University of Rajasthan
Jaipur

SYLLABUS

M.Sc. Bio-Chemistry
(Annual Scheme)

2015-2017

Asstt. Registrar (Acad-I)
University of Rajasthan
JAIPUR

NOTICE

1. The Ordinance governing the examinations in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce and Law are contained in a separate booklet. The students are advised to refer to the same.

2. Changes in Statutes/Ordinances/Rules/Regulations/ Syllabi and Books may, from time to time, be made by amendment or re-making and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change.

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for University of Rajasthan
Printed by **Harish Printers, Jaipur**

UNIVERSITY OF RAJASTHAN
JAIPUR- 302 004
(TWO YEAR COURSE-ANNUAL SYSTEM)
COURSE OUTLINE AND SCHEME OF EXAMINATION FOR
M.Sc. BIOCHEMISTRY

M.Sc. (Previous) Biochemistry

Paper No.	Title of the Paper	Hours of Exam.	Max. Marks
P-I	Cell Biology and Physiology	3	100
P-II	Chemistry of Biomolecules	3	100
P-III	General Metabolism	3	100
P-IV	Enzymology and Bioenergetics	3	100
P-V	Endocrine Biochemistry	3	100
P-VI	Biochemical techniques and Computational Methods	3	100
Lab Course		12 (Spread up in two days)	200
			800

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COURSE OUTLINE AND SCHEME OF EXAMINATION FOR
M.Sc. BIOCHEMISTRY

M.Sc. (Final) Biochemistry

Paper No.	Title of the Paper	Hours of Exam.	Max. Marks
P-VII	Biochemical genetics and DNA replication	3	100
P-VIII	Protein synthesis and regulation	3	100
P-IX	Microbial Biochemistry and Virology	3	100
P-X	Immunology	3	100
P-XI	Biotechnology	3	100
P-XII	Genetic Engineering	3	100
Lab Course		12 (Spread up in two days)	200
			800

M.Sc. (Previous) BIOCHEMISTRY

PAPER-I : CELL BIOLOGY AND PHYSIOLOGY

UNIT-I CELL STRUCTURE AND COMPOSITION

Evolution of molecules and cells. Prebiotic origin of organic molecules. Characterization of prokaryotic and eukaryotic cells, mycoplasma, viruses, viroids and virusoids. Structural organization of cells. Development of cell theory and levels for organization in Biology. Dynamic nature of cell constituents and their functions. The nucleus and chromosomes. Relations between nucleus and cytoplasm. Chemistry of nucleus and nucleolus. Localisation of nucleic acid. Chemical nature of the gene and comparision of the genome in bacteria, viruses and eukaryotic cells.

Cell cycle. Events in cell cycle. Synchronized cell division and methods to achieve it. Synthesis of international molecules during cell cycle. Regulation of transition from G1 to S and G2 to M phases of cell cycle. Cytokinesis in plant, animal and bacterial cells. Accelerating and blocking cell division CDC mutants. Cell culture methods. Growth studies on single cells. Measuring growth rates of cells, growth of plants and animal cells in tissue culture. Culture of cancer cells. Unbalanced growth and regulation of growth. Cell death.

UNIT-II WATER ELECTROLYTE AND ACID BASE BALANCE

Water turnover and balance functions of distributions of body water. Water intake and output. Electrolyte balance. Electrolyte composition of body fluids. Osmolarity and osmolality of body fluids, regulation of electrolyte balance. Acid base balance. Maintenance of blood pH, blood buffers, respiratory and renal mechanisms of pH regulation. Disorders of acid-base balance-acidosis and alkolosis.

UNIT-III LIVER AND KIDNEY FUNCTIONS AND THEIR TESTS

Functions of liver, tests based on the secretory, excretory,

conjugation carbohydrates, protein and lipid metabolic functions of liver. Formation of urine, physical characteristics, normal and abnormal constitutents of urine. Renal function test.

UNIT-IV BIOMEMBRANES

Composition and structure of cell membranes, Membrane lipids, lipid bilayers. Membrane proteins–their location and function. Sugar moieties of membranes, Glycoprotenis and glycolipids, Molecular models of cell membranes and liposomes. Membrane fluidity and membrane fusion. Membrane asymmetry. Reconstitution of functional membranes system from purified components. The RBC membrane. Glycophorin. Transmembrane hilices. Cell permeability and transport. Functions of Na^+/K^+AT pase and sodium transport. Transport proteins and carriers. Compartmentation of cell by membranes.

UNIT-V TRANSPORT MECHANISMS

Transport across cell emmbranes. Permeation at the expense of kinetic energy. Metabolically coupled active transport. Bulk transport by endocytosis, phagocytosis, phagotrophy, autotrophy, pinocytosis and excytosis. Adenyl cyclase, permease and other membrane bound enzymes. Control of membrane fluidity. Action potenials of cells. Nature of nerve impulse. Metabolism of nerve cells at rest and in activity. Action potentials in the muscle fibres and in excitable plant cells. Development, propagation and transmission of action potential across the synapsis and the neuromuscular junctions. Contractility and its chemical basis. Structural proteins of muscle cells and their organization. The sliding mechanism of muscle contraction. Role of calcium ions in muscle contraction.

