DEVI AHILYA VISHWAVIDYALAYA, INDORE

School of Biochemistry

1.1.2
Minutes of the Meetings and Changes in Syllabus

SCHOOL OF BIOCHEMISTRY
DEVI AHILYA VISHWAVIDYALAYA
KHANDWA ROAD, INDORE – 452001

M.Sc. BIOCHEMISTRY (2017-2019)

Course Duration - 2 years
(4 Semesters)

SEMESTER	COURSE TITLE	CREDIT HRS
I	Analytical Biochemistry (Core course)	3
I	Chemistry of Biomolecules (Core course)	4
I	Cell Biology (Core Course)	3
I	Microbial Biochemistry (Discipline specific elective)	3
I	Genetics & Microbial Genetics (Discipline specific elective)	3
I	Lab work related to courses taught	8
I	Viva-Voce	4
II	Enzymology (Core course)	3
II	Immunology (Core course)	3
II	Metabolism I (Core course)	3
II	Metabolism II (Core course)	3
II	Nutritional Biochemistry (Discipline specific elective)	3
II	General Physiology (Discipline specific elective)	3
II	Environmental Toxicology (Discipline specific elective)	3
II	Lab work related to courses taught	8
II	Viva-Voce	4
III	Plant Biochemistry (Core course)	3
III	Molecular Biology (Core course)	3
III	Biotechnology (Core course)	3
III	Clinical Biochemistry (Discipline specific elective)	3
III	Biostatistics (Generic elective)	3
III	Computer Applications (Generic elective) 3	
III	Lab work related to courses taught	8
III	Seminars	2
III	Viva-Voce	4
IV	Research Project Work	8
IV	Project Work Presentation	8
IV	Viva-Voce	4
	Total Credit Hours	110

Elective Courses: Nutritional Biochemistry, Microbial Biochemistry, Clinical Biochemistry, Genetics, and Environmental Toxicology. The candidate has to opt for at least 4 courses in different semesters.

Examination Pattern: As per Ordinance 31.

SCHOOL OF BIOCHEMISTRY
SYLLABUS - M. Sc.

SEMESTER I

PAPER I : ANALYTICAL BIOCHEMISTRY (Core course) - 3 CREDITS

The concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson Hasselbalch equation, ionization of amino acids and proteins, measurement of pH.

Chomatography : Principles and applications of different types of chromatography. Thin layer, ion-exchange, hydrophobic-interaction, size-exclusion and affinity chromatography. High performance liquid chromatography.

Electrophoresis : Principle and applications of different types of electrophoretic techniques. Electrophoretic support media. Separation of proteins by one and two dimensional polyacrylamide gel electrophoresis. Isoelectric focussing technique.

Centrifugation techniques: Sedimentation velocity and RCF, differential and density gradient centrifugation, sub cellular fractionation, analytical and preparative ultracentrifugation techniques.

Molecular weight determination of macromolecules (in particular proteins) by size-exclusion chromatography, gel electrophoresis and ultracentrifugation.

Radioactivity : Disintegration of radionuclides, half-life of radioactive compounds, measurement of radioactivity, scintillation counting, Use of radioisotopes, *in vivo* and *in vitro* labelling of compounds, Isotopic tracer techniques, Autoradiography.

Spectrophotometry: Beer-Lamberts law, extinction coefficient and its importance, design of colorimeter, spectrometer and spectrophotometer. Applications of uv-vis spectrophotometry.

Principles of Atomic absorption spectrophotometry and its application in Biology.

Principles of optical rotatory dispersion and circular dichroism and X-ray diffraction and their applications in structure determination.

Principle of NMR spectroscopy and its application in Biology.

PAPER II : CHEMISTRY OF BIOMOLECULES (Core course) - 4 CREDITS

Carbohydrates: Occurrence, stereochemistry. classification, structure, properties and biological importance of carbohydrates. Mucopolysaccharides and amino sugars.

Proteins: Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation

and structure of proteins-primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins.

Lipids: Structure, distribution and biological importance of fats and fatty acids. Chemical properties and characterisation of fats. Waxes, cerebrosides, gangliosides, phospholipids and proteolipids. Steroids and bile salts. Prostaglandins.

Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides. Structure, types and biological role of RNA and DNA.

Vitamins: Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity.

Hormomes: Endocrine system, Chemical diversity of hormones, Synthesis of protein/ peptide hormones, steroid hormone synthesis, eicosanoid hormone synthesis. Hormone transport. Mechanism of hormome action and its regulation.

PAPER III : CELL BIOLOGY (Core Course) - 3 CREDITS

General structure of plant and animal cell, models of the biomembranes, lipid composition and structure of the plasma membrane, fluidity of lipids and mobility of proteins in the plasma membrane, factors affecting fluidity, ultrastructure of erythrocyte membrane.

Plant cell wall and its composition, primary and secondary cell wall, Transport of metabolites across the plasma membrane, non-mediated and mediated, passive and active transport, primary and secondary active transport. Glucose transporters, ionophores and different types of transport ATPases.

Structure and functions of the cell organelles: rough and smooth endoplasmic reticulum, ribosomes, golgi body, lysosomes and nucleus, marker enzymes. Protein sorting, signal hypothesis, membrane protein targeting and secretory process. Glycosylation of proteins.

Structure of mitochondria, different enzymes and their location, electron transport complexes, ATP synthase, mitochondrial DNA.

Structure of chloroplast, protein complexes and photosynthetic electron transport chain, DNA of the chloroplast.

PAPER IV: MICROBIAL BIOCHEMISTRY (Discipline specific elective) - 3 CREDITS

Microscopy and Staining: Light microscopy and electron microscopy. Preparation of specimens for light and electron microscopy, principle of staining. Handling and sterility maintenance in microbiological work.

Cellular organisation of bacteria with special reference to molecular organisation of cell wall, flagella and pilli, Chemotaxis, Endospore, Identification of bacteria.

Microbial nutrition, Requirement of various nutrients and their uptake, Nutritional types of microorganisms, culture media, Methods of isolation of pure culture.

Bacterial growth and its kinetics. Measurement of microbial growth. Effect of environmental factors on growth.

Energy metabolism in bacteria – Glucose metabolism, Fermentation types, Aerobic and anaerobic respiration, oxidation of inorganic molecules and bacterial photosynthesis.

Fermentation technology - Primary and secondary metabolites, Continuous and batch type culture techniques, Types and design of fermentors, fermentation processes - brewing, manufacture of penicillin, production of other antibiotics and organic compounds, single cell proteins.

Application of microbes in food industry, dairy products and food preservation. Food Spoilage and food borne diseases.

Viruses- Properties, cultivation, purification and assays, Structure, Classification. Replication of RNA and DNA bacteriphages. Virus-host interaction, Vaccines and prevention, Virions, viroids, prions.

