

M. Sc. BIOCHEMISTRY

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
-------------	--------------	-----------------

SEMESTER-I

MCE 701	MOLECULAR CELL BIOLOGY	3(2-0-1)
BCBT 702	INTERMEDIARY METABOLISM-I	3(2-0-1)
CHEM 710	QUANTITATIVE ANALYTICAL METHODS	3(2-0-1)
MAS 711	STATISTICS-I	3(2-0-1)
CHEM 716	APPLIED CHEMISTRY	3(2-0-1)
MBFT 720	GENERAL MICROBIOLOGY	3(2-0-1)

TOTAL CREDITS: 18

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
-------------	--------------	-----------------

SEMESTER-II

BCBT 705	INTERMEDIARY METABOLISM-II	3(2-0-1)
BCBT 706	TECHNIQUES IN BIOCHEMISTRY & INSTRUMENTATION	3(2-0-1)
BCBT 813	ENZYME TECHNOLOGY	3(2-0-1)
COMP 705	COMPUTER ORIENTATION	3(2-0-1)
MAS 715	STATISTICS-II	3(2-0-1)
MCE 703	MOLECULAR GENETICS	3(2-0-1)
BCBT 780	SEMINAR-I	1(0-0-1)

TOTAL CREDITS: 19

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
-------------	--------------	-----------------

SEMESTER-III

BCBT 801	IMMUNOLOGY & MEDICAL BIOCHEMISTRY	3(2-0-1)
BCBT 803	PLANT BIOCHEMISTRY	3(2-0-1)
BCBT 804	ANIMAL BIOCHEMISTRY	3(2-0-1)
BCBT 805	NUTRITIONAL BIOCHEMISTRY	3(2-0-1)
CBBI 801	BIOINFORMATICS	3(2-0-1)
TE 801	PLANT TISSUE CULTURE TECHNOLOGY	3(2-0-1)
BCBT 880	SEMINAR-II	1(0-0-1)

TOTAL CREDITS: 19

COURSE CODE	COURSE TITLE	CREDITS (L-T-P)
-------------	--------------	-----------------

SEMESTER-IV

BCBT 899	DISSERTATION	15(0-0-30)
----------	--------------	------------

CREDITS GRAND TOTAL: 71

SEMESTER-I

CHEM 710

Quantitative Analytical Methods

3(2-0-1)

Unit 1: Introduction to Quantitative Analytical Methods.

Unit 2: Errors, Precision & Accuracy in Analytical Methods.

Unit 3: Classical methods in Analysis – Gravimetric, Volumetric – Neutralization titrations, complexometry & Iodometry.

Unit 4: Electrochemical Methods – Redox Titration, Potentiometry, Thermogravimetry, Coulometry, Voltametry.

Unit 5: Colorimetry, Spectrophotometry.

Unit 6: Chromatography – Adsorption, Partition, Gel filtration, Ion exchange.

CHEM 716

Applied Chemistry

3(2-0-1)

Unit 1: Amino acids: Structure and properties & optical active non-standard amino acids. **Proteins:** Classification, structure & properties.

Unit 2: Carbohydrate: Monosaccharides, Oligosaccharide, Polysaccharide, Glyco protein.

Unit 3: Lipids: Classification, structure & properties of lipids, Properties of lipid Aggregates.

Unit 4: Nucleic Acid: The molecules involved in Expression and Transmission of genetic information, Chemistry of Nucleic acid, Structure and composition of purine and pyrimidines, Nucleosides, Nucleotides, general composition of DNA & RNA.

Unit 5: Biological significance: Carbohydrates, Lipids proteins & Nucleic acids.

Unit 6: Synthetic Polymers: Addition polymers, copolymers thermo-plastic and thermosetting polymers, Natural & synthetic rubbers.

Unit 7: Colour, Dye and Pigments: Constitution classification of dyes.

Unit 8: Ionization of water, Equilibrium constants, pH scale, Weak acids and bases, Expression relating pH pK and buffer concentration application of pH, buffer in biological systems.

Unit 9: Bioenergetics and Thermodynamics, laws of thermodynamics relating biological energy transformations, relation of standard free energy change to equilibrium constant, Additive nature of the standard free energy changes.