PAPER-II : CHEMISTRY OF BIOMOLECULES

UNIT-I CHEMISTRY OF CARBOHYDRATES

Chemistry and classification of carbohydrates. Monosaccharides, disaccharides and oligosaccharides. Stability and formation of glycosidic bond. Configuration and conformation. Polysaccharides. Storage and structural polysaccharides and Glycosominolycans (heparin, hyaluronic acid and others) Structural determination of

polysaccharides, glycoproteins and glycolipids. Blood group substances. Acid-mucopolysaccharides and proteoglycans.

UNIT-II LIPIDS

The molecular structure and behaviour of lipids. Classification of lipids. Chemistry of fatty acids, triacyl glycerols, waxes, glycerol phospholipids, sphingolipids, glycosphingolipids, cerebrosides, cholesterol. Bile acids and bile salts. Biological role of neutral fats, phospholipids, cholesterol. Structure and biological role of lipoproteins. Liposomes. Structure and functions of prostaglandins, prostancilins, leukotrienes.

UNIT-III PORPHYRINS AND VITAMINS

Structure and functions, porphyrins heme and chlorophyll. Vitamins-Discovery and importance of vitamins. Classification, chemistry. Biological role and deficiency disorders of vitamins.

UNIT-IV CHEMISTRY OF AMINO ACIDS AND PROTEINS, STRUCTURE AND CONFORMATION

Introduction to proteins, chemistry and properties of the amino acids, properties of amino acid side chains, modified and unusual amino acids. Peptides and the peptide bond, stability and formation of the peptide bond. Proteins–structure and classification. Introduction to chemical modification of proteins. Isolation, purification and criteria of proteins. Peptide synthesis–solution and solid phase methods.

Amino acid analysis of proteins. Primary structure, determination of the N and C terminal residues of a protein, sequence determination of a protein. Secondary structure–peptide foldings, peptide mapping. Ramachandran plots. Fibrous proteins–keratins, collagen. Globular proteins–Tertiary structure–Functional diversity. Myoglobin, hemoglobin and Rnase–structural features. Quaternary structure of proteins. Determination of molecular weights and number of sub units in a protein.

UNIT-V NUCLEIC ACIDS-I

Chemistry of Nucleic acids. Structure and properties of purines, pyrimidines, nucleosides and nucleotides. Nomenclature for base derivatives and polynucleotides. Structure of nucleic acids. Ribo and deoxyribonucleic acids. Base composition, helical molecules,

double helical structure (B, A and Z forms). Forces stabilizing nucleic acid structure, elementary treatment of superconed. Introduction to t-RNA structure. Physicochemical properties of nucleic acids. Spectral characters, thermal denaturation and annealing. Action of acid, alkali and enzymes on nucleic acid structure. Fractionation and analysis of nucleic acids. Solution methods, chromatography, electrophoresis, centrifugation, blotting techniques and autoradiographic methods. Nucleoproteins. Basic features of eukaryotic chromosomal structure–DNA binding proteins.

PAPER-III: GENERAL METABOLISM

UNIT-I CARBOHYDRATE METABOLISM-I

Glycolysis and fermentation, different forms of fermentation, Pasteur, Crabtree and Warburg effects. Control of glycolysis in muscle. Metabolism of fructose, galactose and mannose. Reaction of TCA cycle, energy yields and central importance of the cycle. Pyruvate dehydrogenase mutienzyme complex and its regulation. Regulation of TCA cycle and its amphibolic nature, Anaprerotic reactions. Glucoenergenesis and its regulation.

UNIT - II CARBOHYDRATE METABOLISM-II

The coricycle. Glyoxylate shunt, lactose and sucrose synthesis. Glycoprotein synthesis. HMP shunt, Glucoronic acid cycle, Glycogen metabolism and its regulation, Defects in carbohydrate metabolism and its regulation. Glycogen storage diseases, pentoruria, galactosuria, lactose intolerance. Regulation of blood glucose and diabetes. Mucopolysaccharide disorders.

UNIT-III LIPID METABOLISM-I

Lipids as energy reserves. Utilization of triacylglycerols in animals. Fat digestion and absorption. Transport of fat to tissues. Lipoproteins. Mobilization of stored fat. Fatty acid oxidation–α, β and W. Energy yields from fatty acid oxidation. Oxidation of unsaturated fatty acids and fatty acids with odd numbered carbon atoms, Control of fatty acid oxidation, role of cornitine, Ketogenesis.