Environmental microbiology: Microbial interactions, Nitrogen, Carbon and Sulphur cycles, Biopesticides, Bioremediation.

PAPER V: GENETICS AND MICROBIAL GENETICS (Discipline specific elective) - 3 CREDITS

Mendelian laws of inheritance: concept of genetic linkage, sex linked inheritance, multiple alleles, crossing over, genetic mapping by recombination frequency in diploids and haploids, Somatic cell hybridisation, complementation analysis, Gene fine structure, non mendelian inheritance.

Gene mutation: Molecular basis of mutation, Types of mutation, e.g. transition, transversion, frame shift, insertion, deletion, suppressor sensitive, true reversion and suppression, dominant and recessive, spontaneous and induced mutations, Mutagenicity testing.

DNA repair: UV repair systems in E. coli. Significance of thymine in DNA.

Genetic analysis in microbes: Modes of DNA transfer in bacteria, transformation, transduction and conjugation and their mechanisms, mapping by recombination, genetic map of E. coli.

SEMESTER - II

PAPER I : ENZYMOLOGY (Core course) - 3 CREDITS

Isolation and purification of enzymes, Systemic classification and nomenclature of enzymes.

Enzyme kinetics: Factors affecting rates of enzyme catalyzed reactions, unisubstrate reactions, concept of Michaelis - Menten, Briggs - Haldane relationship, Determination and significance of kinetic constants, catalytic rate constant and specificity constant, Limitations of Michaelis-Menten Kinetics, Co-operativity phenomenon, Hill and Scatchard plots.

Activation energy and Arrhenius concept. Michaelis pH functions and their significance.
Classification and kinetics of multisubstrate reactions, methods used to differentiate multisubstrate reaction mechanisms.

Reversible and irreversible inhibition, competitive, non competitive and uncompetitive inhibitions, Inhibitor constants.

Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes.

Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis.

Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease. Multienzyme system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Coenzyme action.

Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modifications of enzymes, cascade systems.

Immobilised enzymes and their industrial applications.

PAPER II : IMMUNOLOGY (Core course) - 3 CREDITS

Types of immunity, innate, acquired, passive and active, self vs nonself discrimination.
Physiology of immune response: HI and CMI specificity and memory, antigen-antibody reactions. Antigen types. Primary and secondary response.

Effector mechanisms in immunity, major effector proteins. Monocyte macrophage , phagocytosis and oxidative pathways in neutrophils.
Lymphokines, dendritic cells, K and NK cells.

Inflammation, mediators of inflammation, mechanism of inflammation.
APC, Presentation of antigens, costimulation, T_H cells.

Lymphoid tissue, origin and development, differentiation of lymphocytes, lymphocyte-sub-populations of mouse and man. Structure and function of lymphoid tissue. T and B cells and their antigens.

Antigen processing and presentation, cytosolic and endocytic pathways,

Immunoglobulins - structure, distribution and functions, Isotypic, Allotypic and Idiotypic variants. Immunoglobulin genes and DNA rearrangement. Synthesis of light and heavy chains, Immunoglobulin superfamily.

B cell development, T cell receptor, Superantigens, Signalling pathways in the activation of T and B cells.

MHC genes and products, polymorphism in MHC genes, Role of MHC antigens in immune responses, MHC antigens in transplantation and HLA tissue typing. H2 in mice, Structure and function of class I and class II molecules.

Hypersensitivity reactions and its types.

Complement system, mode of activation, classical and alternate pathway, biological functions of complement proteins.

Immunological tolerance and supression.

Immunotechniques- Agglutination and precipitation, Single and double immuno diffussion, Immunoelectrophoresis, Immunofluorescence, RIA and ELISA, Mixed lymphocyte reaction, cell mediated cytotoxicity.

PAPER III: METABOLISM- I (Core course) - 3 CREDITS

Bioenergetics : Laws of thermodynamics (no derivation). The concept of Gibbs free energy, exergonic and endergonic reactions, redox potential. High energy bond and key position of ATP, substrate level and oxidative phosphorylation. The importance of organophosphates.

Carbohydrates: Digestion and absorption of carbohydrates, glycogenesis and glycogenolysis, glycogen storage diseases, interconversion of hexoses, glycolysis and gluconeogenesis, Cori's cycle, pyruvate dehydrogenase complex, tri carboxylic acid-cycle, glyoxalate pathway, pentose phosphate pathway and uronic acid pathway. Regulation of carbohydrate metabolism.

Lipids: Digestion and absorption of fats. Oxidation of fatty acids: mitochondrial and peroxisomal β-oxidation, α-and ω-oxidation, oxidation of unsaturated and odd-chain fatty acids, ketone bodies, biosynthesis of fatty acids, desaturases, phospholipids and glycosphingolipids: synthesis and degradation, lipid storage diseases, cholesterol biosynthesis, bile acids and salts, lipoproteins, regulation of lipid metabolism.

PAPER IV: METABOLISM- II (Core course) - 3 CREDITS

Proteins: Digestion and absorption of proteins, general reactions of protein metabolism, essential amino acids. Nitrogen balance, Krebs Hanseleit cycle, its regulation and inherited disorders associated with it.

Metabolism of individual amino acids, Synthesis of important biochemical compounds from amino acids, One carbon metabolism, Inborn errors of protein metabolism.

Nucleic acids : Biosynthesis and degradation of purines and pyrimidine nucleotides and their regulation. Ribonucleotide reductase, Structure, mechanism of action, types and regulation. Synthesis of coenzymes involving nucleotides. Inhibitors of nucleic acid biosynthesis. Inherited disorders of purine and pyrimidine nucleotide metabolism.

Mineral metabolism: Biological role of minerals and trace elements, toxic effects of heavy metals.

PAPER V: NUTRITIONAL BIOCHEMISTRY (Discipline specific elective) - 3 CREDITS

Direct and indirect calorimetry, energy value of the foods, thermal equivalent of oxygen, respiratory quotient, calorigenic action of the foods, basal metabolic rate: definition and its measurement, factors affecting BMR, energy requirements of the human beings.

Nutritional aspects of the carbohydrates: Different dietary types, available and unavailable carbohydrates and their functions. Special role of the non-starch polysaccharides as dietary fibre.

Nutritional aspects of the lipids: Different dietary types and their functions. Fatty acid composition of dietary lipids and essential fatty acids.

Nutritional aspects of the proteins: Nutritional classification of proteins, essential amino acids, nutritive value of proteins and the methods for its determination: nitrogen balance, digestibility coefficient, biological value, NPU, chemical score and limiting amino acids.

Nutritional aspects of the water and fat soluble vitamins: Sources, requirements, functions and related disorders.

Nutritional aspects of the minerals: Sources, requirements, functions and related disorders.