BCBT 702

Intermediary Metabolism- I

3(2-0-1)

Unit 1: Bioenergetics: Energy & its- transformation in living systems ; Thermodynamic principles; concept of free energy changes in biochemical reactions, Electro-chemical gradient, energy rich compounds. Introduction to metabolism: methods to study metabolism.

Unit 2: Carbohydrate metabolism: Introduction to digestion and absorption of carbohydrates.

Catabolism of carbohydrates: Glycogenolysis, glycolysis, fermentation. TCA, ETS, Energy aspects, HMPS. Anabolism: Biosynthesis of structural polysaccharide. Eg.- peptidoglycon, chitin. Anabolic role of TCA cycle (anapleurotic reactions), gluconeogenesis, glycogenesis, glyoxalate cycle, regulation of carbohydrate metabolism.

Unit 3: Lipid metabolism: Introduction to digestion and absorption, oxidation and biosynthesis of fatty acids. Phospholipids: energy aspects, importance and regulation. Biosynthesis of biologically important lipids: biosynthesis of sterols, glycolipids, prostaglandins, prostacyclins, thromboxins. Energy aspects, regulation and importance.

Unit 4: Oxidative phosphorylation, introduction to electron transport, chain structure localization. Components, oxidative phosphorylation, ATP formation.

Practicals:

1. Determination of lactic acid from milk.
2. Estimation of total carbohydrates from potato by anthron method.
3. Extraction of glycogen from liver.
4. Extraction of starch from potato.
5. Determination of citric acid from citrus fruits.
6. Determination of lactose from milk.
7. Determination of fat in milk.
8. Determination of acid value/peroxidation/ saponification no. of fats.
9. Separation of carbohydrate lipid by TLC.

MBFT 720

General Microbiology

3(2-0-1)

History and scope of Microbiology

General characteristics, classification, morphology and reproduction of Bacteria, Mycoplasma, Chlamydia, Rickettsiae, and Actinomycetes

General characteristics, classification, morphology and reproduction of Fungi, Algae, Protozoa

Control of microorganisms by physical and chemical agents

Practical

1. Familiarity with equipment and apparatus used in Microbiology
2. Methods of isolation, purification and maintenance of microorganisms
3. Staining techniques (Simple, Differential, Special) in bacteria
4. Preparation of media and reagents and their sterilization
5. Study of cultural and morphological characteristics of important groups of: Fungi, Algae, Protozoa
6. Effect of physical agents (viz. temperature, osmotic pressure, UV radiation etc.) on microorganisms
7. Effect of chemicals (viz. alcohol, phenol, halogens, heavy metals etc.) on microorganisms

MCE 701

Molecular Cell Biology

3 (2-0-1)

Unit 1. Macromolecules: Biochemical and molecular aspects of living cells, Carbohydrates, Proteins and Nucleic acids. Cell fractionation procedure.

Unit 2. Cell organelles: Molecular organization of cell organelles (structure and function), cell wall, plasma membrane (various models), endoplasmic reticulum, mitochondria, chloroplast, nucleus, etc.

Unit 3. Cytoskeleton and Extra Cellular Matrix: Microtubules, intermediate filaments and micro filaments. ECM- definition, significance and biomolecules involved in ECM.

Unit 4. Cell growth and division: Cell cycle, mitosis, meiosis, DNA replication, apoptosis, cancer.

Unit 5. Cell signaling and cell- cell interactions: signal transduction, endocrine, paracrine and autocrine signalling, surface receptor mediated transduction, chemistry and function of signaling molecules.

Practicals

1. Mitosis of Onion Root Tips
2. Tissue Types in Dicot Stem
3. Tissue Types in Monocot Stem
4. Tissue Types in Dicot Root
5. Tissue Types in Monocot Root
6. Gram Staining of Bacteria

MAS 711

Statistics I

3 (2-0-1)

Standard – deviation, Coefficient of variation, standard error of mean.

Theory of Probability : equally likely, mutually exclusive events , definitions of probability, addition & multiplication theorems of probability & problems based on them.

Normal & Binomial Distributions.

Simple correlation & regression, Multiple- regression, Multiple & Partial- Correlation.

