A] Evaluation scheme for Theory courses

I. Continuous Assessment (C.A.) - 40 Marks
   (i) C.A.-I : Test – 20 Marks of 40 min. duration
   (ii) C.A.-II : Precis writing, Documentary making, Presentations, Quizzes based on videos, Surveys etc.

II. Semester End Examination (SEE)- 60 Marks

[B] Evaluation scheme for Practical courses

I. Continuous Assessment (C.A.) For each Practical – 20 Marks

II. Semester End Examination (SEE) For each Practical – 30 Marks

Grand total of Practical = 100+100=200

Note: The Department of Life Sciences offers "Food Nutrition, Preservation and Dietetics" as the applied component. The Syllabus of the same is available separately.