Food processing and loss of nutrients during processing and cooking, naturally occurring anti-nutrients.

Balanced diet: Recommended dietary allowances for different categories of the human beings.

Protein energy malnutrition, starvation and obesity.

PAPER VI : GENERAL PHYSIOLOGY (Discipline specific elective) - 3 CREDITS

Composition, properties and functions of blood, plasma and blood corpuscles, functions of plasma proteins, structure and functions of hemoglobin, abnormal hemoglobins, blood coagulation - mechanism and regulation. Blood groups.

Respiratory unit, respiratory membrane, exchange and transport of respiratory gases in the body, role of 2,3 DPG, Bohr effect and chloride shift. Non respiratory functions, pulmonary function tests.

Structure of nephron, blood and nerve supply to nephron, composition and mechanism of urine formation, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Autoregulation, Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance. Hydrogen ion homeostasis, acid-base balance - metabolic and respiratory acidosis and alkalosis. Kidney function tests.

Classification of muscles, Structure of skeletal, smooth and cardiac muscles. Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles. Role of ATP during muscle contraction, sources of energy. Types of muscle fibres.

Structure and types of neurons, nerve fibres, nerve impulse; origin and transmission, neuromuscular junction; mechanism of nerve conduction. Reflex action and reflex arc.

PAPER VII : ENVIRONMENTAL TOXICOLOGY (Discipline specific elective) - 3.0 CREDITS

Toxicology principles, Types, characteristics and sources of pollutants, Exposure, absorption, biotransformation. Abiotic transformation.
Toxicity testing and rating. LD50, animal testing-acute and systemic toxicity.
Toxokinetics, Risk assessment.
Occupational and Eco-toxicology. Trace elements, pesticide toxicology, heavy metal toxicology. Organic and Inorganic toxicants. Biomagnification.
Detection of toxicants.
Carcinogens, teratogens, mutagens.
Mechanisms of toxicity.
Epidemiology.

SEMESTER - III

PAPER I: PLANT BIOCHEMISTRY (Core course) - 3 CREDITS

Photosynthesis: Ultrastructure and organisation of chloroplast, lipid compostion of chloroplast membranes, chloroplast genome, Light reaction, electron transport chain. Thylakoid membrane protein complexes.

Benson-Calvin cycle, its regulation, Biochemistry of RUBP carboxylase/oxygenase, activation of RUBISCO, stereochemistry of RUBISCO, oxygenation reaction, photorespiration and CO_2 compensation point,

C_4 photosynthesis - Hatch and slack pathway, CAM plants and regulation of CAM pathway.

Nitrogen Metabolism: Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure and organization of 'NIF' genes and its regulation. Hydrogen uptake and bacterial hydrogenases. Genes involved in symbiotic nitrogen fixation

Nitrate Assimilation: Enzymes of nitrate assimilation, nitrate reductase and nitrite reductase, their properties and regulation of their synthesis and activity.
Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and glutamate dehydrogenase.

Special features of secondary plant metabolism, Defence system in plants.

Water and mineral balance in plants.

Structure, functions and mechanism of action and synthesis of phytohormones.

PAPER II : MOLECULAR BIOLOGY (Core course) - 3 CREDITS

Concept and definition of the gene, complexity of the eukaryotic gene, structural organization of the DNA in the nuclear material, general properties of histones, nucleosomes and solenoid structure.

DNA synthesis : The enzymes of DNA replication in prokaryotes and eukaryotes, mechanism of replication in bacteria and viruses, reverse transcriptase, salient features of eukaryotic nuclear and mitochondrial DNA replication.

RNA synthesis : The enzymes of transcription in prokaryotes and eukaryotes, mechanism of transcription in bacteria, post transcriptional processing of mRNA, rRNA and tRNA: differential mRNA processing, cap and poly A tail formation, role of ribozymes.

Protein synthesis : Concept of the genetic code, wobble hypothesis, enzymes of translation in prokaryotes and eukaryotes, mechanism of protein synthesis in prokaryotes, post translational processing of proteins. Inhibitors of protein synthesis.

Regulation of gene expression in prokaryotes, structure and mechanism of different operons.

PAPER III : BIOTECHNOLOGY (Core course) - 3 CREDITS

Basic principles of genetic engineering: Methods of creating recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action, construction of DNA library, genomic vs cDNA library, chemical synthesis of gene, cloning vectors (lambda phage, plasmid, M-13 phage, cosmid, shuttle vectors, yeast and viral vectors, expression vectors). Ligation, transformation, transfection selection/screening.

Ananlysis of genomic DNA by Southern hybridization. Northern and Western blotting techniques. Preparation of radiolabelled and synthetic probes.

Restriction mapping: Restriction fragment length polymorphism (RFLP). DNA footprinting, Modification interference assay.

DNA sequencing techniques: plus and minus, dideoxynucleotide, Maxam and Gilbert methods,

Amplification of DNA by polymerase chain reaction (PCR). Types of PCR,

Site directed mutagenesis.

Gene transfer methods for animals and plants; Agrobacterium mediated gene transfer, electroporation and particle gun. Transgenic animals and transgenic plants.

Application of genetic engineering in medicine and agriculture and environment.

DNA microarrays, antisense technology, RNA interference.

PAPER IV : CLINICAL BIOCHEMISTRY (Discipline specific elective)
- 3 CREDITS

Automation in clinical biochemistry, Quality assurance, External and internal quality control measurements.

Collection and preservation of biological fluids. Chemical analysis of CSF.
Electrolytes and various disorders related to electrolyte imbalance.

Disorders of carbohydrate metabolism, Diabetes mellitus, Glycohemoglobins, Hypoglycemia, Ketone bodies, Glucose tolerance test.

Lipids, lipoproteins and apolipoproteins-role in diseases.

Evaluation of organ function tests of gastric, pancreas, kidney and liver.

Bilirubin, direct and indirect vanderwaal tests and their clinical significance, fatty liver, jaundice. Bile pigments - chemical nature and physiological significance.

Enzymes in differential diagnosis of diseases and their clinical significance.

Detoxification, Phase I and Phase II reactions, Enzymes of detoxication.

Carcinogenesis, characteristics of cancerous cells, agents promoting carcinogenesis.

Free radicals in biological systems, Antioxidants.

PAPER V: BIOSTATISTICS (Generic elective) - 3 CREDITS

Representation of Data : Frequency distribution. Line diagram. Bar diagram. Histogram and Relative Frequency Histogram. Frequency Polygon and Frequency curve. Pie diagram, cumulative frequency distribution . Ogive curve, Stem and Leaf plot and Box-Plot.

Measures of Central Tendency : Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean.
Measures of Dispersion : Range, Semi-interquartile range, Mean deviation. Standard deviation. Coefficient of variation.