Testing of Hypothesis : Concept of Hypothesis, Degrees of freedom, Level of significance. Type I & Type II errors. χ^2 , t, Z & F – tests. (definition, applications & problems based on these tests).

SEMESTER-II

BCBT 705

Intermediary Metabolism- II

3(2-0-1)

Unit 1: Amino acid catabolism: introduction to digestion and absorption, amino acid degradation pathways and their mode of degradation- Transamination, oxidative deamination, deamination and importance. Urea cycle, formation of excretory products, linking to TCA cycle and regulation.

Unit 2: Amino acid biosynthesis: overview, biosynthesis of essential amino acid tryptophan, tyrosine, valine, lysine. Biosynthesis of non-essential amino acids: glycine, serine, cystine, threonine, phenylalanine, histidine, proline, arginine.

Unit 3: Purine & Pyrimidine nucleotide metabolism: introduction, de novo and salvage pathways of purine and pyrimidine nucleotide biosynthesis. Catabolism of purine and pyrimidine nucleotides. Biosynthesis of nucleotide coenzymes.

Unit 4: Membranes- Transport phenomenon: biomembranes, diffusion- passive and facilitated and active transport processes. Mechanism of ATP synthase and its regulation, malate aspartate shuttle.

Practicals:

1. Parametric analysis of section of protein-dye.
2. Determination of protein from milk.
3. Fractionation of egg proteins.
4. Quantification of serum proteins by honey method.
5. Estimation of protein from leaf tissue.
6. Isolation of DNA from plant /bacterial sample.
7. Quantification of DNA.
8. Isolation of RNA from bacterial/ plant tissue.

BCBT 706

Techniques in Biochemistry and Instrumentation

3(2-0-1)

Unit I: Chromatography: Adsorption, partition, exclusion, ion exchange, affinity, H.P.L.C., G.L.C., column.

Unit II: Biosensors: Types and uses.

Unit III: Centrifugation Techniques: Differential, zonal and density gradient, ultra, types of centrifuges and applications.

Unit IV: Electrophoresis: Principles and applications, paper, gel, S.D.S., P.A.G.E., P.F.G.E., Isoelectric phosphor.

Unit V: Molecular Biology Techniques: Isolation and purification of DNA, RNA, plasmid DNA, sequencing of proteins and nucleic acids, chemical synthesis of nucleotides, competent cell preparation and transformation, DNA foot printing, DNA fingerprinting, PCR.

Unit VI: Immunological Techniques: RIA, ELISA, flow cytometry.

Unit VII: Radio isotopic and tracer techniques: Detection and measurement of isotopes (GM and scintillation counters), autoradiography.

Practicals:

1. Determination of pH using indicators.
2. The separation of amino acids by paper electrophoresis.
3. The validity of Beer's law for the colorimetric estimation of creatinin.
4. Total chlorophyll estimation from the plant sample.
5. Protein estimation- A. Biuret method, B. Lowry's method.
6. Estimation of nucleic acid by electrophoresis.

BCBT 813

Enzyme Technology

3(2-0-1)

Unit1: Introduction of enzymes:General properties and significance, classification and nomenclature.Terms and definition in enzymology, co-factors, coenzymes, active site concept, isoenzymes, allosteric enzymes, marker enzymes, multienzyme complex, ribozyme, abzyme, synzyme, extremozyme, therapeutic enzymes and immobilized enzymes etc.

Unit 2: Enzyme kinetics:steady rate kinetics, Derivation of Michaelis-menten equation using steady state/equilibrium kinetics, plots of lineweaver- Bruke, Hanes, Eadie- Hofster etc. Mechanism of bisubstrate and multisubstrate enzyme catalyzed reaction, Enzyme inhibitors, mechanism of enzyme action-lysozyme, chymotrypsin, alcohol DH.

Unit 3: Regulation of enzyme activity: Covalent modification, allosteric model concerted and sequential, cooperativity. Feedback inhibition.

Unit 4:Enzyme Technology: Commercial production of enzymes, immobilization of enzymes, example of enzyme engineering, application of enzyme(therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme reactors.

Unit 5: Isolation, purification and localization of enzymes. Various methods to estimate the enzyme activity.

