Vidyasagar University
Syllabus for M. Phil in Life Sciences

Semester	Course No.	Course Title	Marks	Credits
I		**Compulsory papers**		
	LSc 111	Research Methodology	50	4
	LSc 112	Biostatistics, Computer & Bioinformatics	50	4
	LSc 113	Advanced Cell Biology	50	4
	LSc 114	Instruments and Techniques in Biological Research	50	4
	LSc 115	Biodiversity, conservation and application of RS GIS	50	4
II *(any five to be selected among offered electives)*	**Optional papers** *(Any five)*			
	LSc 121	Non communicable disease and life style	50	4
	LSc 122	Advanced Microscopy and Tomography	50	4
	LSc 123	Structural Elucidation of Biomolecules	50	4
	LSc 124	Genomics & Proteomics	50	4
	LSc 125	Food Security & Food biotechnology	50	4
	LSc 126	Advanced Immunology	50	4
	LSc 127	Aqua informatics	50	4
	LSc 128	Human evolution and Genetics	50	4
	LSc 129	Plant Evolution and Diversity	50	4
	LSc 1210	Nano biotechnology	50	4
	LSc 1211	Developmental Biology	50	4
III & IV	LSc 231	Development of Laboratory skills (Dry/ Wet)	50	4
	LSc 241	Term paper and Seminar	50	4
Total			600 marks	48 credits

Semester I: 250 marks, 20 credits; Semester II: 250 marks, 20 credits; Semester III: 100 marks, 8 credits.

Semester I

LSc 111: Research Methodology

1. Fundamentals of Research: - Meaning of research, Purpose of research, Types of research i.e, Basic, Applied and Action research, Research hypothesis.
2. Qualitative and Quantitative Research:- Qualitative research Model and its themes. Data collection technique of this research. Advantages and its limitation. Quantitative research model, its themes and its characters.
3. Experimental and Quari-Experimental Research: - Nature, Value, steps, design and types of experimental research, Single subjected experimental research.
4. Selection of research problem and preparation of research proposal:- Source of problems, Evaluation of the problem, Model of Research proposal, Ethics in Research.
5. Review of Literature:- Purpose of revive, process, Modern aspect, its importance.
6. Sampling – different types, methods for sampling, scaling techniques
7. Data Collection and Data Analysis: - Data gathering tools and techniques, Featuces of data, Parametric and non parametric data.
8. Significance of Impact factor, citation index, science citation index, IST, SCOPUS etc.
9. The Research Report: - General format, editing of report.

LSc 112: Biostatistics, Computer & Bioinformatics

1. Application of Computer in biological research and Bioinformatics
2. MS office and its application in Research – MS Word, MS Power point and MS Excel
3. Computer Operating system (OS) - functions, types of OS. Basic structure and features of Windows, Unix, and Linux
4. Use of Internet in research – Websites, searches Engines, E-journal and E-Library –INFLIBNET.

5. Data base – definition , types , management of database, biological database Bioinformatics – computer languages for bioinformatics, Application of Bioinformatics,
6. Bioinformatics Resources: NCBI, EBI, ExPASy, RCSB, DDBJ: The knowledge of databases and bioinformatics tools available at these resources, software tools for
7. structure analysis of biomolecules, structure prediction, Sequence Analysis: Basic concepts of sequence similarity, identity and homology, genome analysis, Phylogenetic tree, motif analysis
8. Open access bibliographic resources and literature databases: PubMed, BioMeb Central, Public Library of Sciences (PIoS), CiteXplore.,
9. Statistical analysis of biological data; Sampling – different types, methods for sampling, scaling techniques
10. Correlation: simple , partial and multiple, regression- simple and multiple, and stepwise regression Experimental design
11. Analysis of Variance (ANOVA) : One way and two way anova, Model of anova, assumptions and computation of anova, Multiple comparison tests, Anocova , multivariate analysis technique
12. Nonparametric statistics- Chi square test (or G test) for normality of distribution, non parametric test for correlation studies.

