Course Structure FOR
Choice Based Credit System of
B.Sc. (Biochemistry) Program with effect from 2020-21
School of Science, UPRTOU, Prayagraj

Semester	Course Code	Title of Paper	Credits	Max. Marks
I	UGBCH -101	Introduction to biochemistry	2	100
	UGBCH -101P	Practical Work	2	100
II	UGBCH -102	Nutritional biochemistry	2	100
	UGBCH -102P	Practical Work	2	100
III	UGBCH -103	Intermediary metabolism	2	100
	UGBCH -103P	Practical Work	2	100
	Skill Enhancement Course			
	SBSBCH- 01	Bio-analytical techniques	2	100
IV	UGBCH -104	Enzymology	2	100
	UGBCH -104P	Practical Work	2	100
V	**Discipline Centric Elective Course**			
	DCEBCH -105	Microbiology	2	100
	DCEBCH -106	Spectroscopy	2	100
	DCEBCH -107P	Practical Work Based on 105 & 106	2	100
VI	**Discipline Centric Elective Course**			
	DCEBCH -108	Plant biochemistry	2	100
	DCEBCH -109	Immunology	2	100
	DCEBCH -109P	Practical Work Based on 108 & 109	2	100
	Skill Enhancement Course			
	SBSBCH-04	Clinical biochemistry	4	100
		Total Credit/Max. Marks	**36**	**1600**

B.Sc. (BIOCHEMISTRY)

UGBCH -101

(INTRODUCTION TO BIOCHEMISTRY)

Unit-1. The origin of biochemistry and unity of life: History, scope and current prospective of biochemistry.

Unit-2. Water: Unique properties, weak interactions in aqueous systems, ionization of water, buffers.

Unit-3. Cell structure and functions**:** Prokaryotic and eukaryotic cell, animal and plant cells, units of measurement, light microscope and electron microscope, centrifugation for subcellular fractionation.

Unit-4. Cell organelles: Structure and functions of cell nucleolus, Endoplasmic reticulum, Golgi complex, Lysosome, mitochondria, chloroplasts and peroxisomes.

Unit-5. Amino Acids: General introduction, classification, structure and functions of amino acids, basic properties of amino acids.

Unit-6. Proteins the basic molecules: Nature, classification and types of protein structure, Peptides classification and conformational structure.

Unit-7. Carbohydrates: General introduction, classification and structure, monosaccharides - structure of aldoses and ketoses, ring structure of sugars, formation of disaccharides, polysaccharides.

Unit-8. Lipids: General introduction, classification, building blocks of lipids - fatty acids, glycerol, ceramide, structure of fatty acids and their derivatives.

Unit-9. Nucleic acids: Nucleotides and nucleosides-structure and properties, nitrogenous bases: purines and pyrimidines, structure of DNA and RNA.

Unit-10. Vitamins: Types and functions, structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms.

UGBCH -102

(NUTRITIONAL BIOCHEMISTRY)

Unit-1.Elements of Nutrition**:** Dietary requirements of carbohydrates, lipids and proteins. Essential amino acids, essential fatty acids, Malnutrition.

Unit-2.Basal Metabolic Rate (BMR): Concept of BMR, factors affecting BMR, measurement of fuel value of foods. basal and resting metabolism, physical activity, energy balance.

Unit-3. Biological oxidation of foodstuff: Measurement of energy content of food, physiological energy value of foods, measurement of energy expenditure, factors affecting thermogenesis.

Unit-4. Minerals and Vitamins: Nutrition importance of dietary calcium; phosphorus; magnesium; iron; iodine; zinc and copper, requirements and deficiency diseases associated with vitamin B Complex, C A,D, E and K.

Unit-5. Dietary carbohydrate: Functions, digestion, absorption, storage and utilization of carbohydrates, hormonal regulation of blood glucose.

Unit-6. Lipids: Role of lipid in dietary supplement. Dietary fiber, role of fibre in lipid metabolism, blood glucose level and GI tract functions, role of saturated fat.

Unit-7. Proteins: Sources, functions, digestions and absorptions, essential and nonessential amino acids, antagonism, toxicity and imbalance, effects of deficiency and kwashiorkor.

Unit-8. Fats: Sources, functions, digestions and absorptions, types of fats dietary fats, role of omega-3 fatty acids in living human body, essential and nonessential fatty acids.