Correlation and Regression : Scatter diagram. Correlation coefficient. Method of Least Squares. Fitting of regression line. Coefficient of determination. Non linear reqression.

Probability and Probability distributions : Classical and Statistical defination of probability. Conditional Probability. Binomial. Poisson and Normal Distributions.
Statistical Hypothesis, Level of Significance,Type I and Type II errors, P- value.
Parametric and Non-Parametric Tests.

Tests of Significance : Tests based on t, z, F and Chi-square distributions and their applications.
Analysis of Variance : One way and Two way.
Designing of Experiments, Factorial Experiments.

PAPER VI : COMPUTER APPLICATIONS (Generic elective) - 3 CREDITS

Computer Fundamental : Introduction to software and hardware, Introduction to computers, Application of computers,Use of computer in general Life, use in Scientific research, Types of software, Concept of OS, Different types of OS.
Basic Concepts of databases and RDBMS.

Introduction to DOS/Basic commands of DOS, Internal and External commands

Introduction to Windows operating system. Application of Windows. Tools of Windows 10.

Introduction to MS-Office 2013. Application of MS-Word. MS-Excel. MS-Powerpoint (with complete Tools of each).

Definition of Network. Application of networking. Introduction to Internet, Intranet and Extranet. Various application components of Internet. Differentiate between Internet and Intranet. Introduction to E-Commerce and M-Commerce concept

Basics of Bioinformatics, Biological Database: Nucleic acid Sequence, Protein Sequence, Protein structure and Genome database. Bioinformatics Tools and software: BLAST, ClustalW, Rasmol and Expasy tools.

SEMINAR : PRESENTATION OF RESEARCH PAPERS - 2 CREDITS

List of Practicals

M.Sc. Semester I

1. Qualitative identification of carbohydrates and proteins.
2. Normal and abnormal constituents of urine.
3. Free & total acidity in gastric juice
4. Quantitative estimation of proteins by different methods.
5. Quantitative estimation of carbohydrates.
6. Estimation of Amino Acids by Sorenson formal titration.
7. Separation of amino acids, sugars and phospholipids by chromatography.
8. Isolation of casein from milk, lecithin from egg yolk and glycogen from liver.
9. Isolation of cell organelles.
10. Cultivation, isolation and staining of microorganisms.

M.Sc. Semester II

1. Estimation of reducing sugars by Nelson Somogyii Method.
2. Estimation of maltose by DNS Method.
3. Estimation of creatinine, chloride and inorganic phosphate in urine sample.
4. Estimation of ascorbic acid and riboflavin.
5. Estimation of methionine, tyrosine and tryptophan.
6. RBC and WBC Count, Hb estimation and blood group determination.
7. Determination of iodine value and saponification number of fats.
8. Assay and kinetic analysis of salivary amylase; Effect of enzymes and substrate concentration, pH, and temperature on activity.
9. Assay and partial purification of urease
10. Assay of activities of enzymes from different sources.

M.Sc. Semester III

1. Extraction and estimation of proteins, RNA and DNA from plant material.
2. Assay and partial purification of wheat germ amylase.
3. Assay of enzymes of N-metabolism: NR, GDH, GS and GOGAT.
4. Partial purification of proteins by salt precipitation.
5. Separation of proteins by ion exchange chromatography.
6. Electrophoretic separation of protein.
7. DNA and RNA Isolation and Estimation.
8. Estimation of Blood Sugar
9. Estimation of the following : Phosphate, Ca, Creatinine, Chloride, Urea, Bilirubin, Uric acid, Cholestrol, Proteins etc.
10. Assay of Serum enzymes : Acid and alkaline phosphatase, GOT, GPT and Amylase.

M.Sc. Semester IV

Research Project Work.

NOTE :

1. The practicals will be designed by the course teacher(s) as per available facilities.
2. The research paper for Seminars in III Semester shall be selected by the student with the advice of course teachers.
3. Summer Training is optional, for which additional credits will not be awarded. The School will try to arrange for summer training programme.

GUIDELINES FOR SEMESTER CREDIT SYSTEM

- A semester consists of 18 weeks.
- One hour per week of lecture for one semester constitutes 1 credit.
- One hour per week of laboratory work for one semester constitutes 0.5 credit.
- The grading is made on a 10 point scale. O at 10, A+ at 9, A at 8, B+ at 7, B at 6, C at 5, P at 4, F at 0, Ab at 0 .
- The asterisk (*) against the grade earned indicates second attempt.
- A comprehensive viva voce of 4 virtual credits is conducted at the end of each semester by a board of 4 examiners, at least one of them is external.
- The SGPA is Semester Grade Point Average, a measure of performance of a student in a semester. The CGPA is Cumulative Grade Point Average, a measure of cumulative performance of a student over all the semesters completed.
- The division obtained is correlated with calculated CGPA as follows:

First division with Distinction	CGPA>8.0
First Division	6.50<CGPA<8.0
Second Division	5.00<CGPA<6.50
Pass Division	4.00<CGPA<5.00

- From CGPA the percentage is calculated as follows:

  Equivalent Percentage = CGPA X 10.

References:

Michael M. Cox and David L. Nelson – Lehninger's Principles of Biochemistry

Donald Voet – Principles of Biochemistry

Donald Voet and Judith Voet – Biochemistry

Harper, Granner and Murray – Harper's Review of Biochemistry

Geoffrey M. Zubay – Biochemistry

West and Todd – Textbook of Biochemistry

Devlin – Textbook of Biochemistry

Horton – Principles of Biochemistry

Garrett and Grisham – Biochemistry

Lubert Stryer – Biochemistry

Keith Wilson and John Walker – Principles and Techniques of Biochemistry and Molecular Biology.

E.J. Gardner – Principles of Genetics

D. Peter Snustad – Principles of Genetics (5^{th} edition)

Daniel L. Hartl – Genetic analysis of Genes and Genomes

Klaus D. Elgert – Immunology

Kimball – The Nature of Immunity

Kuby J, Richard J. – Immunology

Roitt and Brostoff - Immunology

William Hopkins – Introduction to Plant Physiology

Lincoln Taiz and Eduardo Zeiger – Plant Physiology

Hopkins – Introduction to Plant Physiology

Salisbury and Ross – Plant Physiology

Guyton – Textbook of Medical Physiology

C.V.S. Murthy – Bioinformatics

Brody – Nutritional Biochemistry

Lodish, Berk, Zipursky, Matsudaria et.al. – Molecular Cell Biology

Albert, Johnson, Lewis, Raff, Robert, Walter – Molecular Biology of the Cell

Gerald Karp – Cell Biology

Tom Pollard – Cell Biology

Becker – The World of the Cell

Bruce Alberts – Essential of Cell Biology

Geoffrey M. Cooper – The Cell – A Molecular Approach

Glick & Pasternack – Molecular Biotechnology

Varley – Practical Clinical Biochemistry

Jacquelyn G. Black – Microbiology

Benjamin Lewin – Genes

David Freifelder – Molecular Biology

T.A. Brown – Genomes, Gene Cloning

SCHOOL OF BIOCHEMISTRY
DEVI AHILYA VISHWAVIDYALAYA
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M.Sc. BIOCHEMISTRY (2017-2019)

