

M.G. KASHI VIDYAPITH, VARANASI

Three Years Degree Course Syllabus for

Biotechnology

(BASED ON UNIFORM SYLLABUS FOR U.P. STATE UNIVERSITIES)

(w.e.f. session 2012-13)

| Year | Paper No. | Title of paper | Marks |
|-----------------|------------------|---|--------------|
| I year | Paper I | Introductory Biological Chemistry | 50 |
| | Paper II | Biophysical Chemistry | 50 |
| | Paper III | Cell Biology and Genetics | 50 |
| | | Practical | 50 |
| | | | Total |
| II year | Paper I | Bioenergetics and Biomembranes | 50 |
| | Paper II | Animal and Plant Physiology | 50 |
| | Paper III | Biostatistics and Computers | 50 |
| | | Practical | 50 |
| | | | Total |
| III year | Paper I | Molecular Biology and Genetic Engineering | 75 |
| | Paper II | Animal and Plant Biotechnology | 75 |
| | Paper III | Industrial and Environmental Biotechnology | 75 |
| | | Practical | 75 |
| | | | Total |

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B.Sc. Part-I (Biotechnology)

Paper-I: Introductory Biological Chemistry

50 Marks

General account of the chemical nature of living cells.

Carbohydrates: Classification, configurations and conformations, sugar derivatives, structural and storage polysaccharides.

Amino acids: General properties, peptide bond, essential and non-essential amino acids.

Lipids: Classification, properties of lipid aggregates, biological significance.

Nucleic acid: Chemical structure and base composition, double helical structures, T_m, super-coiled DNA.

Protein chemistry: Classification, different levels of protein structure, forces stabilizing protein structure, protein folding, protein modification.

Enzymes: Nomenclature, apoenzyme and holoenzyme, substrate specificity, coenzymes, factors affecting enzyme activity, regulation of enzyme activity, enzyme inhibition, isozymes, ribozymes, abzymes.

Vitamins, water and fat soluble vitamins, deficiency and diseases.

Paper II: Biophysical Chemistry

50 Marks

Water: Structure and interactions, water as solvent, proton mobility, acid-base reactions, pH and buffers, isoelectric pH.

Photometry: Basic principles of UV-Visible spectrophotometry and colorimetry, instrumentation and application.

Centrifugation: Principles and application, sedimentation coefficient, differential, density gradient and ultra-centrifugation.

Chromatography: Ion Exchange, partition, gel filtration and affinity chromatography their principles and applications.

Electrophoresis: Principle, types (polyacrylamide and agarose gel electrophoresis), applications, Isoelectric focusing.

Microscopy: Principles and applications of light, phase contrast, fluorescence and electron microscopy.

Tracer technique: Applications of radioisotopes in biotechnology, autoradiography.

Paper III: Cell biology and Genetics

50 Marks

Cell theory, cell as basic unit of life.

Structure and organization of prokaryotic and eukaryotic cells. Cell organelles- structure, function and integration, micro bodies.

Cell division- mitosis and meiosis, Cell cycle, its regulation and cancer, Characteristic of cancer cells.

Major signaling pathways of eukaryotic cells.

Mendel's law of inheritance, Gene interactions. Sex determination, linkage, crossing over, recombination and gene mapping.

Chromosome structure and behaviour through the cell cycle, karyotype. Chromatin organization. Polytene and Lampbrush chromosome, Banding patterns in human chromosome, structural and numerical changes in chromosomes, hereditary defects.

Extra-chromosomal inheritance, sex-linked inheritance in humans, Mutation at phenotypic level, biochemical level and molecular level.

Gene frequencies in population, Hardy-Weinberg law.

Practical

50 Marks

1. Preparation of buffers.
2. Qualitative tests of sugars.
3. Estimation of sugar by anthrone method
4. Qualitative tests of proteins.
5. Estimation of protein by Lowry's method
6. Estimation of DNA by diphenylamine method
7. Estimation of RNA by orcinol method
8. Chemistry practicals- group analysis, gravimetry
9. Assay of salivary amylase activity
10. Isolation of casein from milk.

B.Sc. Part II (Biotechnology)

Paper I : Bioenergetics and Biomembranes

50 Marks

Fundamentals of thermodynamics- endergonic and exergonic processes, enthalpy, entropy, activation energy, free energy change, phosphoryl transfer reaction, oxidation reduction reaction, redox potential, equilibrium and non equilibrium thermodynamics, high energy compounds, causes of energy richness in ATP.

Glycolytic pathway and its regulation, homolactic fermentation, alcoholic fermentation, energetics of fermentation, glycogen breakdown, Citric acid cycle and its regulation, gluconeogenesis, Electron transport and oxidative phosphorylation, pentose phosphate pathway, glyoxalate pathway.

Fatty acid oxidation- major and minor pathways of fatty acid oxidation, ketone bodies.

Metabolic breakdown of amino acids, transamination, deamination, urea cycle.

Biological membranes- membrane proteins, fluid mosaic model of membrane structure, erythrocyte membrane, plant cell membrane, bacterial cell wall.

Thermodynamics of transport, kinetics and mechanism of transport, active and passive transport, ATP-driven active transport, Ion gradient driven active transport.

Paper II : Animal and Plant Physiology

50 Marks

Photosynthesis: Photosynthetic pigments, electron transport, Photophosphorylation and Carbon fixation pathways. Fixation of atmospheric nitrogen by plants and microorganisms. Nitrate uptake and metabolism.

Plant hormones: Cytokinins, Gibberellic acid, Auxins, Ethylene. Abscissic acid- their physiological effects and mode of action. Nutrition- Macronutrients and micronutrients and their uptake by plants.