UNIT-IV LIPID METABOLISM-II

Fatty acid biosynthesis. Elongation of fatty acid chains. Fatty acid desaturation. Control of fatty acid synthesis. Biosynthesis of triacylglycerols. Metabolism of phospholipids and glycolipids. Cholesterol transport and utilization. Biosynthesis of cholesterol and its regulation. Biosynthesis of bile acids. Metabolism of arachidonate, eicosanoids, prostaglandin's thromboxanes and leukotrienes. Disorders of lipid metabolism (Ketosis, Niemann-Pick disease, Gaucher's disease, hyper cholesterolemia, hyper and hypolipoproteinemia, fatty liver, obesity and atherosclerosis).

UNIT-V AMINO ACID AND NUCLEOTIDE METABOLISM

Nitrogen metabolism. Nitrogen cycle, biological nitrogen fixation. Utilization of ammonia. Biogenesis of organic nitrogen. General reactions in amino acid metabolism. Role of pyridoxal phosphate. Urea cycle and its regulation. Protein turnover. Metabolism of essential and non-essential amino acids. Genetic disorders of amino acid metabolism. Metabolism of heme. Biogenic amines. Metabolism and role of glutathione tetrahydrofolate cofactors and metabolism of C-1 units. Metabolism of purines and pyrimidines and their regulation. Biosynthesis of deoxyribonucleotides and its regulation. Disorders of nucleotide metabolism-Gout, Lesca-Nyhan syndrome and orotic aciduria. Biological and medical importance of nucleotide analogs.

PAPER-IV : ENZYMOLOGY AND BIOENERGETICS

UNIT-I BIOCATALYSIS

Introduction to enzymology, nomenclature and classification of enzymes, properties of enzymes, enzyme assay and units of activity. Isolation and purification of enzymes. Factors affecting the rate of enzyme catalyzed reactions. Isozymes and zymogens. Enzyme inhibitors. Feed-back inhibition and regression. Allosteric inhibition catalytic RNA.

UNIT-II ENZYME KINETICS

Chemical kinetics, Michaelis-Menten and Briggs-Haldane kinetics. Determination of K_m. Analysis of kinetic data. Importance of

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K_m, K_i and V_{max} coenzymes and their role in metabolism. Reversible reactions.

UNIT-III ENZYMOLOGY

Classification of catalytic mechanisms. Acid-base, covalent, proximity and orientation. Transition state binding and metal ion effects of enzyme catalysis. Metal ion and electrostatic catalysis. Structure and nature of active site. Chemical modification of active site. Mechanism of catalysis of Rnase, lysome, chymotrypsin, trypsin, papain and carboxypeptidase.

UNIT-IV ENZYMOLOGY-II

Coenzymic catalysis. Mechanism of pyridoxal phosphate and thiamine pyrophosphate dependent enzymes. Metabolloenzymes. Brief description of Hill and Scatchard plots. Allosteric regulation of enzyme activity. Models of monod and kashland for allosteric regulation. Regulatory features of aspartate transcarbamylase, glutamine synthetase and ribonucleotide reductase.

UNIT-V BIOENERGETICS AND PHOTOSYNTHESIS

Biological oxidations. Free energy changes and high energy compounds. Redox potentials. Biological redox systems. Electron transport chain, components and importance. Substrate level and oxidative phosphorylation. Mechanism of oxidative phosphorylation. Energy change and states of oxidative phosporylation. ATP generation from carbohydrate and fatty acid oxidation. Cytochrome P450 and microsomal oxidations. Bioluminescence.

Photosynthesis pigments and organelles. Photosynthetic electron transport. Calvin cycle. Quantum efficiency, Regulation of photosynthesis, C3 and C4 plants, HSK pathway, Cyclic and non-cyclic photophosphorylation. Photorespiration. Bacterial and anoxygenic photosynthesis.

PAPER-V : ENDOCRINE BIOCHEMISTRY

UNIT-I ENDOCRINE SYSTEM

Organization of the endocrine system. Biosynthesis, processing and secretion of hormones. Classification of hormones. Disorders of endocrine function. The second messenger concept and

mechanism of hormone action. Hormone receptors. Up and down regulation of receptors. Insulin, glucocorticoid and adrenergic receptors. Super family of steroid and thyroid hormone receptors. Growth factors, chemistry and functions of IGF-I and II NGF, EGF and PDGF.

UNIT-II HYPOPHYSIS, HYPOTHALAMUS AND RELATIONSHIP, PINEAL

Classification, chemistry, functions and regulation of anterior and posterior pituitary hormones. Role of hypothalamus in control and regulation of endocrine orchestra. Hypothalamo-hypophyseal relationship. Chemistry, biosynthesis, regulation and functions of Pineal.

UNIT-III THYROID, PARATHYROID, THYMUS AND OTHER GLANDS

Biosynthesis, regulation chemistry and functions of thyriod hormones. Hormones that regulate Ca^{++} and phosphate metabolism. Parathyroid and calcitrol hormones, calcitonin. Chemistry, biosynthesis, regulation and functions of thymus, Melatonin endocrine role of kidney, Mechanism of erethropoietin, gastrointestinal hormones.