Unit -9. Food and drug interactions: Nutrient interactions affecting ADME of drugs, alcohol and nutrient deficiency, antidepressants, psychoactive drugs and nutrient interactions.

Unit-10.Nutritional status: Anthropometric measurements, biochemical assessment, reactive oxygen species (ROS), glycosylated Hb, differential diagnosis of B12 and foliate.

UGBCH -103

(INTERMEDIARY METABOLISM)

Unit-1.Bioenergetics: Introduction to bioenergetics, photochemical reaction in plants, chemical energy of organic substance.

Unit-2. Thermodynamics: Notions and laws of thermodynamics, state functions, equilibrium constant, coupled reactions, free energy charge, and application to chemical reaction.

Unit-3.ATP: ATP cycle and formation of ATP by phosphorylation, importance of ATP and other compounds of high energy potential.

Unit-4. Oxidative phosphorylation: Mitochondria, electron transport chain-its organization and function, regulation of oxidative phosphorylation, alternative respiratory pathways in plants.

Unit-5. Photophosphorylation: Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II. Photo inhibition.

Unit-6. Metabolism of carbohydrates: Glycolysis, Kreb's cyde, electron transport system in mitochondria, Oxidative phosphorylation and mechanism of ATP synthesis

Unit-7. Photosynthesis: Pigments of Photosynthesis, Oxygenic and anoxygenic Photosynthesis, adsorption of light by chlorophyll, Calvin cycle.

Unit-8. Protein Biosynthesis: transcription, role of ribosome's in protein synthesis, translation, genetic code, protein processing.

Unit-9. Metabolism of lipids; Catabolism of triglycerides, biosynthesis of cholesterol, B-oxidation of fatty acids.

Unit-10.Nitrogen metabolism: Nitrogen fixation and assimilation, amino acid metabolism, the urea cycle, hems and chlorophylls.

SBSBCH -01

(BIO ANALYTICAL TECHNIQUES)

Unit-1. Basic concept of bio analytical techniques, normality, morality and molality, brief about purification, centrifugation, filtration, dialysis, homogenization.

Unit-2.pH and buffer: Hydrogen ion concentration, Buffer- definition, types and its preparation, buffers of biological importance such as carbonate bicarbonate, phosphate and acetate.

Unit-3.Properties of Light: light spectra, wave length, plane polarized light, optical rotation, optical rotatory, absorbance-chromophore, auxochrome,

Unit-3. Chromatography: Principals of partition chromatography, exchange, gel filtration chromatography, high performance liquid chromatography (HPLC).

Unit-4.Spectroscopy-I: Concepts of spectroscopy, Beer-Lambert's law, Visible and UV Spectroscopy, applications of colorimetry.

Unit-5. Spectroscopy-II: Basic principle of FT-IR and NMR spectrometer and their role in detection of organic molecules detection.

Unit-6. Electrophoresis: Principles of electrophoresis, separation of proteins by PAGE and SDS-PAGE.

Unit-7. Centrifugation: Principles of centrifugation, differential centrifugation, applications of centrifugation and density gradient.

Unit-8. Microbial techniques: Isolation of bacteria, antimicrobial activity by using DISC diffusion techniques.

Unit-10.Use of different solvent system for amino acid, carbohydrate and lipid separation.

UGBCH -104

(ENZYMOLOGY)

Unit-1. Introduction to enzymes: Basic concept and classification of enzymes, enzymes as biocatalysts, effects of various factors on enzymatic-catalyzed reactions.

Unit-3.Enzyme cofactors and inhibition: Role cofactors, mode of action of coenzymes, principle co-enzymes, prosthetic groups, allosteric activators and inhibitors.

Unit-4. Enzymes kinetics: enzymes classification, concept of ES complex, Michaelis- Menten equation, KM constant.

Unit-5. Enzyme inhibition: Reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition.

Unit-6. Mechanism of enzyme Action: Acid-base catalysis, chemical modification of active site group; mechanism of action of chymotrypsim and lysozyme.

Unit-7. Enzyme regulation: General mechanisms of enzyme regulation, inhibition, allosteric enzymes, positive and negative cooperatively with special reference to aspartate, transcarbamoylase.

Unit-8. Multienzyme System: Mechanism of enzyme action and regulation of pyruvate dehydrogenase, isoenzymes.