Practical:

1. Effect of temperature, pH, substrate concentration and enzyme concentration and enzyme concentration on enzyme activity.
2. Action of salivary amylase on starch.
3. Determination of acid phosphatase activity in sample.
4. Determination of alkaline phosphatase activity in sample.
5. Determination of SGOT in serum.
6. Determination of SGPT in serum.

7. Determination of urease in plant sample.
8. Assay of protein by lowry method.
9. Assay of catalase in vegetables.
10. Hydrolysis of egg protein by pepsin.

COMP 705 **Computer Orientation** **3 (2-0-1)**

- 1. Information Concepts**
- 2. Computer Appreciation** – a) Definition, Characteristics and Application of Computers
b) Computer Hardware, I/O Devices, Memory CPU
c) Software Concepts
- 3. Operating System:** DOS, Windows
- 4. Application Software:** MS Word, MS Excel
- 5. Computer Programming:** Concepts of Algorithm & Flowchart, Introduction to ‘C’ Language. History, Input and Output Statements, Variables and Constants, Expressions and Operators, Control Statements, Branching Statements (if, if-else, nested if), Looping Statements (while, do-while, for-next), Functions and arrays.
- 6. Internet concepts and search engine.**

MCE 703 **Molecular Genetics** **3 (2-0-1)**

Unit 1. Gene concept and Gene analysis: The gene and gene concept, cistron as a unit of genetic function. Prokaryotic genome, eukaryotic genome, viral genome, genetic code, central dogma including reverse transcription.

Unit 2. Transcription: Enzymatic synthesis of RNA, classes of RNA molecules, mechanism of transcription in prokaryotes and eukaryotes- RNA polymerases, promoter sequences for RNA polymerases, enhancers and silencers, transcription factors and initiation of transcription, basal transcription apparatus, elongation and termination of transcription. Post transcriptional modifications (mRNA processing reactions- 5' capping, polyadenylation, splicing).

Unit 3. Translation: Introduction to protein synthesis (ribosomes, codon- anticodon interaction). Protein synthesis in prokaryotes and eukaryotes. Translational factors and their functions. Initiation, elongation and termination phases of translation. Comparison of protein synthesis in prokaryotes and eukaryotes. Post translational modification of proteins (protein folding and protein trafficking). Antibiotics as inhibitors of protein synthesis.

Unit 4. Gene regulation: Gene regulation in prokaryotes, transcriptional control (lac operon model, catabolite repression, tryptophan operon model). Regulation of gene expression in eukaryotes (transcriptional and translational controls). Gene regulation in plant cells.

Unit 5. Mutation: Study of mutation at molecular level. Types of mutation (gene mutation and chromosomal aberrations); Molecular basis of gene mutation, tautomeric shifts and abnormal base pairing (transitions and transversions); Frame shift mutations (deletions or additions); Mutagenesis, physical and chemical mutagenic agents; DNA damage and DNA repair mechanisms.

Practicals

1. Estimation of DNA by Diphenylamine Method

2. Screening of auxotrophic mutants in *E. coli*
3. Study of UV induced mutagenesis in bacteria
4. Quantification of microbial growth
5. Study of thermal death kinetics

MAS 715

Statistics- II

3 (2-0-1)

Analysis of variance technique: Definition & assumptions, One way classification, two way classification with more than one observation per cell.

Designs of experiments: Principles of Experimental- Design, Randomized Block Design (R.B.D), Latin Square Designs (L.S.D)., Missing Plot Technique in R.B.D & L.S.D. Critical-difference (C.D) Split plot design.

Factorial – Experiments: 2^2 , 2^3 , 3^2 , & 3^3 , factorial-designs. (Yates method of Analysis), 2×3 & 2×4 factorials.

Durcan's Multiple Range Test. Newman's Kuel's Test

Sampling techniques: Simple Random Sampling, Stratified Random Sampling & Systematic Sampling.

SEMESTER-III

BCBT 801

Immunology & Medical Biochemistry

3(2-0-1)

Unit I: Fundamental Immunology: Basic terminology: Antigen, antibody, lymphokines, cytokines, haptens, adjuvants, immunogen, pathogen, epitopes, paratopes, etc. specific and nonspecific immune response, humoral and cell mediated immunity. Cells of adaptive immune response- B & T cell. Cells of innate immune response- macrophages, phagocytes, mast cells, dendritic cells, granulocytes, agranulocytes.