L Sc 113: Advanced Cell Biology

1. Cytoskeleton: Microtubule and Microfilaments, Actin Dynamics, Actin Binding Proteins, Molecular Motors, Mitosis, Cell Polarity, Intermediate Filaments.
2. Types of Cellular Vesicle Transport, Cargo Sorting, Membrane Trafficking, The Endocytic Pathway: Phagocytosis, Lysosome.
3. Extracellular Matrix, Cell Adhesion, Apoptosis, Nuclear Pore Complex, Mitochondrial Dysfunction and Cell Death, Nucleolus Structure and Function.
4. Cell Signalling and Control of Growth, Growth Factors, MAP Kinase Pathway, Tumor Microenvironment, Cytopathology: Basic Principles and Applications, Basic Concept of Cell Imaging.

LSc 114: Instruments and Techniques in Biological Research

1. Microscopy,- principle of using , application in biological research
2. Spectroscopy: UV-VIS, IR, NMR
3. Chromatography: HPTLC, GC, HPLC, Ultracentrifugation
4. Gel-electrophoresis: 2D Gelelectrophoresis, PCR
5. Radioisotopes: X-ray diffraction technique
6. DNA and RNA purification , isoelectric focusing
7. DNA sequencing, RFLP, RAPD, CLIA, AFLP techniques,
8. FACS, Flowcytometry
9. Electrophysiological techniques: Patch-clamp technique, ECG, EEG, USG,MRI Imaging,

LSc 115: Biodiversity, conservation and application of RS GIS

1. Conservation biology: Introduction; Ethics and conservation.
2. Metapopulation dynamics and conservation, The nature and function of biological diversity, Functioning of novel ecosystems,
3. Issues of biodiversity : Regional and Indian scenario ; Significance and threats ; conservation strategies in biodiversity management , genetic diversity
4. Distribution of biodiversity, Earth history and changes in species distributions, Speciation, Over exploitation, habitat destruction, and extinction
5. Bioresource and uses of biodiversity – animal and plants ; species interaction: types of interaction , competition , symbiosis
6. Tropical deforestation and extinction; Global climate change and extinction, Species interaction; Agenda for the future.
7. Bio-Resources: Application of remote sensing; spectral properties; mapping using remote sensing data.
8. Application of Geoinformtics, Models in Resource Management. RS and GIS for drawing out action plans and recent development.

Semester II

LSc 121: Non communicable disease and life style

1. Non-Communicable Diseases with Lifestyle and Lifestyle Diseases; Cardiovascular Diseases Cancer, Allergies, Asthma, Diabetes, and Arthritis
2. Understanding Hereditary Diseases
3. Understanding Immune Disorders and Autoimmune Disorders, Understanding Disabilities
4. Overview of NCDs /Life-styledisorders/ Epidemiology (morbidity and mortality)
5. Health Promotion Strategies:a.Health Promotion Strategies (in general), Health Promotion in schools, Health Promotion in community School Health Programmes
6. CVD, stroke, hypertension, diabetes, obesity
7. Mental health and Stress management
8. Tobacco, alcohol, drugs abuse
9. Role of Diet and Nutrition (in management NCDs, importance of vegetarianism
10. Physical activity and yoga
11. Health problems related to technology (ailments, mobile use, and computer related injuries, BPO,etc.)
12. Designing, implementing, monitoring and evaluation of health promotion programme

LSc 122: Advanced Microscopy and Tomography

1. Basics of electron microscopy:
   General Background; Fixation and Sample preparation.
2. Scanning transmission electron microscope (STEM): Basics of STEM; Application of STEM to Nanomaterials and biological specimens.
3. Electron probe Microscopy: Configuration and Instrumentation; Topographic image of AFM; Advantages and disadvantages; Applications.
4. High voltage electron microscopy (HVEM): Basic principle of HVEM; Applications in material/biological sciences.

5. Understanding of cell structure: Major subcellular structures in living organisms.
6. Electron tomography: Principles, instrumentation and functions.