UNIT-IV PANCREAS AND ADRENALS

Chemistry, biosynthesis, regulation and functions of pancreatic hormones. Chemistry, biosynthesis, regulation and functions of hormones of adrenal cortex and medulla.

UNIT-V GONADS AND REPRODUCTION

Chemistry, biosynthesis, regulation and functions of androgens and estrogens. Hormonal and physiological changes in human menustrual cycle. Placenta as Endocrine Gland. Introduction to oral contraceptives. Gastrointestinal hormones.

PAPER-VI : BIOCHEMICAL TECHNIQUES AND COMPUTATIONAL METHODS

UNIT-I SPECTRO-PHOTOMETRY AND CHROMATOGRAPHY

Concepts of spectroscopy, visible and UV spectroscopy. Laws of photometry. Beer Lambert law. Principles and applications of colorimetry, Fluorimetry, Atomic absorption spectro-photometry.

Basic principles and applications of UV, IR, ESR, NMR and mass spectroscopy. Chromatography, Principles and partition, Paper and thin layer chromatography, Ionexchange chromatography, Gel permeation chromatography, GC and HPLC.

UNIT-II METABOLIC TECHNIQUES

Principles of centrifugation. Concepts of RCF. Different types of instruments and rotors. Preparative, differential and density gradient centrifugation. Analytical ultracentrifugation, determination of molecular weights and other applications. The oxygen electrode. Organ perfusion. Use of experimental animals, tissues homogenates and mutant organisms in the study of intermediary metabolism. Stable and radioactive isotopes, Concepts of half life and decay. Use of various isotopes in metabolic studies.

UNIT-III RADIOACTIVITY

Radioactivity, Principles of scintillation counting. GM counters. Applications of isotopes. Isotope dilution technique. Autoradiography. Turnover studies. Precursor-product relationship. Production of radio-labelled biomolecules. Calculations involving isotopes. Radiation hazards and methods for contaminant prevention.

UNIT-IV ELECTROPHORESIS AND MICROSCOPY

Principles of electrophoretic separation. Zonal and continuous electrophoresis. Paper, cellulose acetate/nitrate, gel and capillary electrophoresis. Use of native and denaturating gels. Isoelectric focussing and two dimensional gel electrophoresis. Electroporation. Pulse field gel electrophoresis. Gradient gels. Microscopy : Basics of phase contrast, polarization, fluorescence and electron microscopy. Confocal microscopy. Cell-sorting and FACS.

UNIT-V STATISTICS AND COMPUTER SCIENCE

Statistics, Introduction to statistics. Probability and randomness. Distribution. Normal pioisson and binominal Mean, mode and range. Standard Deviation and error, Regression coefficient and use regression for linear data. Experimental design, sampling. Methods of Data Presentation. Graphs and histograms. Tests of significance, Correlation, coefficient of variation. Student's T and Chi_2 test.

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Elements of computer science, general awareness of development of computers, Mainframe, mines, micro's and super computer systems. CPU and peripherals I/O auxillary storages. Software and programming languages (Machine, assembly and higher level) popular software packages for use in biology. Networking concepts and its use in data search.

LAB COURSE-I

A. BASIC BIOCHEMICAL METHODS

1. Orientation. Units in biochemistry, calibration of volumetric glassware, introduction to biochemical instrumentation. Care and handling of instruments. Colorimetry and spectrophotometry. Verification of Beer-Lambert's law and deviations. Parts of a colorimeter and spectrophotometer. Care and use of cuvettes. Determination of molar extinction coefficients of NAD, NADH, tyrosine, tryptophan, adenine, etc.
2. Determination of absorption spectra of compounds such as proteins and nucleic acids. Preparation of standard solutions. Calibration graphs, methods of plotting data. A typical colorimetric estimation such as Biuret method and proteins. Preparation of buffers. Use of pH meters. Qualitative test for amino acids, carbohydrates and lipids. Estimation of amino acids using the ninhydrin reagent.
3. Dialysis experiments. Ascending and descending paper chromatography. Separation and identification of sugars and amino acids. Paper electrophoresis. Separation of amino acids. Cellulose acetate electrophoresis, Separation of proteins, Polyacrylamide gel electrophoresis.
4. Thin layer chromatography. Separation of lipids, purines, pyrimidines and their quantitation. Ion exchange chromatography. Quantitative separation of amino acids, nucleosides using Dowex 1 and Dowex 50 resins, Gel filtration; Separation of blue dextran and cobalt chloride on Sephadex G25 or similar experiment.

B. CLINICAL BIOCHEMISTRY

1. Determination of hemoglobin content in blood. Osmotic fragility, PCV, ESR, differential counts. Determination of blood-glucose by Hagedorn-Jensen methods by Nelson-Somogyi method, and glucose oxidase method. Glycosylated hemoglobins.