Unit-9. Mechanisms of enzyme**:** Mechanism of action of chymotrypsim, inhibitors of enzymes - antibiotics, regulation of enzyme activity and its importance.

Unit 10. Enzymes in medicine**:** Enzymes used in clinical biochemistry as reagents, diagnostics and therapy, role of immobilized enzymes in industry.

DCEBCH -105

(MICROBIOLOGY)

Unit-1. Diversity of Microbial world: Classification of microbiology**,** and their nomenclature. Whittaker's five kingdom classification systems and their utility.

Unit-2. Development of microbiology: Spontaneous generation vs. biogenesis, general characteristics of different groups, acellular microorganisms (Viruses, Viroids, Prions).

Unit-3. Isolation and Cultivation: Culture media, nutritional requirements and growth characteristics of bacteria, development of various microbiological techniques.

Unit-4.Bacteria: Structure of bacterial cell, gram positive and gram negative bacteria, microscopy- simple, compound, applications of bacteria and archaea in industry, environment and food.

Unit-5. Role of Bacteria in Agriculture: Biological nitrogen fixation, microbes as bio fertilizers, role of bacteria in N,P, S, C cycle, role of bacteria in nutrient cycle.

Unit-6. Genetic: Recombination of bacteria conjugation, transduction, and transformation, significance of genetic recombination in bacteria.

Unit-7.Viruses: General structure and classification, properties of viruses, structure and replication of poliovirus and HIV.

Unit-8. Protozoa: General characteristics with special reference to Amoeba and Paramecium.

Unit-9.Algae: Types and occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves.

Unit-10.Fungi: General classification, occurrence, habitat, distribution, nutritional requirements, fungal cell ultra- structure, role of fungi in agriculture, environment, Industry, medicine and food.

DCEBCH-106

Spectroscopy

Unit-1. Spectroscopy: Fundamental law of spectroscopy, electromagnetic radiation, origin of spectra, application of spectroscopy in biochemistry.

Unit-2.UV-Visible spectroscopy-I: principle and instrumentation of UV-Visible, Beer-Lambert law, qualitative and quantitative analysis by UV-Visible spectroscopy.

Unit-3.UV-Visible spectroscopy-II: Origin of spectra and electronic transition, composition of color complex, application of UV-Visible spectrometer in enzyme kinetics reaction

Unit-4.IR spectroscopy: Theory and principle of infrared spectroscopy, components of IR spectroscopy, application of FTIR in biochemistry.

Unit-5.NMR Spectroscopy: Principle of NMR spectroscopy, NMR spectra measurement, types of NMR, chemical shift, application of NMR in biochemistry

Unit-6.Atomic adsorption spectroscopy: Principle of adsorption spectroscopy, instrumentation and application of adsorption spectroscopy.

Unit-7.Atomic Emission Spectroscopy: Principle of emission spectroscopy, Instrumentation Emission spectroscopy, principle of flame photometry.

Unit-8.ICP-atomic emission spectroscopy: Principle of plasma spectroscopy, application of adsorption spectroscopy, comparison of ICP-AES with ass

Unit-9.Luminisece spectroscopy: Luminescence and chemiluminescence, principle of fluorescence, application of Fluorimetry.

Unit-10. Electron spectroscopy: principle of electron spectroscopy, electron spectroscopy for chemical analysis (ESCA), chemical shift in ESCA.

DCEBCH -108

(PLANT BIOCHEMISTRY)

Unit-1.Electron Transport System in Plants: Oxidative phosphorylation, mitochondrial respiratory complexes.

Unit-2. Nitrogen Metabolism: Assimilation of nitrate, enzyme of nitrate reduction and their regulation and assimilation of ammonia into organic compounds.

Unit-3. Nitrogen fixation and assimilation: Biological nitrogen fixation by free living and in symbiotic association, structure and function of enzyme nitrogenase, nitrate assimilation.

Unit-4.Nitrogen Metabolism: Photosynthetic apparatus and pigments involved in photosynthesis, Hill reaction, generation of NADPH and ATP, light harvesting complexes.

Unit-5. Synthesis of phytochmical: Classification and biosynthesis of Terpenes, Lignins, Waxes and Alkaloids

Unit-6. Stress Metabolism in Plants: A biotic and biotic stress; salinity, water stress, chilling, heat, pathogenesis, heavy metals and their impact on plant growth and metabolism.