Organ of immune system- 1.primary lymphoid organs

2.secondary lymphoid organs

Defens **hosphor** - 1.inflammation

2.phagocyties

Unit 2: Generation of antibody diversity, clonal selection hypothesis definition idiotopes, idiotypes, allotypes, structure and function of M.H.C(both class 1&class 2), chemistry of antigen –antibody interaction, precipitation & agglutination.

Unit 3: structure and function of natural killer cells, superantigens, cells-mediated cytotoxicity (A.D.C.C), the complement system (both classical & alternative path ways).experimental assessment of A.D.C.C i.e. by C.M.L, M.L.R and graft vs. host reaction .

Unit 4: Primary B&T-cells immunodeficiencies, auto immunity hypersensitivity, structure of t-cells receptor and comparison with antibody molecule.

Unit 5: Techniques of immunology, immunoelectrophoresis (one dimensional and two dimensional), ELISA, RIA, Immunofluorecence, western immuno blotting, biochemistry of cancer & AIDS.

Practical:

1. Preparation of blood smears
2. Separation of serum & plasma
3. Qualitative test for assessment of different constituent of plasma/seven
4. Separation of plasma proteins (i.e fibrinogen, globulin and albumin)
5. Determination of E.S.R of the given blood sample
6. Preparation of antigens from blood

7. Determination of the blood group
8. Determination of the haematocrit value of any blood sample
9. Use the widal kit for rapid quantitative slide test.

BCBT 803

Plant Biochemistry

3(2-0-1)

Unit 1: Photosynthesis: significance of photosynthesis, ultra structure of chloroplast, photosynthetic pigments. Light absorption phenomenon, Photosynthesis in C₃ and electron transport, photophosphorylation: photo respiration, CAM.

Unit 2: Bacterial Photosynthesis, photochemistry and electron transport and CO₂ fixation.

Unit 3: Nitrogen metabolism: Metabolism of N-compounds in plants, biological nitrogen cycle, nitrogenase structure and function, nitrate reduction, nitrification, denitrification, symbiotic and non symbiotic nitrogen fixation, Nif- genes- organization, function and regulation, Assimilation of fixed nitrogen by plants.

Unit 4: Plant Hormones: Definition of phyto hormones, Auxins, biochemistry and mode of action of Auxins, Gibberellin, Cytokinins and other natural growth hormones in plants (ethylene, abscissic acid).

Unit 5: Plant disease and defense mechanism: Biochemistry of bacterial and viral and fungal diseases, Micro and Macro nutrients deficiency in plants. (Biochemical role of inorganic ions in plants).

Unit 6: secondary metabolism in plants: Phenolic metabolism shikimate, and phenyl propanoid pathways, flavonoids, lignins, and anthocyanins. Isoprenoid metabolism, terpenoids and carotenoids, **hosphor , cyanogenic glycosides and non protein amino acids.**

Practicals:

1. Analysis of plants and plant product for various constituents.
2. Extraction and identification of sugars from plants, fruits and vegetables.
3. Extraction and determination of amino acid and protein.
4. Determination of lipids, phospholipids, cholesterol in food, fruits and vegetables.
5. Determination of various plants nutrients.

BCBT 804

Animal Biochemistry

3(2-0-1)

Unit 1: Biochemistry of Blood and Body fluids-Biochemical composition of blood groups, path way of blood clotting, physiological function of blood, buffering action of blood, kinds other body fluids and their chemistry.

Unit 2: Biochemistry of Blood tissue-Connective tissue, collagen, elastin muscle protein, muscle construction, lens proteins.

Unit 3: Biochemistry of Fat in adipose tissue , steroids-structure and biochemical function cholesterol-Structure and biochemical synthesis, plasma lipids, transport of lipids, lipo-protein, chylomicrons, VLDL, HDL, LDL, and Lp(a), free fatty acids, nonesterified fatty acids.

Unit 4: Gastrointestinal physiology-Digestion of food ruminants and non-ruminants absorption of food, biochemical role of liver, bile acids and bile salt.

