

Syllabus (NEP-2020) - HNBGU

Program: B Sc

Subject: Biotechnology

First Semester

**1. Core Paper:
(Course code: CBT-1)**

**Introductory Biotechnology
No. of Credits: 4**

UNIT – I (Cr-01)

History and scope of Biotechnology.

New vs old biotechnology, Interdisciplinary nature of Biotechnology,

Importance of various biological disciplines e.g. Genetics, Cell and Molecular Biology, Microbiology, Biochemistry, Immunology etc.

UNIT – II (Cr-01)

Introduction to Genetic Engineering, Restriction endonuclease. Ligases,

Alkaline phosphatase, Reverse transcriptase, DNA polymerase,

Cloning Vectors (plasmid-based).

Biotechnology hazards and safety. Social, moral and ethical issues

UNIT – III (Cr-01)

Biotechnology in diagnostics and therapeutics.

Biotechnological innovations with vaccine development

Introduction to PCR, DNA sequencing and fingerprinting

UNIT – IV (Cr-01)

Introduction to plant biotechnology, importance, significance, applications

Biotechnology in agriculture, Totipotency, Clonal propagation/micropropagation

in vitro conservation of plant genetic resources, its applications and limitations.

Recommended Books :

1. A textbook of Biotechnology; R.C. Dubey; S.Chand & Company Ltd.
2. Biotechnology- Expanding Horizons; B.D. Singh; Kalyani publishers
3. Gene Cloning & DNA Analysis- An Introduction; T.A. Brown; (6th Edition); Wiley Blackwell

2. Practical Based on Core Paper (CBT-1)

**Introductory Biotechnology
Credits-02**

Suggested Practical's:

1. Demonstration of Laminar air flow, autoclave, etc.
2. Demonstration of PCR
3. Isolation of DNA
4. Restriction digestion of DNA
5. Any Other based on Syllabus

- 3. Additional-Interdisciplinary Paper: (AID-1): Introductory Biotechnology**
(Course Code: AID-BT-1) No. of Credits: 2
Note: This course will be opted by those students who don't have Biotechnology as core subject)

UNIT – I (Cr-0.5)

History and scope of Biotechnology.

New vs old biotechnology, Interdisciplinary nature of Biotechnology

UNIT – II (Cr-0.5)

Introduction to Genetic Engineering. Tools and techniques.

Enzymes used in genetic engineering. Cloning Vectors (pBR322 and pUC)

Features and applications.

UNIT – III (Cr-0.5)

Applications of Biotechnology in diagnostics and therapeutics.

Introduction to PCR, DNA fingerprinting, DNA sequencing

UNIT – IV (Cr-0.5)

Introduction to plant biotechnology, importance, significance, applications of

Plant tissue culture

Recommended Books :

1. A textbook of Biotechnology; R.C. Dubey; S.Chand & Company Ltd.
2. Biotechnology- Expanding Horizons; B.D. Singh; Kalyani publishers
3. Gene Cloning & DNA Analysis- An Introduction; T.A. Brown; (6th Edition); Wiley Blackwell

- 4. Practical Based on Theory (AID BT-1) (AID Introductory Biotechnology)**
Credits-02

Suggested Practical's:

1. Demonstration of Laminar air flow, autoclave, etc.
2. Demonstration of PCR
3. Isolation of DNA
4. Restriction digestion of DNA
5. Any Other based on Syllabus

5. **Skill Course:** **Cell & Tissue Culture**
(Course Code: SEC-BT-1) **No. of Credits: 2**
(Note: Students can opt skill course of Biotechnology in either 1-2 semester or in 3-4 semester)

UNIT – I (Cr-0.5)

Cell Culture: Laboratory organization of tissue culture lab, Sterilization techniques, aseptic conditions, and care.
Media components and types for cell culture. Primary & Secondary cell culture.

UNIT – II (Cr-0.5)

Applications of Animal Cell Culture:
concepts of Stem cells and application, monoclonal antibody production.

UNIT – III (Cr-0.5)

Plant Tissue Culture:
Concept of totipotency, history of plant tissue culture, media components and types, and different phytohormones.

UNIT – IV (Cr-0.5)

Applications of Plant Tissue Culture: Clonal propagation, Somatic Embryogenesis and artificial seed, Protoplast culture, Preservation of plant genetic resources and germplasm conservation.