Seed germination and dormancy. Photoperiodism. Vernalization, Flowering. Senescence. Abscission.

Blood, its cellular and chemical composition, blood clotting.

Respiratory system: diffusion of oxygen and carbon dioxide, transport of oxygen, role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, Bohr's effect, transport of CO₂ and chloride shift. Various buffer system of the blood, acidosis, alkalosis. Role of lung and kidney in regulation of acid base balance.

Kidney- structure, its organization and function. Structural and functional characteristics of tubules, ultrafiltration, selective reabsorption and secretion, role of aldosterone and antidiuretic hormones and mechanism of urine formation.

Digestive System- different components, digestion and absorption of carbohydrates, lipids and proteins,

Endocrine- brief outline of various endocrine glands and their physiological roles, storage and secretion of hormones. Nervous System- Nerve cells, nerve fibers, nerve impulse and neurotransmission, chemical and electrical synapses, functional properties of nerve fibers, action potential, the reflex action and reflex arc.

Immunity, antigen, antibody, hapten, antigen-antibody interaction, introduction to antigen presentation, role of MHC, complement system, vaccines.

Paper III : Biostatistics and Computers

50 Marks

Graphic and Diagrammatic representations. Classification and tabulation. Measures of central tendency and dispersion. Skewness and Kurtosis.

Introduction to probability, and distribution, sampling theory and errors. Tests of significance. Z, t, Chi square and F-test.

Analysis of variance. Correlation and regression.

Introduction to computers, hardware, storage and memory devices, input and output devices, file and folders concepts. File management , networks, printers, floppies, mouse, keyboard.

Different types of booting, operating systems-single user, multi-user and multi tasking operating systems with examples.

Internet and E-Mail. Important services provided by internet. Use of internet in Biotechnology studies and research.

Practical

50 Marks

1. Determination of urine urea nitrogen.
2. Isolation of serum albumin by salting out method.
3. Determination of serum albumin by Bromocresol green method.
4. Determination of total cholesterol.
5. Determination of SGOT.
6. Determination of SGPT.
7. Determination of serum bilirubin.
8. Blood group analysis
9. Ouchterlony double diffusion test
10. Determination of haemoglobin content by haemoglobinometer.

B.Sc. III year (Biotechnology)

Paper I: Molecular Biology and Genetic Engineering

Marks 75

Nucleic acids as genetic material, structure of A-, B- and Z-DNA, palindromic sequences, structure of RNA (t-RNA, m-RNA and r-RNA), DNA denaturation and renaturation.

DNA replication in prokaryotes, DNA polymerase I, II and III, modes and mechanism of DNA replication, DNA repair mechanisms.

Transcription in prokaryotes, RNA polymerase, types and functions of RNA polymerases in eukaryotes. Genetic code, translation in prokaryotes, Post-translational modifications. Gene organization, Operon concept and introduction to gene regulation mechanisms.

Transposons: An elementary idea

Basic concept of recombinant DNA technology, principles of gene cloning. Restriction-modification systems, use of restriction enzymes in biotechnology, cloning vectors.

Methods of gene transfer, DNA libraries.

Introduction to PCR, RFLP, DNA sequencing, blotting techniques.

Paper II : Animal and Plant Biotechnology

75 Marks

Plant tissue culture techniques, *in vitro* pollination and fertilization, embryo culture and its applications, embryogenesis and organogenesis, micropropagation, haploids and their applications, somaclonal variations and applications, Endosperm culture and production of triploids.

Introduction to protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization. Protoplast and tissue culture manipulation for genetic manipulation of plants, methods of gene transfer in plants, crop improvement and development transgenic plants.

Single cell protein (SCP), economic implications of SCP.

Basic techniques in animal cell culture and organ culture, cell line and isolation of cell line, culture media, contaminations and their laboratory management, cell fusion, cell differentiation and growth of cultured cells, bioreactors for large scale culture of cells.

Cloning in mammalian cells, integration of DNA into mammalian genome- different methods.

Development of recombinant vaccines, monoclonal antibody their applications. Introduction to transgenics, gene therapy.

Production of secondary metabolites/products: Insulin, growth hormones, interferons etc.

Paper III : Industrial and Environmental Biotechnology

75 Marks

General characteristics of microorganisms, structure of bacteria and viruses, bacterial growth - bacterial growth curve, factors affecting bacterial growth.

Recombination in bacteria- transformation, conjugation and transduction, reproduction in bacteria, Bacterial diseases of humans, Food spoilage, food preservation.

Environmental microbiology- water pollution, treatment of water and sewage, biogeochemical cycles of elements in the environment.

Renewable and non renewable sources of energy.

Disposal of solid wastes, oil spills, cellulose etc.

Microbes in industry – foods from microorganism (vinegar and cheese). production of citric acid, amylases, proteases, vitamin B₁₂, beer, wine, biogas, methane, hydrogen

Bacteriology of water and sewage, Bacteriological examination of water.
Biodegradation of plastic , pesticides and hydrocarbons

Bioremediation, Bioleaching, Biosorption, Biopesticides, Biofertilizers, Biofuels, Biosensors, Bioindicators, Biodegradable plastics

Practical

75 Marks

1. Methods of sterilization.
2. Preparation of culture media
3. Simple staining
4. Differential staining
5. Culture of bacteria on solid medium
6. Culture of bacteria on liquid medium (broth culture)
7. Determination of bacterial growth by turbidimetric method.
8. Preparation of alcohol from fruit juice(s).
9. Isolation and of DNA
10. Agarose gel electrophoresis of DNA