Unit 5: Anti-oxidant-Generation of free radicals, damage produced by reactive-oxygen species (ROS), free-radicals, scavenging enzyme system.

Unit 6: Animal Hormones-Origin, site of action, biochemical mechanism of hormone action, feed-back mechanism of hormonal secretion.

Practicals:

1. Separation of plasma and serum.

2. Determination of haematocrit value of blood.
3. Calculation of density of blood.
4. Determination of bleeding and clotting time of human blood.
5. Determination of blood typing.
6. Determination of haemoglobin.
7. Preparation of human blood film and study of different type of cells.
8. Determination of glucose in sample.
9. Determination of cholesterol in sample.
10. Determination of qualitative analysis of urine- normal sample, pathological sample.
11. Determination of colour index and volume index of blood.
12. Determination of mean corpuscular hemoglobin and MCHC of blood.

BCBT 805

Nutritional Biochemistry

3(2-0-1)

Unit 1: Nutritional aspects of carbohydrates- Biochemical functions the relative importance of different carbohydrates in diet, utilization of absorbed carbohydrates in the body, regulation of blood glucose level of blood dietary fibre and their biochemical effect in human nutrition.

Unit 2: Nutritional aspects lipids- Fats in the body and food, biochemical function of fats, role of in diet, effect of trans fatty acids, blood lipids, transport and storage of lipids, role of liver in lipid metabolism, omega fatty acids.

Unit 3: Nutritional aspects proteins- Nutritional significance of amino acids , specific function of some important amino acids, complementary value of proteins, methods of proteins (BV, NB, PER, NPR)

Unit 4: Role of vitamins minerals in health and disorders biochemical function of water detoxification.

Unit 5: Biochemical features some diet related disorders like protera-calorie malnutrition diabetes , cardiovascular disease goitre anemia etc.

Practical:

1. Determination of moisture in food sample
2. Determination of total ash in the food sample
3. Quantitative analysis in ash for mineral constituent eg calcium, phosphorus etc.
4. Determination of crude fat in the given food sample
5. Determination of total carbohydrate by anthrone method
6. Determination of protein by lowery method in the food sample
7. Determination of ascorbic acid in food sample
8. Identification of phenols carotenoids etc in blood samples

CBBI 801

Bioinformatics

3 (2-0-1)

Unit 1: Introduction to Bioinformatics, philosophical, directional and application oriented background of bioinformatics.

Unit 2: HGP – influence area in Bioinformatics, Application in different industries, and its Indian scenario, as a business, problem and future aspects.

Unit 3: Information network – Internet, web Browser and address (NCBI, EBI etc).

Unit 4: Databases – information resources for Proteins and Genomics.

Unit 5: SRS, Algorithms, Alignment.

Unit 6: Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation – Paralogues and orthologues, Tree building and tree evaluation, Phylogenetic software.

Unit 7: Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

Unit 8: Molecular structure Prediction and visualization (X-ray crystallography/ NMR/ Bioinformatics).

Unit 9: Micro array data analysis.

Unit 10: Different analysis packages and other Miscellaneous Tools etc.

TE 801

Plant Tissue Culture Technology

3 (2-0-1)

Unit 1: Introduction to plant tissue culture: Historical developments and landmarks in Plant Tissue Culture. Organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, Totipotency: growth, differentiation and morphogenesis in tissue culture.

Unit 2: Micropropagation: Concept, various stages, organogenesis and somatic embryogenesis. Meristem culture: Meristem culture for mass and clonal propagation, production of pathogen free plants, application in forestry.

Unit 3: Somatic hybridization: Isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization, identification and characterization of somatic hybrids / cybrids, its applications.

Unit 4: Secondary metabolites: Production of secondary metabolites by plant cell culture, hairy root culture, and biotransformation.

Unit 5: Cell Lines: Cell line selection for resistance to herbicide, stress, insect and diseases

Unit 6: Haploid culture: Tissue culture methods for haploid production & its applications

Practicals:

1. Media preparation
2. Explant selection, sterilization & inoculation
3. Callus & cell suspension culture: Induction and growth parameters
4. Androgenesis: Anther & Pollen culture
5. Plant regeneration from embryo, meristem & callus culture
6. Synthetic seed preparation