Suggested Readings:

1. Bhojwani and Razdan- Plant Tissue Culture- Elsevier
2. John Masters- Animal Cell Culture – Oxford University Press
3. M.K. Razdan-Introduction to plant tissue culture –Oxford and IBH
4. R Ian Freshney- Culture of Animal Cells- John Wiley
5. R Sasidhara- Animal Biotechnology – MJP Publisher

Suggested Practicals for sessional exams (Note: There will be no separate practical in skill course)

1. Sterilization techniques
2. Surface sterilization of seeds
3. Media, Buffer preparation for cell and tissue culture

Second Semester

1. Core Paper:
(Course code: CBT-2)

Biomolecules
No. of Credits: 4

UNIT – I (Cr-1)

Introduction to Bio-molecules, pH and buffers.
Concept of Nucleic-Acids: Structure, Nucleoside and Nucleotide,
Watson and Crick model

UNIT – II (Cr-1)

Carbohydrates: Definition, classification, structure and importance of
monosaccharides and oligosaccharides.
Polysaccharides: Homopolysaccharides and Heteropolysaccharides,
Storage and Structural Polysaccharides

UNIT – III (Cr-1)

Structure, classification and Properties of Amino Acids., Peptide bond.
Protein Structure: Primary, Secondary, Tertiary and Quaternary Structure.
Protein types: Globular and Fibrous. Protein Functions.

UNIT – IV (Cr-1)

Lipids: Structure, classification and properties & types. Types of fatty acids
Vitamins: Water and fat soluble vitamins, functions and deficiency symptoms.
Introduction to Enzymes and their classification.

Suggested reading :

1. Lehninger: Principles of Biochemistry, 4th ed., Nelson & Cox, WH Freeman and Company, 2007
2. Voet&Voet: Biochemistry, 2nd ed., Wiley & Sons.
3. Berg, Tymoczko, Stryer: Biochemistry, 5th ed., WH Freeman and Company, 2003.
4. Garrett & Grisham: Biochemistry, 4th ed., Brooks/Cole Cengage learning, 2010.
5. Murray, Granner, Rodwell: Harper's Illustrated Biochemistry, 27th ed. McGraw Hill, 2006.
6. Conn & Stumpf: Outlines of Biochemistry, 5th ed., Willey India, 2007.

2. **Practical Based on Core Paper (CBT-2)**

Biomolecules
(Credits-02)

Suggested practical :

1. Preparation of buffers.
2. Qualitative tests for Carbohydrates.
3. Qualitative tests for Lipids.
4. Qualitative tests for Amino acids.
5. Any other based on Syllabus

- 3. Additional-Interdisciplinary Paper: (AID-2): Biomolecules**
(Course Code: AID-BT-2) No. of Credits: 2
Note: This course will be opted by those students who don't have Biotechnology as core subject)

UNIT – I (Cr-0.5)

Introduction to Biomolecules, pH and buffers.
Introduction to Purines, Pyrimidines and nucleic acids.

UNIT – II (Cr-0.5)

Carbohydrates: Definition, classification, structure and importance of Monosaccharides, Oligosaccharides and Polysaccharides.

UNIT – III (Cr-0.5)

Structure, Properties of Amino Acids
Protein Structure: Primary, Secondary, Tertiary and Quaternary Structure.
Globular and Fibrous proteins.

UNIT – IV (Cr-0.5)

Lipids: Structure, classification and properties of oils & fats,
Introduction to Vitamins
Introduction to Enzymes.

Suggested reading :

1. Lehninger: Principles of Biochemistry, 4th ed., Nelson & Cox, WH Freeman and Company, 2007
2. Voet & Voet: Biochemistry, 2nd ed., Wiley & Sons.
3. Berg, Tymoczko, Stryer: Biochemistry, 5th ed., WH Freeman and Company, 2003.
4. Garrett & Grisham: Biochemistry, 4th ed., Brooks/Cole Cengage learning, 2010.
5. Murray, Granner, Rodwell: Harper's Illustrated Biochemistry, 27th ed. McGraw Hill, 2006.
6. Conn & Stumpf: Outlines of Biochemistry, 5th ed., Willey India, 2007.

- 4. Practical Based on Theory (AID BT-2) (AID-2 Biomolecules) Credits-02**

Suggested practical:

1. Preparation of buffers.
2. Qualitative tests for Carbohydrates.
3. Qualitative tests for Lipids.
4. Qualitative tests for Amino acids.