LSc 123: Structural Elucidation of Biomolecules

1. Carbohydrates: Introduction to naturally occurring sugars: Deoxysugars, aminosugars, branched sugars. Structure elucidation of lactose and D-glucosamine. Structural features and applications of inositol, starch, cellulose, chitin and heparin.
2. Lipids: Classification, structure and function of major lipid subclasses-acylglycerols, Lipoproteins, chylomicrons, LDL, HDL and VLDL, rancidity. Formation of micelles, monolayers, bilayer, liposomes.
3. Vitamins and Co-enzymes: Classification, watersoluble and fatsoluble vitamins. Structure, dietary requirements, deficiency conditions, coenzyme forms and their mechanism.
4. Proteins, Amino acids: Classification, Properties, reactions, rare amino acids. Protein classification: Reactions, functions, properties and Solid phase synthesis, Structural levels of protein: **a.** Primary Structure: Peptide bond, importance of primary structure. **b.** Secondary structure: X ray diffraction, alpha-helix, β -structure, β-helix, super secondary structure. **c.** Tertiary Structure: Forces stabilizing, unfolding/ refolding expt. Prediction of tertiary Structure **d.** Quaternary structure – hemoglobin. End group analysis, sequencing and peptide synthesis; Ramachandran plot.
5. Hormones, steroids
6. Natural pigments: General structural features, occurrence, biological importance and applications of: carotenoids, anthocyanins, quinones, flavones, pterins and porphyrins (chlorophyll). Structure elucidation of β-carotene. Synthesis of ubiquinone from 3,4,5-trimethoxyacetophenone.
7. Pheromones:General structural features and importance. Synthesis of bombykol from acetylene, disparlure from 6-methylhept-1-ene, grandisol from 2-methyl-1,3-butadiene.
8. Alkaloids:Occurrence and physiological importance of morphine, coniine and

papaverine. Structure elucidation of papaverine.

LSc 124: Genomics & Proteomics

1. Genomics: Introduction, definition, objective, model organisms, Vectors.
2. DNA sequencing methods and Genome mapping,
3. Genome sequencing methods,
4. Functional genomics,
5. The human genome project.
6. Proteomics : Introduction, definition, objective
7. Characterization of Protein (brief information on gel electrophoresis, Peptide Mass Fingerprinting (PMF), Protein sequencing.
8. LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions,

LSc 125: Food Security & Food biotechnology

1. Microorganisms associated with food (milk, meat, fish, cereals, vegetables and fruits).
2. Spoilage of foods and factors governing the spoilage
3. Food preservation methods: physical, synthetic, natural and biological.
4. Microbial food processing: role of indicator microorganisms like lactic acid and other bacteria, yeast and molds. Starter cultures.
5. Lactic acid, bacterocins and other metabolites, their applications.
6. Fermented food: Production and beneficial effects.
7. Oriental fermented foods (preparation, microbes and benefits)
8. Food deterioration by mycotoxins. Characteristics of food borne diseases caused by *Clostridium, E. coli, Salmonella.*
9. Current and future implications concerning food safety, hazards and risks.
10. Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI.
11. Genetically modified foods and their acceptability.

12. Food rheology and structure.

LSc 126: Advanced Immunology

1. **History and Basic concepts-** History on Immune system, Cell (B cell, T cell, Macrophage and NK cells), tissue and Organ (Lymphoid organ) of the immune system, Types of Immunity-Innate, Cellular and Humoral. Role of TLR in Innate immunity
2. **B-cell Biology**- B-cell receptor and co-receptor complex, Activation, Antibody diversity, Class switching, Monoclonal antibody.
3. **T-cell Biology and Immunoregulation-** T-cell receptor and co-receptor complex, Activation, T-cell diversity, Macrophage activation, Antigen processing and Presentation, Major histocompatibility complex (MHC)- types and functions. Cytokines- family and its role in immunoregulation.
4. **Transplantation, Cancer and AIDS Immunology-** Transplantation- definition, types, graft rejection and prevention of graft rejection. Cancer immunology- Cancer antigens, oncogenes, immunoregulation and immunotherapy. AIDS immunology- HIV structure and functions, Infection and Immunity.
5. **Hypersensitivity, Autoimmunity and Vaccine-** Hyper sensitivity- types, Immune response during hypersensitivity reactions. Autoimmunity- auto immune diseases, Organ specific auto immune diseases (Hashimoto's thyroiditis, Good pastures syndrome, Insulin dependent diabetes mellitus, Grave's) diseases and Myasthenia gravis. Systemic autoimmune diseases (SLE, multiple sclerosis, Rheumatoid arthritis). Vaccine and vaccination.

LSc 127: Aqua informatics

1. Spatial data base development through different survey information analysis, Decision base support system formation.
2. Climate change and policy research design on Aquatic resources from beginning to end. Role of Information technology in Aquaculture Sectors.
3. Recent approaches in floral -faunal conservation/ assessment through Web based system.