Course Duration - 2 years
(4 Semesters)

SEMESTER	COURSE TITLE	CREDIT HRS
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I	Cell Biology (Core Course)	3
I	Microbial Biochemistry (Discipline specific elective)	3
I	Genetics & Microbial Genetics (Discipline specific elective)	3
I	Lab work related to courses taught	8
I	Viva-Voce	4
II	Enzymology (Core course)	3
II	Immunology (Core course)	3
II	Metabolism I (Core course)	3
II	Metabolism II (Core course)	3
II	Nutritional Biochemistry (Discipline specific elective)	3
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III	Biostatistics (Generic elective)	3
III	Computer Applications (Generic elective) 3	
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III	Seminars	2
III	Viva-Voce	4
IV	Research Project Work	8
IV	Project Work Presentation	8
IV	Viva-Voce	4
	Total Credit Hours	110

Elective Courses: Nutritional Biochemistry, Microbial Biochemistry, Clinical Biochemistry, Genetics, and Environmental Toxicology. The candidate has to opt for at least 4 courses in different semesters.

Examination Pattern: As per Ordinance 31.

SCHOOL OF BIOCHEMISTRY
SYLLABUS - M. Sc.

SEMESTER I

PAPER I : ANALYTICAL BIOCHEMISTRY (Core course) - 3 CREDITS

The concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson Hasselbalch equation, ionization of amino acids and proteins, measurement of pH.

Chomatography : Principles and applications of different types of chromatography. Thin layer, ion-exchange, hydrophobic-interaction, size-exclusion and affinity chromatography. High performance liquid chromatography.

Electrophoresis : Principle and applications of different types of electrophoretic techniques. Electrophoretic support media. Separation of proteins by one and two dimensional polyacrylamide gel electrophoresis. Isoelectric focussing technique.

Centrifugation techniques: Sedimentation velocity and RCF, differential and density gradient centrifugation, sub cellular fractionation, analytical and preparative ultracentrifugation techniques.

Molecular weight determination of macromolecules (in particular proteins) by size-exclusion chromatography, gel electrophoresis and ultracentrifugation.

Radioactivity : Disintegration of radionuclides, half-life of radioactive compounds, measurement of radioactivity, scintillation counting, Use of radioisotopes, *in vivo* and *in vitro* labelling of compounds, Isotopic tracer techniques, Autoradiography.

Spectrophotometry: Beer-Lamberts law, extinction coefficient and its importance, design of colorimeter, spectrometer and spectrophotometer. Applications of uv-vis spectrophotometry.

Principles of Atomic absorption spectrophotometry and its application in Biology.

Principles of optical rotatory dispersion and circular dichroism and X-ray diffraction and their applications in structure determination.

Principle of NMR spectroscopy and its application in Biology.

PAPER II : CHEMISTRY OF BIOMOLECULES (Core course) - 4 CREDITS

Carbohydrates: Occurrence, stereochemistry. classification, structure, properties and biological importance of carbohydrates. Mucopolysaccharides and amino sugars.

Proteins: Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation

and structure of proteins-primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins.

Lipids: Structure, distribution and biological importance of fats and fatty acids. Chemical properties and characterisation of fats. Waxes, cerebrosides, gangliosides, phospholipids and proteolipids. Steroids and bile salts. Prostaglandins.

Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides. Structure, types and biological role of RNA and DNA.

Vitamins: Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity.

Hormomes: Endocrine system, Chemical diversity of hormones, Synthesis of protein/ peptide hormones, steroid hormone synthesis, eicosanoid hormone synthesis. Hormone transport. Mechanism of hormome action and its regulation.

PAPER III : CELL BIOLOGY (Core Course) - 3 CREDITS

General structure of plant and animal cell, models of the biomembranes, lipid composition and structure of the plasma membrane, fluidity of lipids and mobility of proteins in the plasma membrane, factors affecting fluidity, ultrastructure of erythrocyte membrane.

Plant cell wall and its composition, primary and secondary cell wall, Transport of metabolites across the plasma membrane, non-mediated and mediated, passive and active transport, primary and secondary active transport. Glucose transporters, ionophores and different types of transport ATPases.

Structure and functions of the cell organelles: rough and smooth endoplasmic reticulum, ribosomes, golgi body, lysosomes and nucleus, marker enzymes. Protein sorting, signal hypothesis, membrane protein targeting and secretory process. Glycosylation of proteins.

Structure of mitochondria, different enzymes and their location, electron transport complexes, ATP synthase, mitochondrial DNA.

Structure of chloroplast, protein complexes and photosynthetic electron transport chain, DNA of the chloroplast.

PAPER IV: MICROBIAL BIOCHEMISTRY (Discipline specific elective) - 3 CREDITS

Microscopy and Staining: Light microscopy and electron microscopy. Preparation of specimens for light and electron microscopy, principle of staining. Handling and sterility maintenance in microbiological work.

Cellular organisation of bacteria with special reference to molecular organisation of cell wall, flagella and pilli, Chemotaxis, Endospore, Identification of bacteria.

Microbial nutrition, Requirement of various nutrients and their uptake, Nutritional types of microorganisms, culture media, Methods of isolation of pure culture.

Bacterial growth and its kinetics. Measurement of microbial growth. Effect of environmental factors on growth.

Energy metabolism in bacteria – Glucose metabolism, Fermentation types, Aerobic and anaerobic respiration, oxidation of inorganic molecules and bacterial photosynthesis.

Fermentation technology - Primary and secondary metabolites, Continuous and batch type culture techniques, Types and design of fermentors, fermentation processes - brewing, manufacture of penicillin, production of other antibiotics and organic compounds, single cell proteins.

Application of microbes in food industry, dairy products and food preservation. Food Spoilage and food borne diseases.

Viruses- Properties, cultivation, purification and assays, Structure, Classification. Replication of RNA and DNA bacteriphages. Virus-host interaction, Vaccines and prevention, Virions, viroids, prions.

Environmental microbiology: Microbial interactions, Nitrogen, Carbon and Sulphur cycles, Biopesticides, Bioremediation.

PAPER V: GENETICS AND MICROBIAL GENETICS (Discipline specific elective) - 3 CREDITS

Mendelian laws of inheritance: concept of genetic linkage, sex linked inheritance, multiple alleles, crossing over, genetic mapping by recombination frequency in diploids and haploids, Somatic cell hybridisation, complementation analysis, Gene fine structure, non mendelian inheritance.