5. **Skill Course:**
(Course Code: SEC-BT-2)

Enzymology
No. of Credits: 2

UNIT – I (Cr-0.5)

Enzymes: History, classification, properties, activation energy, holoenzyme, apoenzyme cofactor, coenzyme, prosthetic group, factors affecting enzyme activity,

UNIT – II (Cr-0.5)

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, lock and key model, induced fit model, inhibitors

UNIT – III (Cr-0.5)

Allosteric enzymes: Nature and properties, Qualitative description of concerted and sequential models, Ribozymes, Zymogens, Multifunctional enzyme- eg. Fatty- Acid synthetase.

UNIT – IV (Cr-0.5)

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

Suggested reading :

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999

Suggested Practicals for sessional exams (Note: There will be no separate practical in skill course)

1. Buffer preparation, pH
2. Amylase activity
3. Effect of temperature and pH on enzyme activity

Third Semester

1. Core Paper: (Course code: CBT-3)

**Elementary Microbiology
No. of Credits: 4**

UNIT – I (Cr-1)

Introduction to the microbial world: Historical developments,
Microscopes: Types and Uses, importance of electron microscopy.

UNIT – II (Cr-1)

Brief introduction to bacteria, fungi, protozoa, algae and viruses.
Methods of Sterilization and disinfection,
Methods of identification: staining techniques .

UNIT – III (Cr-1)

Cultivation and Maintenance of microorganisms: Types of culture media and their preparation; Methods of isolation, pure culture preparation and preservation of microorganisms

UNIT – IV (Cr-1)

Bacterial growth curve and Generation time, General account of Conjugation, Transformation and Transduction. Microorganisms as a causative agent of infectious diseases.

Suggested Reading :

1. Microbiology by Michael Pelczar and Roger Delbert Reid
2. Microbiology: An Introduction; GJ Tortora & CL Case, 13th edition, Pearson Publications, 2019
3. A textbook of Microbiology: RC Dubey and DK Maheshwari, S. Chand Publication

2. Practical Based on Core Paper (CBT-3)

**Elementary Microbiology
Credits-02**

1. Sterilization Techniques
2. Preparation of culture media
3. Methods of Isolation of bacteria from different sources.
4. Pure culture through streak plate method
5. Gram staining

- 3. Additional-Interdisciplinary Paper: (AID-3): Elementary Microbiology**
(Course Code: AID-BT-3) No. of Credits: 2
Note: This course will be opted by those students who don't have Biotechnology as core subject)

UNIT – I (Cr-0.5)

Introduction to the microbial world: Historical developments, Microscopes: Types and Uses.

UNIT – II (Cr-0.5)

Brief introduction to bacteria, fungi, protozoa, algae and viruses.
Methods of Sterilization, Staining Techniques.

UNIT – III (Cr-0.5)

Types of culture media and their preparation; Methods of isolation, pure culture preparation of microorganisms.

UNIT – IV (Cr-0.5)

Bacterial growth curve and Generation time, General account of Conjugation, Transformation and Transduction.

Suggested Reading :

1. Microbiology by Michael Pelczar and Roger Delbert Reid
2. Microbiology: An Introduction; GJ Tortora & CL Case, 13th edition, Pearson Publications, 2019
3. A textbook of Microbiology: RC Dubey and DK Maheshwari, S. Chand Publication

4. Practical Based on Theory (AID BT-3) (AID-3 Elementary Microbiology)
Credits-02

1. Sterilization Techniques
2. Preparation of culture media
3. Methods of Isolation of bacteria from different sources.
4. Pure culture through streak plate method
5. Gram staining

5. **Skill Course:** **Food Biotechnology**
(Course Code: SEC-BT-3) **No. of Credits: 2**
(Note: Students can opt skill course of Biotechnology in either 1-2 semester or in 3-4 semester)

UNIT I (Cr-0.5)

Food and Microorganisms: Microorganisms in food & beverage industry, contamination of food. General principles underlying spoilage and chemical changes

UNIT II (Cr-0.5)

Biotechnology of food and feed: Introduction to fermentation; fermentation process and raw materials used for production of alcoholic beverages, cheese, SCP, bakery products and food additives.

UNIT III (Cr-0.5)

Food borne Diseases: Food borne illness due to microbial contamination, food-borne disease outbreaks: management and prevention; concepts of pro and pre biotics.

UNIT IV (Cr-0.5)

Food hygiene: Food sanitation, food manufacturing practice. Hazard Analysis Critical Control Points. Principles of food preservation; Preservation by high temperature, low temperatures, drying, food additives and radiation.