2. Assays of serum transaminase. Determination of bilirubin and calcium. Qualitative tests for normal and abnormal urinary constituents. Determination of urinary creatine and creatinine.
3. Nitrogen estimation by Micro-Kjeldahl Method. Total nitrogen excretion in humans, balance studies.
4. Estimation of Vitamin 'A' in foods. Estimation of Vitamin 'C' in citrus fruits both titrimetric and colorimetric methods. Estimation of thiamine in foods by fluorimetry.

LAB COURSE-II

A. ANALYTICAL METHODS

1. Preparation of buffers.
2. Biochemical preparations. Preparations of egg albumin, casein, glucosamine, cysteine, ATP glycogen, Preparation of DNP amino acids and separation by TLC and quantitative identification.
3. Determination of calcium as calcium oxalate. Determination of iron in food stuffs by colorimetry. Use of atomic absorption spectrophotometer to determine Na and K in serum. Determination of Na and K by flame photometry. Determination of Mg in biological samples. Methods of cell distruption. Preparation of tissue homogenates using different homogenizers.
4. Lipid analysis. Determination of lipid content in oil seeds. Triglyceride composition by TLC in germinating seeds.

B. CARBOHYDRATE AND LIPID ANALYSIS

1. Isolation of glycogen from liver. End group analysis by periodate oxidation and determination of average chain length of glycogen.
2. Differential analysis of sugars in a mixture. Use of polarimetry for configurational analysis of carbohydrates. Estimation of sucrose.
3. Extraction and adsorption column chromatography of plant pigments. TLC and GC analysis of lipids. Determination of iodine number, saponification and acid value of a fat.
4. Isolation of cholesterol from brain and its estimation. Preparation and analysis of sphingomyclin.

M.Sc. (Final) BIOCHEMISTRY

PAPER-VII : BIOCHEMICAL GENETICS AND DNA REPLICATION

UNIT-I HERIDITY AND GENETIC ANALYSIS

Basic concepts of Mendelian and non-Mendelian inheritance. Importance of meiosis in heridity. Sex linked inheritance. Polygenic and maternal inheritance.

Somatic and germinal cell mutations. Different kinds of mutation (Forward and back, point, frameshift, deletion mutations) Conditional mutants, resistance mutants. Suppressor mutations. Chromosomal mutations. Detection, selection and isolation of mutants. Mutation rates. Mechanism of action of mutagens. Polyploidy. Site directed mutagenesis. Photoreactivation and mechanisms for repair of UV damaged DNA (Post replication and SOS repair).

UNIT-II GENOME ORGANIZATION

Genome organization in procaryotes and eucaryotes. Plasmids, transporons, insertion sequences and retroposons. Mitochondrial and chloroplast DNA. Benzer's fine structures of rll loci. Organization of eucaryotic chromosomes. Histones and non-histone type DNA binding proteins. Nucleosomes and higher order structures. C-value pradox and the significance of introns. Single copy genes, repeating sequences, and tandem gene clusters. r-RNA genes, histone genes and immunoglobulin genes. Selfish DNA.

UNIT-III MUTATIONS, RECOMBINATION AND GENE TRANSFER

Mutations. Different kinds of mutations, Isolation of mutants, phage mutants, host range rapidlysis and temperature sensitive mutants. Mechanism of mutants. Gene transfer mechanisms, transformation, trasduction. (generalized, abortive and specialized). Conjugation $F^+ \times F^-$ Hfr strains. Mechanism of recombinant and cross over. Elements of gene mapping. Mapping by recombination analysis, multiple cross over and interference. Circular chromosome and mapping by conjugation. Tetrad and complement analysis. Mapping by transformation and transduction. Map units and cytological maps of eukaryotic chromosomes. Somatic cell genetics.

UNIT-IV DNA REPLICATION-I

Semiconservative replication. Replication forks. Role of DNA gyrase. Continuous and discontinuous synthesis. Evidence for Okazakai model. RNA primers. Enzymes in replication. Single strand DNA binding proteins. Helicases. TD poisomerases. DNA primases, DNA ligases, DNA polymerases. E coli DNA polymerases I and II. Eucaryotic DNA polymerases. Procaryotic replication mechanisms, Rolling cycle replication. Replication of $\phi \times 174$ RF DNA. Bacteriophate M13. Replication of E coli DNA.

UNIT-V DNA REPLICATION-II AND REPAIR

Eucaryotic DNA replication, Eucaryotic DNA polymerases, Autonomous replicating Sequences, yeast plasmid replication (Double rolling circle). Mitochondrial DNA replication, Reverse transcriptase, Termination and fidelity of replication, fusion of replicons and termination signals. Telomers, Inhibition of DNA replication. DNA repair : Direct reversal of damage, Excision repair, Recombinant repair, the SOS response, Identification of carcinogens. Inhibitors of DNA replication.

PAPER-VIII : PROTEIN SYNTHESIS AND REGULATION

UNIT-I TRANSCRIPTION

Polynucleotide phosphorylase, RNA polymerase, structure of **E.coli** RNA polymerase. Interaction between RNA polymerase and template, chain initiation and the ( ) cycle, elongation and termination. Eucaryotic RNA polymerases. Promoter and enhancer sequences. Inhibitors of transcription. Synthesis of different RNA molecules. Synthesis of r-RNA, 5 sRNA and tRNA. Synthesis of eucaryotic mRNA, hnRNA capping, Methylation and polyadenylation.