Gene mutation: Molecular basis of mutation, Types of mutation, e.g. transition, transversion, frame shift, insertion, deletion, suppressor sensitive, true reversion and suppression, dominant and recessive, spontaneous and induced mutations, Mutagenicity testing.

DNA repair: UV repair systems in E. coli. Significance of thymine in DNA.

Genetic analysis in microbes: Modes of DNA transfer in bacteria, transformation, transduction and conjugation and their mechanisms, mapping by recombination, genetic map of E. coli.

SEMESTER - II

PAPER I : ENZYMOLOGY (Core course) - 3 CREDITS

Isolation and purification of enzymes, Systemic classification and nomenclature of enzymes.

Enzyme kinetics: Factors affecting rates of enzyme catalyzed reactions, unisubstrate reactions, concept of Michaelis - Menten, Briggs - Haldane relationship, Determination and significance of kinetic constants, catalytic rate constant and specificity constant, Limitations of Michaelis-Menten Kinetics, Co-operativity phenomenon, Hill and Scatchard plots.

Activation energy and Arrhenius concept. Michaelis pH functions and their significance.
Classification and kinetics of multisubstrate reactions, methods used to differentiate multisubstrate reaction mechanisms.

Reversible and irreversible inhibition, competitive, non competitive and uncompetitive inhibitions, Inhibitor constants.

Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes.

Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis.

Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymease. Multienzyme system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Coenzyme action.

Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modifications of enzymes, cascade systems.

Immobilised enzymes and their industrial applications.

PAPER II : IMMUNOLOGY (Core course) - 3 CREDITS

Types of immunity, innate, acquired, passive and active, self vs nonself discrimination.
Physiology of immune response: HI and CMI specificity and memory, antigen-antibody reactions. Antigen types. Primary and secondary response.

Effector mechanisms in immunity, major effector proteins. Monocyte macrophage , phagocytosis and oxidative pathways in neutrophils.
Lymphokines, dendritic cells, K and NK cells.

Inflammation, mediators of inflammation, mechanism of inflammation.
APC, Presentation of antigens, costimulation, T_H cells.

Lymphoid tissue, origin and development, differentiation of lymphocytes, lymphocyte-sub-populations of mouse and man. Structure and function of lymphoid tissue. T and B cells and their antigens.

Antigen processing and presentation, cytosolic and endocytic pathways,

Immunoglobulins - structure, distribution and functions, Isotypic, Allotypic and Idiotypic variants. Immunoglobulin genes and DNA rearrangement. Synthesis of light and heavy chains, Immunoglobulin superfamily.

B cell development, T cell receptor, Superantigens, Signalling pathways in the activation of T and B cells.

MHC genes and products, polymorphism in MHC genes, Role of MHC antigens in immune responses, MHC antigens in transplantation and HLA tissue typing. H2 in mice, Structure and function of class I and class II molecules.

Hypersensitivity reactions and its types.

Complement system, mode of activation, classical and alternate pathway, biological functions of complement proteins.

Immunological tolerance and supression.

Immunotechniques- Agglutination and precipitation, Single and double immuno diffussion, Immunoelectrophoresis, Immunofluorescence, RIA and ELISA, Mixed lymphocyte reaction, cell mediated cytotoxicity.

PAPER III: METABOLISM- I (Core course) - 3 CREDITS

Bioenergetics : Laws of thermodynamics (no derivation). The concept of Gibbs free energy, exergonic and endergonic reactions, redox potential. High energy bond and key position of ATP, substrate level and oxidative phosphorylation. The importance of organophosphates.

Carbohydrates: Digestion and absorption of carbohydrates, glycogenesis and glycogenolysis, glycogen storage diseases, interconversion of hexoses, glycolysis and gluconeogenesis, Cori's cycle, pyruvate dehydrogenase complex, tri carboxylic acid-cycle, glyoxalate pathway, pentose phosphate pathway and uronic acid pathway. Regulation of carbohydrate metabolism.

Lipids: Digestion and absorption of fats. Oxidation of fatty acids: mitochondrial and peroxisomal β-oxidation, α-and ω-oxidation, oxidation of unsaturated and odd-chain fatty acids, ketone bodies, biosynthesis of fatty acids, desaturases, phospholipids and glycosphingolipids: synthesis and degradation, lipid storage diseases, cholesterol biosynthesis, bile acids and salts, lipoproteins, regulation of lipid metabolism.

PAPER IV: METABOLISM- II (Core course) - 3 CREDITS

Proteins: Digestion and absorption of proteins, general reactions of protein metabolism, essential amino acids. Nitrogen balance, Krebs Hanseleit cycle, its regulation and inherited disorders associated with it.

Metabolism of individual amino acids, Synthesis of important biochemical compounds from amino acids, One carbon metabolism, Inborn errors of protein metabolism.

Nucleic acids : Biosynthesis and degradation of purines and pyrimidine nucleotides and their regulation. Ribonucleotide reductase, Structure, mechanism of action, types and regulation. Synthesis of coenzymes involving nucleotides. Inhibitors of nucleic acid biosynthesis. Inherited disorders of purine and pyrimidine nucleotide metabolism.

Mineral metabolism: Biological role of minerals and trace elements, toxic effects of heavy metals.

PAPER V: NUTRITIONAL BIOCHEMISTRY (Discipline specific elective) - 3 CREDITS

Direct and indirect calorimetry, energy value of the foods, thermal equivalent of oxygen, respiratory quotient, calorigenic action of the foods, basal metabolic rate: definition and its measurement, factors affecting BMR, energy requirements of the human beings.

Nutritional aspects of the carbohydrates: Different dietary types, available and unavailable carbohydrates and their functions. Special role of the non-starch polysaccharides as dietary fibre.

Nutritional aspects of the lipids: Different dietary types and their functions. Fatty acid composition of dietary lipids and essential fatty acids.

Nutritional aspects of the proteins: Nutritional classification of proteins, essential amino acids, nutritive value of proteins and the methods for its determination: nitrogen balance, digestibility coefficient, biological value, NPU, chemical score and limiting amino acids.

Nutritional aspects of the water and fat soluble vitamins: Sources, requirements, functions and related disorders.

Nutritional aspects of the minerals: Sources, requirements, functions and related disorders.

Food processing and loss of nutrients during processing and cooking, naturally occurring anti-nutrients.

Balanced diet: Recommended dietary allowances for different categories of the human beings.

Protein energy malnutrition, starvation and obesity.

PAPER VI : GENERAL PHYSIOLOGY (Discipline specific elective) - 3 CREDITS

Composition, properties and functions of blood, plasma and blood corpuscles, functions of plasma proteins, structure and functions of hemoglobin, abnormal hemoglobins, blood coagulation - mechanism and regulation. Blood groups.