Suggested Reading :

1. Food Microbiology by MR Adams and MO Moss
2. Food Biotechnology: Principles and practices by VK Joshi
3. Food Biotechnology by Foster GN, CBS publication, 2020

Suggested Practical's for sessional exams

(Note: There will be no separate practical in skill course)

1. Basic laboratory procedures and equipments related to food testing and storage
2. Qualitative and quantitative estimation of proteins
3. Detection of microorganisms in food and water samples

Fourth Semester

1. Core Paper:
(Course code: CBT-4)

Basics of Molecular Biology
No. of Credits: 4

UNIT – I (Cr-1)

Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Importance of Molecular Biology. DNA: structure, types. Chemical and physical properties, Organization of DNA.

UNIT – II (Cr-1)

Central Dogma of Molecular Biology. Replication of DNA: Semi-conservative DNA replication, Replication in prokaryotes and eukaryotes, DNA polymerases

UNIT – III (Cr-1)

Transcription: RNA structure and types of RNA, Transcription in Prokaryotes and Eukaryotes, RNA modifications.

UNIT – IV (Cr-1)

Genetic code, properties of genetic code. Components of Protein Translation: Messenger RNA, tRNA structure and function, Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly. Overview of Translation process and Post-translational modifications of proteins.

Suggested readings :

1. Karp, G. (2010). Cell & Molecular Biology: Concepts & Experiments. VI Ed. John Wiley & Sons.
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Ed.) Cold Spring Harbour Lab. Press, Pearson Pub.
3. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.

2. Practical Based on Core Paper (CBT-4)

Basics of Molecular Biology
Credits-02

1. DNA and RNA isolation
2. Agarose Gel preparation and Electrophoresis
3. Estimation of DNA purity by spectroscopy
4. Any Other based on syllabus

**3. Additional-Interdisciplinary Paper: (AID-4): Basics of Molecular Biology
(Course Code: AID-BT-4) No. of Credits: 2**

Note: This course will be opted by those students who don't have Biotechnology as core subject)

UNIT - I (Cr-0.5)

Nucleic acid as the genetic material

(Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment)

Structure and functions of Nucleic acids: Nucleotides & Nucleosides, Purines and Pyrimidines

DNA structure & types, Chemical and physical properties of DNA.

UNIT - II (Cr-0.5)

Replication of DNA: Semi-conservative DNA replication, Overview of Replication, Enzymes involved in Replication

UNIT - III (Cr-0.5)

Transcription: RNA structure and types of RNA, Overview of Transcription, RNA modifications.

UNIT - IV (Cr-0.5)

Introduction of Genetic code and its properties, Overview of Protein Translation, Ribosome structure and assembly. Post-translational modifications of proteins.

Suggested readings :

1. Karp, G. (2010). Cell & Molecular Biology: Concepts & Experiments. VI Ed. John Wiley & Sons
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Ed.) Cold Spring Harbour Lab. Press, Pearson Pub.
3. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.

4. Practical based on Theory Paper (AID-BT-4) (Credits- 2)

1. DNA and RNA isolation
2. Agarose Gel preparation and Electrophoresis
3. Estimation of DNA purity by spectroscopy
4. Any Other based on syllabus

5. **Skill Course:** **Molecular Diagnostics**
(Course Code: SEC-BT-4) **No. of Credits: 2**
(Note: Students can opt skill course of Biotechnology in either 1-2 semester or in 3-4 semester)

UNIT – I (Cr-0.5)

Introduction to Molecular Diagnostics: Overview of Molecular Diagnostics;
History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era
Areas used in Molecular Diagnostics; Future Prospects

UNIT – II (Cr-0.5)

PCR Principle, Instrumentation, Applications.
Nuclear hybridization methods: Southern, Northern, Microarray. Western Blotting.
Biomarkers: Single nucleotide polymorphism, RAPD, RFLP.

UNIT – III (Cr-0.5)

Immunodiagnosics- Introduction, Overview, types and applications of ELISA.
Principle and Applications - Immunoblotting, immunohistochemical techniques
Immunofluorescence, Radioimmunoassay.

UNIT – IV (Cr-0.5)

Genetic testing, Diagnostic Testing for Cystic Fibrosis.
Ethical, Social and Legal Issues to Molecular -Genetic Testing.
Molecular Testing for HIV-1.

Suggested readings :

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
4. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

Suggested Practical's for sessional exams

(Note: There will be no separate practical in skill course)

1. Demonstration of PCR
2. ELISA
3. Dot Blot
4. Western Blotting