RNA splicing-introns and split genes. Splicing mechanisms, splicing of nuclear pre-tRNA introns. Group-I & II pre-mRNA introns. Excision of multiple introns. Nuclear cytoplasmic transport. Factors involved in pre m-RNA splicing, RNP's, protein factors, hnRNP proteins. Splicing complexes (Spliceosomes). Transplicing. Catalytic RNA.

UNIT-II TRANSLATION

The genetic code, elucidation, experimental, codon degeneracy and universality. In vitro translation systems. tRNA structure

and role in protein biosynthesis. Amino acyl t-RNA synthetases. Wobble hypothesis. Mitochonodiral genetic code. Nonsense suppression. Ribosomes-structure and composition. Ribosomal proteins and composition. Ribosomal proteins and reconstitution. Mechanism of initation, elongation and termination of protein biosynthesis. Factors required for translation. Inhibitors of protein synthesis antibiotics and other inhibitors. Nonribosomal biosynthesis of polypeptides. Biosynthesis of gramicidin-S.

UNIT-III REGULATION OF GENE EXPRESSION

Translation feedback. Synthesis of ribosomes and ribosomal RNA. Hemoglobin synthesis. Interferons. Regulation of gene expression at transcriptional level. The lac repressor. Fine structure of lac operon. cAMP and the catabolic activator protein. Gal operon and concept of dual promoters. Dual functions of the repressor the ara opreon. Transcriptional control by attenuation. The trp operon.

Eucaryotic gene regulation. Positioning chromosomes for transcription. Polytene chromosomes. Gene amplification and gene rearrangements. Transcriptional control by alternative RNA processing and enhancers. Homeotic genes. Regulatory molecules that interact with DNA. Helix-turn-helix. Zinc finger and leucine zipper motifs.

UNIT-IV PROTEIN TARGETTING

Proteins sorting and targeting. Cell organelles and proteins in protein sorting. Post-translational modifications. The signal hypothesis. Signal sequences and signal recognition particle. Molecular chaperones. Protein degradation. Lysomal degradation. PEST sequences. The ubiquitin pathway. Protein stability and the N-end rule.

UNIT-V SIGNAL TRANSDUCTION

Totipotency and cell signaling. Role of growth factors and cytokines. Signal transduction mediated by cAMP. Role of nitric oxide and cyclic nucleotides. Calcium ions, calmodulin and inositol phosphatides as second messengers. Protein phosphorylation and signal transduction. Glycosulation, acylation and ADP ribosylation of proteins and their role in signal transduction. Programmed cell death and mechanisms involved therein.

PAPER-IX MICROBIAL BIOCHEMISTRY AND VIROLOGY

UNIT-I MICROBIOLOGY INCLUDING PARASITOLOGY

Isolation, cultivation and identification of bacteria. The bacterial cell wall structure. Gram positive and gram negative bacteria. Microbial nutrition and growth. Bacterial growth and kinetics. Diauxic growth. Synchronous growth. Chemostatic culture. Continuous cultivation of microbes, Bacterial and viral diseases, euteric diseases, tubdderculos is typhoid, tetanus, malaria, Kalazar, prion diseases.

UNIT-II FERMENTATION

Introduction to fermentation. Fermentative production of ethanol, penicillin, riboflavin, glutamic acid, lysine, amylases and proteases. Solid state fermentation. Antibiotics : chemistry and mode of action of pencillin, streptomycin, chloramphenicol, tetracyclines and rifampicin.

Basic design of fermentors. Production of enzymes (amylases, proteases, lipases and cellulases) and high fructose syrup. Microbial transformations of sterols and steroids. Environmental applications of microorganisms in sewage and effluent treatment (aerobic and anaerobic digestors). Downstream processing of valuable products.

UNIT-III VIROLOGY-I

Nature of virusoids, prions and viruses. Composition and structure of viruses. Virus-host interactions. Isolation and assay of viruses. General methods of virus isolation with examples of TMV and T phages. Assay of TMV. Plaque assay for bacteriophages. Assay of animal viruses with special reference to oncogenic viruses. Pock assays. Cytopathic effects. Bacteriophages-structure, regulatory mechanisms and development of T even phages. OX 174, QβM13. Bacteriophage life cycles. Lytic growth of bacteriophages, initial events, one step growth, single burst. Eclipse.

UNIT-IV VIROLOGY-II

Eucaryotic viruses. SV 40 virus system, cell transformation, interactions in permissive and non-permissive hosts. Retroviruses. RSV as protype virus. Animal viruses. General features and outlines of adenovirus, poliovirus 40, retrovirus and HIV/AIDS. Oncogenic viruses and carcinogenesis. Oncogens and mechanisms of cell transformation.