Respiratory unit, respiratory membrane, exchange and transport of respiratory gases in the body, role of 2,3 DPG, Bohr effect and chloride shift. Non respiratory functions, pulmonary function tests.

Structure of nephron, blood and nerve supply to nephron, composition and mechanism of urine formation, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Autoregulation, Regulation of water and electrolyte balance, role of kidneys and hormones in their maintenance. Hydrogen ion homeostasis, acid-base balance - metabolic and respiratory acidosis and alkalosis. Kidney function tests.

Classification of muscles, Structure of skeletal, smooth and cardiac muscles. Actin, myosin, tropomyosin, troponin, Z disc and H line components. The sliding filament mechanism and subcellular ion movements during the contraction cycle in skeletal muscles. Role of ATP during muscle contraction, sources of energy. Types of muscle fibres.

Structure and types of neurons, nerve fibres, nerve impulse; origin and transmission, neuromuscular junction; mechanism of nerve conduction. Reflex action and reflex arc.

PAPER VII : ENVIRONMENTAL TOXICOLOGY (Discipline specific elective) - 3.0 CREDITS

Toxicology principles, Types, characteristics and sources of pollutants, Exposure, absorption, biotransformation. Abiotic transformation.
Toxicity testing and rating. LD50, animal testing-acute and systemic toxicity.
Toxokinetics, Risk assessment.
Occupational and Eco-toxicology. Trace elements, pesticide toxicology, heavy metal toxicology. Organic and Inorganic toxicants. Biomagnification.
Detection of toxicants.
Carcinogens, teratogens, mutagens.
Mechanisms of toxicity.
Epidemiology.

SEMESTER - III

PAPER I: PLANT BIOCHEMISTRY (Core course) - 3 CREDITS

Photosynthesis: Ultrastructure and organisation of chloroplast, lipid compostion of chloroplast membranes, chloroplast genome, Light reaction, electron transport chain. Thylakoid membrane protein complexes.

Benson-Calvin cycle, its regulation, Biochemistry of RUBP carboxylase/oxygenase, activation of RUBISCO, stereochemistry of RUBISCO, oxygenation reaction, photorespiration and CO_2 compensation point,

C_4 photosynthesis - Hatch and slack pathway, CAM plants and regulation of CAM pathway.

Nitrogen Metabolism: Nitrogen fixation, nitrogenase complex, electron transport chain and mechanism of action of nitrogenase. Structure and organization of 'NIF' genes and its regulation. Hydrogen uptake and bacterial hydrogenases. Genes involved in symbiotic nitrogen fixation

Nitrate Assimilation: Enzymes of nitrate assimilation, nitrate reductase and nitrite reductase, their properties and regulation of their synthesis and activity.
Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and glutamate dehydrogenase.

Special features of secondary plant metabolism, Defence system in plants.

Water and mineral balance in plants.

Structure, functions and mechanism of action and synthesis of phytohormones.

PAPER II : MOLECULAR BIOLOGY (Core course) - 3 CREDITS

Concept and definition of the gene, complexity of the eukaryotic gene, structural organization of the DNA in the nuclear material, general properties of histones, nucleosomes and solenoid structure.

DNA synthesis : The enzymes of DNA replication in prokaryotes and eukaryotes, mechanism of replication in bacteria and viruses, reverse transcriptase, salient features of eukaryotic nuclear and mitochondrial DNA replication.

RNA synthesis : The enzymes of transcription in prokaryotes and eukaryotes, mechanism of transcription in bacteria, post transcriptional processing of mRNA, rRNA and tRNA: differential mRNA processing, cap and poly A tail formation, role of ribozymes.

Protein synthesis : Concept of the genetic code, wobble hypothesis, enzymes of translation in prokaryotes and eukaryotes, mechanism of protein synthesis in prokaryotes, post translational processing of proteins. Inhibitors of protein synthesis.

Regulation of gene expression in prokaryotes, structure and mechanism of different operons.

PAPER III : BIOTECHNOLOGY (Core course) - 3 CREDITS

Basic principles of genetic engineering: Methods of creating recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action, construction of DNA library, genomic vs cDNA library, chemical synthesis of gene, cloning vectors (lambda phage, plasmid, M-13 phage, cosmid, shuttle vectors, yeast and viral vectors, expression vectors). Ligation, transformation, transfection selection/screening.

Ananlysis of genomic DNA by Southern hybridization. Northern and Western blotting techniques. Preparation of radiolabelled and synthetic probes.

Restriction mapping: Restriction fragment length polymorphism (RFLP). DNA footprinting, Modification interference assay.

DNA sequencing techniques: plus and minus, dideoxynucleotide, Maxam and Gilbert methods,

Amplification of DNA by polymerase chain reaction (PCR). Types of PCR,

Site directed mutagenesis.

Gene transfer methods for animals and plants; Agrobacterium mediated gene transfer, electroporation and particle gun. Transgenic animals and transgenic plants.

Application of genetic engineering in medicine and agriculture and environment.

DNA microarrays, antisense technology, RNA interference.

PAPER IV : CLINICAL BIOCHEMISTRY (Discipline specific elective)
- 3 CREDITS

Automation in clinical biochemistry, Quality assurance, External and internal quality control measurements.

Collection and preservation of biological fluids. Chemical analysis of CSF.
Electrolytes and various disorders related to electrolyte imbalance.

Disorders of carbohydrate metabolism, Diabetes mellitus, Glycohemoglobins, Hypoglycemia, Ketone bodies, Glucose tolerance test.

Lipids, lipoproteins and apolipoproteins-role in diseases.

Evaluation of organ function tests of gastric, pancreas, kidney and liver.

Bilirubin, direct and indirect vanderwaal tests and their clinical significance, fatty liver, jaundice. Bile pigments - chemical nature and physiological significance.

Enzymes in differential diagnosis of diseases and their clinical significance.

Detoxification, Phase I and Phase II reactions, Enzymes of detoxication.

Carcinogenesis, characteristics of cancerous cells, agents promoting carcinogenesis.

Free radicals in biological systems, Antioxidants.

PAPER V: BIOSTATISTICS (Generic elective) - 3 CREDITS

Representation of Data : Frequency distribution. Line diagram. Bar diagram. Histogram and Relative Frequency Histogram. Frequency Polygon and Frequency curve. Pie diagram, cumulative frequency distribution . Ogive curve, Stem and Leaf plot and Box-Plot.

Measures of Central Tendency : Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean.
Measures of Dispersion : Range, Semi-interquartile range, Mean deviation. Standard deviation. Coefficient of variation.

Correlation and Regression : Scatter diagram. Correlation coefficient. Method of Least Squares. Fitting of regression line. Coefficient of determination. Non linear reqression.

