Syllabus

For B. Sc. In Biotechnology
Submitted to

KAZI NAZRUL UNIVERSITY

Under

National Curriculum and Credit Framework

(With effect from 2023-24)

Syllabus for Biotechnology

Semester I

Course Code: BSCBTLMJ101

Paper MJC-1- Fundamentals of Biotechnology (Theory) 50 marks (3 Credits)

UNIT I:

A historical perspective to the subject of biotechnology. Contribution of Paul Berg, HW Boyer and SN Cohen. Biotechnology & industry. Scope of biotechnology: research, jobs & others.

Principles of Biotechnology; Biotechnology is an applied science with contribution from all basic sciences (plant, animal, microbial, physics, chemistry, statistics, ethics and law). Application of biotechnology for the welfare of human, animals and our planet Earth.

Unit II

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Basics concepts of Gene cloning, Gene transfer, Recombinant DNA (definition, use and creation), cDNA Library: Creation of cDNA library, Isolation of gene from gene library, restriction enzymes, structural features of pBR322, cosmid vector, and bacteriophage. Principle, application and ethical issues related to Transgenic animals, Scopes and limitations of Genetically Modified Organisms (GMO).

Unit III

Basic concept on plant tissue culture. Role of plant hormones.

Basic concept on animal cell culture. Concept of stem cell & its utility. Animal cloning.

Unit IV

Principle and application of various tools & techniques in Biotechnology (you can include up to 10-15 techniques)

Enzyme Technology: Methods for large scale production of enzymes.
Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Application of Immobilized and soluble enzyme in health and industry.

Paper MJC-1- Fundamentals of Biotechnology (Practical) 50 marks (2 Credit)

1. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein and DNA. (ii) To study relation between absorbance and % transmission.

2. Preparation of buffers.
3. Extraction of DNA and RNA.
4. PCR and Gel electrophoresis
5. SDS-PAGE and Western Blotting

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender.
3. Brown, T.A. (1998). Molecular biology Labfax 11: Gene analysis. II Edition. Academic Press, California, USA.3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning, 2005.
5. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

Course Code: BSCBTLMJ201

Paper MJC-2- Cell Biology (Theory) 50 marks (3 Credits)

UNIT I

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.
Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.
Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis.
Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

UNIT IV

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.
Cell cycle. Cell division: basic concept, types and check points. Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Paper MJC-2- Cell Biology (Practical) **50 marks (2 Credit)**

1. Demonstration of dialysis.
2. Demonstration of plasmolysi and de-plasmolysis by Tradescantia/ Rhoeo leaf peel.
3. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
4. Study of structure of any Prokaryotic and Eukaryotic cell.
5. Section cutting, double staining of plant parts like stem, root and leaves.
6. Mitotic Cell division in onion root tip
7. Meiotic cell division in Allium cepa and insect gonads (Grasshopper testis).
8. Study of chromosome aberration in Rhoeo discolor.

SUGGESTED READING

1.Karp, G. Cell and Molecular Biology: Concepts and Experiments. Latest Edition. John Wiley & Sons. Inc.

2.De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. Latest Edition.Lippincott Williams and Wilkins, Philadelphia.

3.Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. Latest edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4.Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. The World of the Cell. Latest edition. Pearson Benjamin Cummings Publishing, San Francisco

Course Code: BSCBTLSE101

Paper SEC-1- Introduction to Biochemistry (Theory) **50 marks (3 Credits)**

UNIT I:

A historical perspective of Biochemistry. Molecular logics of life. Different levels of organization. Amino acids & Proteins: Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins. Denaturation and renaturation of proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoproteins and their biological functions

UNIT II

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

UNIT III

Carbohydrates Metabolism: Reactions, energetics. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Carbohydrates Metabolism: Reactions, energetics. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids. Human diseases associates with metabolic errors and or disorders.

UNIT – IV

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor.
Mechanism of enzyme action and techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.
Enzyme regulation: Product inhibition, feedback control, covalent modification.
kinetics of allosteric enzymes. Isoenzymes Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender.
3. Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning, 2005.
5. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.

Course Code: BSCBTLSE201

Paper SEC-2- Industrial Fermentation (Theory) 50 marks (3 Credits)

UNIT I

Basic concept on Fermentation reaction and process. Types. Fermenters.

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes, microbial flavours and fragrances, newer antibiotics, anti-cancer agents.

UNIT II

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism - its significance and products. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

UNIT III

Purification & characterization of proteins. Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth. ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations

UNIT IV

Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Easter Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrin Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Teclmology. 2nd edition, Elsevier Science Ltd.