Unit-7.Photossynthesis: Chlorophylls, photoperiodism, photosynthetic membranes and organelles, z scheme, light dependant reactions**.**

Unit-8.Carbon assimilation: Cyclic and non cyclic photophosphorylation, Calvin cycle, and photorespiration

Unit-9.Respiration: Regulation of plant glcoysis, regulation of plant glycolysis, translocation of metabolites across mitochondrial membrane, TCA cycle.

Unit-10.Plant growth regulator: Phytohormones and its effect on plant growth and development, regulation of plant morphogenetic processes by light.

DCEBCH -109

(IMMUNOLOGY)

Unit-1.Immune system: Innate and acquired immunity.

Unit-2. Innate immunity: Definitions, non-immunological barriers, cells and soluble mediators of innate immunity, cytokines.

Unit-3.Antigen and Antibody: Criteria of antigen city, haptens; classification, types and functions of antibodies, antigenic determinants of immunoglobulins

Unit-4.Types of immunoglobulins, generation of antibody diversity, B cell activation, theory of clonal selection, formation of plasma and memory cells.

Unit-5.Diversity in Immune system: Clonal selection theory, concept of antigen specific receptor, generation of antibody diversity,

Unit-6.Antigen-antibody: Measurement of antigen-antibody interactions, agglutination, precipitations, opsonizatcon, gel diffusion (ouchterlony double immune diffusion).

Unit-7. Immune system and immunity: Enzyme linked immunosorbent assay (ELISA), T-Cell receptor diversity, concept of autoimmunity.

Unit-8. Disorderds of immune responses: Autoimmunity, acquired immunodeficiency, immune tolerance and hypersensitivity.

Unit-9.Cell mediated immunity: T-cell development, MHC locus, structure, function and distribution of MHC glycoproteins, cell mediated immune responses.

Unit-10. Immunoglobulins: IgG, IgM, IgA, IgD and IgE, active immunity and passive immunity. Brief idea of AIDS, SARS and hepatitis.

SBSBCH -04

(Clinical biochemistry)

Unit-1. Basic concept of clinical biochemistry: A brief review of units and abbreviations used in expressing concentrations and standard solutions.

Unit-2. Electrolytes and acid-base balance: Role and regulation of electrolyte content in body fluids and maintenance of pH, body fluids and fluid compartments.

Unit-3. Clinical enzymology: enzymes and hormones, plasma enzymes, isoenzymes with examples, liver damage, bone disorder.

Unit-4. Diagnostic Enzymes: Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays- SGPT, CPK, LDH.

Unit-5. Nutrition and drugs: Routine hospital diets, special feeding methods, tube feeding, parenteral nutrition, drugs, alcohol and toxicants

Unit-6. Disorders of carbohydrate metabolism: Regulation of blood sugar, glycogen storage diseases, diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood.

Unit-7. Disorders of lipids: Low and high density lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, Gaucher's and Tay-Sach's disease

Unit-8. Abnormalities in nitrogen metabolism: Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance.

Unit-9. Blood Clotting: Blood clotting mechanism-hemorrhagic disorders-hemophilia, thrombotic thrombocytopenic purpura, blood groups, antigen and antibodies, circulating anticoagulants.

Unit-10. Cancer: Types of cancer, multiple steps of tumor development, cell death and apoptosis, carcinogens and cancer therapy.

Suggested books of B.Sc. (Biochemistry) course

1. Biochemistry- Lehninger A.L.
2. Biochemistry –J.H.Weil
3. Biochemistry fourth edition-David Hames and Nigel Hooper.
4. Textbook of Biochemistry for Undergraduates - Rafi, M.D.
5. Biochemistry and molecular biology- Wilson Walker
6. Industrial Microbiology, Dr. P.K. Shivakumar
7. Immunology -Rao
8. Plant Biochemistry: An Introduction- Biju Bharampalan
9. Enzymenolony and enzyme technology- S M Bhatt
10. A text Book of Microbiology- R.C. Dubey, D.K. Maheshwari
11. A text book of immunology and immunology- Dr. Annadurai
12. Clinical Biochemistry- Maheshwari Nandan-
13. Clinical Biochemistry with clinical correlation - Devin, Wiley.
14. Practical clinical biochemistry - Harold Varley, CBS, New Delhi
15. Practical biochemistry- Rameshwar A.
16. Basic Concepts of Analytical Chemistry - S M Khopkar