Tribhuvan University
Institute of Science and Technology
B.Sc. Mirobiology

Description of the Course

Course Title: Biochemistry and Microbial Biotechnology
Course No: MB 201 (Major)
Nature of the Course: Theory

Full Marks: 100
Pass Marks: 35
Year: II
Total Lecture Hours: 150

Course Objectives

After completion of the course, the students will be able to:

a) understand cell and its functions, and macromolecules of living cells and their metabolism
b) understand concept of biotechnology and genetic engineering, and their applications

Course Contents

Living cell and understanding of its biochemical functions **15 hrs**

Origin of biochemistry and its relationship with other sciences, biochemical explanation of living things, the elements of life, chemical elements present in living organisms, organic compounds found in living cells, water: the solvent for life, cell biomembranes- structure and functions

Macromolecules and biomolecules of living cells **20 hrs**

Introduction, functions, classification, structure, important properties of: carbohydrates, amino acids, proteins, lipids, and nucleic acids

Enzymes: nomenclature, classification, functions of enzymes, co-enzymes, cofactor and isozymes, enzyme kinetics, factors affecting regulation of enzymes

Microbial metabolism **20 hrs**

Concept of exergonic and endergonic reactions, heterotrophic and autotrophic metabolism, role of ATP intermediary metabolism, heterotrophic generation of ATP in various pathways of carbohydrate metabolism, lipid metabolism, protein metabolism

Microbial genetics **20 hrs**

Structure, types and functions of DNA and RNA, replication of DNA, transcription and translation, regulation of gene expressions, lac operon, genetic code

Concept of biotechnology **5 hrs**

Definition and history, scope and importance, risk and hazards of biotechnology

Fermentation process **15 hrs**

Introduction, solid state fermentation, submerged state fermentation, fermentation industries, beer, ethanol, acetic acids, fermentor designs

Agricultural microbial biotechnology **15 hrs**

Introduction, biofertilizer and composting, plant tissue culture, micropropagation and disease free plants, general concept of cell fusion and embryo transfer

Biotechnology in diary industry **12 hrs**

Milk and milk products: cheese, yoghurt, ice-cream production, sour milk, skimmed milk, dry powder milk, pasteurization process of milk

Methods in genetic engineering **12 hrs**

Introduction, outline of gene cloning, gene cloning procedure, vectors used in recombinant DNA technology, applications and possible hazards of genetic engineering

Enzyme technology **16 hrs**

Introduction, source of enzymes, selection of source of enzymes, advantage of microbial enzymes, production and purification of protease, amylase, chitinase and pectinase

Recommended Readings

Text books

1. Nelson DL and Cox MM (2004). Lehninger Principles of Biochemistry, 5th Edition. Freeman Publication.
2. Stryer L (1995). Biochemistry, 4th Edition. W.H. Freeman Company, New York.
3. Creuger W and Creuger A (2000). Biotechnology. A textbook of Industrial Microbiology. Sinaeur Associates.
4. Smith JE (1996). Biotechnology, 3rd Edition. Cambridge University Press.
5. Cassida LE Jr (1996). Industrial Microbiology, New Age Int. Publishers.

Reference books

1. Rao KR (1986). Textbook of Biochemistry, 3rd Edition. Prentice Hall of India.
2. Rao RAVSS (1993). A Textbook of Biochemistry, UBSPD Co.
3. Jain JL (2004). Fundamentals of Biochemistry. S Chand and Company Ltd.
4. Dubey RC (2001). Textbook of Biotechnology. S Chand and Company Ltd.

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Course Title: Biochemistry and Microbial Biotechnology Practical
Course No: MB 202 (Major)
Nature of the Course: Practical

Full Marks: 50
Pass Marks: 20
Year: II
Total Lecture Hours: 180

Course Objectives

After completion of the course, the students will be able to:

a) develop practical skills on preparing solutions, buffers and qualitative and quantitative estimate of biomolecules and basic biotechnological laboratory skills.

Course Contents

To prepare solutions of different concentrations: Molar solutions, normal solutions, ppm (part per million) solutions.

To prepare buffer solutions: Measurement of pH using pH meter and indicators, preparation of acetate, phosphate and citrate buffers of different pH.

To perform qualitative and quantitative estimate of various types of carbohydrates: Benedict test (for reducing sugars), Molish's test, Barfoed's test, Seliwanoff's test, hydrolysis test (for di and polysaccharides), iodine test for starch, quantitative estimation of reducing sugars by DNS (3,5 dinitrosalicylic acid method), extraction of glycogen from liver

To estimate lipids: Determination of the value of fat, saponification value of fat, iodine number of fat, estimation of blood cholesterol level.

To estimate amino acids and protein: Ninhydrin reaction, biuret reaction, xanthoproteic reaction, caesin test in milk, test for tyrosine, tryptophan and arginine, test for sulphur containing amino acids, Heat coagulation test for egg albumin

To analyze different enzymes activities: Amylase, sucrase, carboxylase, protease, lipase, phosphatase, lactase.

To use different instruments and techniques for biochemical analysis: Separation and identification of amino acids by paper electrophoresis, separation and identification of sugars and lipids by thin layer chromatography (TLC), separation and identification of amino acids by paper chromatography, separation of

amino acids by single and double ascending paper chromatography, chicken liver fractionation by differential centrifugation, analysis of protein by SDS-PAGE.

To detect microorganisms from various plants and their products: Rhizobium inoculation in different leguminous plants, isolation and characterization of *Rhizobium*, *Azotobacter* and *Mycorrhiza.*

Screening of microorganisms and production of fermented products: Screening of wine yeasts, production of alcohol, kinema, estimation of fermentation yield by substrate variation method

Extraction, purification and estimation of enzymes: Amylase and protease enzymes of bacteria

Isolation of bacteria: Methanogenic bacteria from rumen and compost; actinomycetes from compost and soil