UNIT-V PLANT AND ANIMAL VIRUSES

General features : Host-virus interactions, permissive/ nonpermissive hosts, structure of naked and enveloped viruses, cytopathic effects, assay methods (Pock assay, haemagglutination assay, transformation assay) and purification methods (ultrafiltration, ultracentrifucation and affinity methods).

PAPER-X : IMMUNOLOGY

UNIT-I BASIC IMMUNOLOGY

Elements of immunity. Natural and acquired immunity. Cells and tissues of immune system. Elements of cellular and humoral immunity. Immunogens, antigens, haptans, adjusvants. Immunoglobulin nature, structure, classification and biological properties. Generation of antibody diversity. Genes involved in antibody production. Theories of antibody production. Effector mechanisms of humoral immunity. Activation of B-lymphocytes. T-cell receptors. Triggering the immune response. Cellular cooperation immune response. Complement and its role in immune response.

UNIT-II APPLIED IMMUNOLOGY-I

Hybridoma technique and monoclonal antibodies. Antigen-antibody interactions. Immuno-analytical methods based on Ag-Ab interactions (Gel diffusion techniques, immunoelectrophoresis, immunofluorescence, RIA, ELISA and western blotting). Vaccines. Methods of vaccine production. DNA vaccines, synthetic vaccines.

UNIT-III APPLIED IMMUNOLOGY-II

Hypersensitivity. Basic concept and types of hypersensitivity. Autoimmune diseases. Theories of breakdown in self-tolerance. Selected autoimmune diseases (Organs specific and systemic diseases). Immune deficiency disorders-AIDS. Immunosupressive agents in clinical practice.

UNIT-IV IMMUNO ANALYTICAL METHODS

Production and immuno technology and purification of polyclonal antibodies. Antigen-antibody interactions-gel diffusion, immuno eletrophoresis, immuno fluorescence, RIA, ELISA Western blotting and FACS techniques. Vaccines-types and their applications. (DNA, recombinant DNA, peptide and antiodtypic vaccines).

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UNIT-V CYTOKINES

Effector molecules, cytokine receptors. Complement, classical and alternate pathways of complement activation, regulation of complement activation pathways. Immunological tolerance, hypersensitivity, Autoimunity, immunology in cancer and AIDS, Vaccines.

PAPER-XI BIOTECHNOLOGY

UNIT-I PROTEIN ENGINEERING

Immobilized enzymes and cells. Methods of immobilization and applications. Resolution of amino acid recemates. Synthesis of improved penicillin's increased protein stability and enhanced specific activity. Altering the kinetic properties and pH.

UNIT-II MICROBIAL BIOTECHNOLOGY

Introduction to microbial biotechnology. Large-scale cultivation of microbes, problem of oxygen supply, basic fermeter design, current design of stirred tank reactor, aspetic operation, control systems, batch versus continuous operation, down-stream processing. Production of biomass (microbial insecticides, starter cultures, single cell proteins production). Production of low molecular weight compounds–primary and secondary metabolites. Metabolic end products. Bioconversions. Microbial polysaccharides and production of microbial enzymes. Microbiological mining. Introduction to drug design and delivery.

UNIT-III ANIMAL BIOTECHNOLOGY

Introduction to animal biotechnology. Cells and cell lines, media for cell structure and equipment. Production of viral vaccines. Production of high value therapeutics inteferon and plasminogen activator, urokinase. Monoclonal antibodies. Immunotoxins as therapeutic agents. Chimaric antibodies. Introduction to transgenic animals. Human gene therapy. Animal cloning techniques. Gene knockouts.

UNIT-IV PLANT BIOTECHNOLOGY

Introduction to plant biotechnology. Plant cell culture, plant protoplast and protoplast fusion. plant viruses as vectors. Ti plasmid as vector and transgenic plants. Transgenic technology. Antisense RNA and DNA.

UNIT-V MICROBIAL PATHOGENS AND ANTIMICROBIAL AGENTS-II

Antibiotics : Assay of antibiotics, chemistry and biosynthesis of important antibiotic compounds. First, second, third and fourth generation antibiotics with reference to modified penicillins. Antibiotic resistence. Biochemical modes of action of antibiotics acting as inhibitors of ribosomal function (e.g., aminoglycosides, tetracyclines, puromycin, chloramphenicol etc.) inhibitors of nucleic acid metabolism, actinomycin D, mitomycin C etc.) inhibitors of cell wall biosynthesis (penicillins, bacitracins etc.) and inhibitory of membrane function (polyenes, peptide antibiotics etc.)

PAPER-XII GENETIC ENGINEERING

UNIT-I GENETIC ENGINEERING-I

Introduction and overview of methodology for cloning. Homologous and heterologous expression of genes. Methods of ligation. DNA ligases, ligation of fragments with cohesive ends. Adapters and linkers. Blunt and ligation. Homopolymer tailing. Use of restriction nucleases in cloning. Use of viral and plasmids YAC, shuttle vectors. Eucaryotic vectors. Copy number subcloning strategies.