Probability and Probability distributions : Classical and Statistical defination of probability. Conditional Probability. Binomial. Poisson and Normal Distributions.
Statistical Hypothesis, Level of Significance,Type I and Type II errors, P- value.
Parametric and Non-Parametric Tests.

Tests of Significance : Tests based on t, z, F and Chi-square distributions and their applications.
Analysis of Variance : One way and Two way.
Designing of Experiments, Factorial Experiments.

PAPER VI : COMPUTER APPLICATIONS (Generic elective) - 3 CREDITS

Computer Fundamental : Introduction to software and hardware, Introduction to computers, Application of computers,Use of computer in general Life, use in Scientific research, Types of software, Concept of OS, Different types of OS.
Basic Concepts of databases and RDBMS.

Introduction to DOS/Basic commands of DOS, Internal and External commands

Introduction to Windows operating system. Application of Windows. Tools of Windows 10.

Introduction to MS-Office 2013. Application of MS-Word. MS-Excel. MS-Powerpoint (with complete Tools of each).

Definition of Network. Application of networking. Introduction to Internet, Intranet and Extranet. Various application components of Internet. Differentiate between Internet and Intranet. Introduction to E-Commerce and M-Commerce concept

Basics of Bioinformatics, Biological Database: Nucleic acid Sequence, Protein Sequence, Protein structure and Genome database. Bioinformatics Tools and software: BLAST, ClustalW, Rasmol and Expasy tools.

SEMINAR : PRESENTATION OF RESEARCH PAPERS - 2 CREDITS

List of Practicals

M.Sc. Semester I

1. Qualitative identification of carbohydrates and proteins.
2. Normal and abnormal constituents of urine.
3. Free & total acidity in gastric juice
4. Quantitative estimation of proteins by different methods.
5. Quantitative estimation of carbohydrates.
6. Estimation of Amino Acids by Sorenson formal titration.
7. Separation of amino acids, sugars and phospholipids by chromatography.
8. Isolation of casein from milk, lecithin from egg yolk and glycogen from liver.
9. Isolation of cell organelles.
10. Cultivation, isolation and staining of microorganisms.

M.Sc. Semester II

1. Estimation of reducing sugars by Nelson Somogyii Method.
2. Estimation of maltose by DNS Method.
3. Estimation of creatinine, chloride and inorganic phosphate in urine sample.
4. Estimation of ascorbic acid and riboflavin.
5. Estimation of methionine, tyrosine and tryptophan.
6. RBC and WBC Count, Hb estimation and blood group determination.
7. Determination of iodine value and saponification number of fats.
8. Assay and kinetic analysis of salivary amylase; Effect of enzymes and substrate concentration, pH, and temperature on activity.
9. Assay and partial purification of urease
10. Assay of activities of enzymes from different sources.

M.Sc. Semester III

1. Extraction and estimation of proteins, RNA and DNA from plant material.
2. Assay and partial purification of wheat germ amylase.
3. Assay of enzymes of N-metabolism: NR, GDH, GS and GOGAT.
4. Partial purification of proteins by salt precipitation.
5. Separation of proteins by ion exchange chromatography.
6. Electrophoretic separation of protein.
7. DNA and RNA Isolation and Estimation.
8. Estimation of Blood Sugar
9. Estimation of the following : Phosphate, Ca, Creatinine, Chloride, Urea, Bilirubin, Uric acid, Cholestrol, Proteins etc.
10. Assay of Serum enzymes : Acid and alkaline phosphatase, GOT, GPT and Amylase.

M.Sc. Semester IV

Research Project Work.

NOTE :

1. The practicals will be designed by the course teacher(s) as per available facilities.
2. The research paper for Seminars in III Semester shall be selected by the student with the advice of course teachers.
3. Summer Training is optional, for which additional credits will not be awarded. The School will try to arrange for summer training programme.

GUIDELINES FOR SEMESTER CREDIT SYSTEM

- A semester consists of 18 weeks.
- One hour per week of lecture for one semester constitutes 1 credit.
- One hour per week of laboratory work for one semester constitutes 0.5 credit.
- The grading is made on a 10 point scale. O at 10, A+ at 9, A at 8, B+ at 7, B at 6, C at 5, P at 4, F at 0, Ab at 0 .
- The asterisk (*) against the grade earned indicates second attempt.
- A comprehensive viva voce of 4 virtual credits is conducted at the end of each semester by a board of 4 examiners, at least one of them is external.
- The SGPA is Semester Grade Point Average, a measure of performance of a student in a semester. The CGPA is Cumulative Grade Point Average, a measure of cumulative performance of a student over all the semesters completed.
- The division obtained is correlated with calculated CGPA as follows:

First division with Distinction	CGPA>8.0
First Division	6.50<CGPA<8.0
Second Division	5.00<CGPA<6.50
Pass Division	4.00<CGPA<5.00

- From CGPA the percentage is calculated as follows:

  Equivalent Percentage = CGPA X 10.

References:

Michael M. Cox and David L. Nelson – Lehninger's Principles of Biochemistry

Donald Voet – Principles of Biochemistry

Donald Voet and Judith Voet – Biochemistry

Harper, Granner and Murray – Harper's Review of Biochemistry

Geoffrey M. Zubay – Biochemistry

West and Todd – Textbook of Biochemistry

Devlin – Textbook of Biochemistry

Horton – Principles of Biochemistry

Garrett and Grisham – Biochemistry

Lubert Stryer – Biochemistry

Keith Wilson and John Walker – Principles and Techniques of Biochemistry and Molecular Biology.

E.J. Gardner – Principles of Genetics

D. Peter Snustad – Principles of Genetics (5^{th} edition)

Daniel L. Hartl – Genetic analysis of Genes and Genomes

Klaus D. Elgert – Immunology

Kimball – The Nature of Immunity

Kuby J, Richard J. – Immunology

Roitt and Brostoff - Immunology

William Hopkins – Introduction to Plant Physiology

Lincoln Taiz and Eduardo Zeiger – Plant Physiology

Hopkins – Introduction to Plant Physiology

Salisbury and Ross – Plant Physiology

Guyton – Textbook of Medical Physiology

C.V.S. Murthy – Bioinformatics

Brody – Nutritional Biochemistry

Lodish, Berk, Zipursky, Matsudaria et.al. – Molecular Cell Biology

Albert, Johnson, Lewis, Raff, Robert, Walter – Molecular Biology of the Cell

Gerald Karp – Cell Biology

Tom Pollard – Cell Biology

Becker – The World of the Cell

Bruce Alberts – Essential of Cell Biology

Geoffrey M. Cooper – The Cell – A Molecular Approach

Glick & Pasternack – Molecular Biotechnology

Varley – Practical Clinical Biochemistry

Jacquelyn G. Black – Microbiology

Benjamin Lewin – Genes

David Freifelder – Molecular Biology

T.A. Brown – Genomes, Gene Cloning