LSc 128: Human Evolution and Genetics

1. A brief outline of geological time scale. Theories on emergence of life.
2. Quaternary geology and its importance. Major environmental episodes of Pleistocene and Holocene.
3. Human biocultural evolution. Cultural chronology and advances.
4. Gene and gene pool. Genetic structure of human population; Hardy-Weinberg law.
5. Causes for changes in gene frequencies: mutation, hybridization, genetic drift, and selection. Genetic polymorphism.
6. Biological consequences of mating systems: consanguinity, inbreeding and out-breeding. Inbreeding coefficient (F ratio). Inbreeding: heterozygosis, homozygosis and genetic load.
7. Molecular & Biochemical basis of genetic diseases; Autosomal Disorders: Cystic fibrosis, Thalassemia b) X-linked Disorders: Hemophilia A, Muscular dystrophy c) Metabolic Disorders: Phenylketonuria, Alkaptonuria d) Dynamic Mutations: Huntington disease, e) Late onset disorders:Alzheimer disease.

LSc 129: Plant Evolution and Diversity

1. Introduction: Evolutionary basics
2. Adaptive evolution: a) Adaptation- State and Process b) The Hardy-Weinberg Equilibrium equation
3. Species and Speciation: a) Classical concept; b) Reproductive barriers; c) Polyploidy and sympatric speciation
4. Origins and Early Events: a) Life's beginnings; b) Photosynthesis; c) Evolution of Eukaryotes; d) Sexual reproduction and meiosis; e) A word about Fungi
5. Migration on Land from Water: a) The invasion of land: The Embryophytes; b) The evolution of vascular tissue; c) Heterospory and seed habit; d) The flower

6. The aquatic landscape: a) Relative fitness and complexity; b) The Semiaquatic landscape
7. The terrestrial landscape: a) A morphospace for vascular plants; b) The adaptive walk of early seeds
8. Divergence and Convergence: a) Analogy and Homology; b) Divergence and Convergence; c) Other kind of trees
9. Tempos and Pattern.
10. The origin and diversification of land plants.
11. Plant identification and nomenclature, botanical accuracy of medicinal plants, edible and toxic plants, evolutionary bioprospecting, DNA-Bar Coding.

LSc 1210: Nanobiotechnology

1. Functional Principles of Nanobiotechnology- Information-Driven nanoassembly- Energetic- Chemical ransformation- Regulation- Traffic Across Membranes- Biomolecular Sensing- Self-Replication- Machine-Phase Nanobiotechnology .
2. Self assembling nanostructures- Self-Assembled Artificial Transmembrane Ion Channels-types, Methods, Self-Assembling Nanostructures from Coiled-Coil Peptides, Synthesis and Assembly using Bio-Derived Templates-Self-Assembling for Patterned Molecular Assembly.
3. Biological Nanomotors-Nanomotors, Architecture of Motor Domain- Force Generation- Stepping, Hopping and Slithering- Directionality- Motor Interactions.
4. Biologically Inspired Hybrid Nanodevices- Membrane Proteins and their native Condition- Protein Tool box- ATPase and Bacteriorhodopsin, Ion Channels and Connexin- Methods- Muscle Power, ATPase and BR Devices- Excitable Vesicles-Biochips.

LSc 1211: Developmental Biology

A. Plant system

1. Seed germination and seedling growth, Growth & differentiation of shoot and leaf.
2. Development of floral organs; Microsporogenesis & formation of male gametophyte; Megasporogenesis & formation of embryo sac.
3. Pollen-pistil interactions & fertilization.
4. Endosperm development and embryogenesis.
5. Fruit growth & development.

B. Animal system

1. Induction: Primary and secondary induction of the organizer, organizer concept, diffusible protein of the organizer. The functioning of Niewkoop center.
2. Regeneration: Regeneration of animals with special emphasis on the process of regeneration in Hydra and Amphibia.
3. Fertilization: Molecular mechanism and biochemical changes during the process.
4. Organogenesis in Animal with special reference to mammal.

Semester III

LSc 231: Development of Laboratory skills (Dry/ Wet)

Laboratory skills to be developed by the candidate under specific field of choice (30 marks)

Review of literature on the field of choice (other than dissertation topic) / presentation of innovative ideas (preparation of research project etc) (20 marks).

Semester IV

LSc 241: Term paper and Seminar

Term paper should be submitted in bound form and should contain at least 80 pages. Report preparation 30 marks, Presentation 10 marks, and viva-voce 10 marks.