UNIT-II GENETIC ENGINEERING-II

Identification of clones of interest. The use of genomic DNA library and DNA library in gene cloning. Chromosome walking and mapping techniques. Use of expression vectors to over produce proteins. Baculoviral expression. Reporters genes and identification of upstream control elements. Secretion of recombinant proteins. Fusion proteins. Yeast expression. Site directed mutagenesis. Subtractive cDNA cloning. Phage display of proteins and peptides. 2-hybrid system.

UNIT-III DNA CLONING, TOOLS AND TECHNIQUES

Production of recombinant proteins with examples of insulin, somatostatin and interferon. PCR and its applications. RFLP and its applications. DNA finger printing, trans genics and cloning techniques.

DNA Sequencing methods. Maxam and Gilbert's method. Dideoxy chain termination method of Sanger. Gene probes in detection prenatal and antenatal detection of disease. Human genome project.

(10)

UNIT-IV GENE REGULATION AND HUMAN DISEASE

Oncogensis with reference to protooncogenses. Transcription factors as oncogensis (Fos, Jun, AP, 1, V erb Aand thyroid harmone receptor). Antioncogensis. P53, Retinoblastoma protein.

UNIT-V REGULATION OF GENE EXPRESSION IN PROKARYOTES AND EUKARYOTES

Negative and positive control of gene expression (Lac operon). Dual promoters (Gal operon). Dual function of repressor (ara operon). Transcriptional control by attenuation (trp operon). Phase variation (Salmonella flagellar protein synthesis). Translational feedback.

LAB COURSE-I

A. ANALYSIS OF BIOMOLECULES

1. Absorption spectra of nucleic acids and base derivatives. Preparation and quantitation of nucleic acids. Analysis of nucleic acids for base composition and GC content.
2. Hyperchromicity. Correlation of T_m and base composition. Incorporation of ^3H thymidine into DNA. Plasmid mini preparations.
3. Large scale isolation of a plasmid DNA. Use of restriction endonucleases and ligase. Agarose gel electrophoresis.
4. Insertion of foreign DNA into a vector and transformation. Blot analysis for RNA and DNA. DNA sequencing by Sanger's method (demonstration).

B. ENZYME KINETICS AND IMMUNOLOGY

1. Determination of blood groups. Ouchterlony double immuno diffusion.
2. Immuno electrophoresis. RIA and ELISA methods (demonstrations).
3. Cell-fractionation. Preparation of cell free homogenate. Isolation of mitochondria. Intracellular localization of dehydrogenases and respiratory enzymes. Preparation of chloroplasts and nuclei. Isolation and purification of enzymes (lysozyme from egg white, urease from jack bean meal, arginase from liver, pyrophosphatase from yeast).
4. Kinetic studies including determination of K_m and K_j-Metal ion activation of enzymes. Determination of activation energy of an enzyme. Turnover number of catalase or trypsin. Enzyme inhibition.

LAB COURSE-II

A. ANALYTICAL METHODS AND ENZYMOLOGY

1. Qualitative tests for salivary amylase. Determination Of enzyme activities (V_{max} and specific activity) of the following enzymes, Sweet potato amylase, horse gram urease, liver catalase, arginase, yeast acid and alkaline phosphatases, yeast invertase. Proteolytic activity of pancreatin.
2. Qualitative tests for inhibition of enzyme activity with above enzymes. Determination of order of a Chemical reaction.
3. Saponification of esters, Identification of organic functional grmps by qualitative tests. Formol titration of amino acids.
4. Determination of pk of amino acids. Polarimetric experiments. Respirometry, study of tissue respiration by tissue slices and effect of inhibitors on oxygen consumption.

B. PROTEIN ANALYSIS

1. Absorption spectra of proteins and methods of protein estimation. Determination of aromatic amino acid content in proteins.
2. Isolation of a protein by salt or solvent or isoelectric precipitation.
3. Purification of protein and determination of molecular weight by SDS-PAGE. End group analysis by DABITC method.
4. Incorporation of labeled amino acids into proteins (demonstration). Protein phosphorylation (demonstration). Western transfer. Identification of proteins on membranes using avidin-biotin and/ or antibodies.

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M.Sc. BIOCHEMISTRY

(Previous and Final)

Instructions to examiners to all theory papers.

Max. Marks of each theory paper is : 100

Time : 3hrs.

Note:

1. Ten questions will be set in all selecting two questions from each unit.
2. Candidates have to attend five questions, one from each unit.

M.Sc. BIOCHEMISTRY
(Previous and Final)

Max. Marks : 200

Duration of Exam : 12 hrs.
(Spread in 2 days)

4 Exercises to be performed selecting one exercise from each section.

Two quantitative exercises	= 50×2	= 100
Two qualitative exercises	= 25×2	= 50
Viva		= 30
Record		= 20
		= 200

Note— The practical examination will be conducted by the board of two external and one internal examiners who will conduct practical on both days.