Department of Biotechnology

B.Sc. (Biotechnology)

Four-Year Undergraduate Program (FYUP)

As per NEP

Course Contents & Syllabus

(w.e.f. Academic session 2025-2026)

Hemvati Nandan Bahuguna Garhwal University

(A Central University)

Srinagar, Garhwal, 246 174, Uttarakhand

FOUR YEAR UNDERGRADUATE PROGRAMME (FYUP)

Subject: Biotechnology

First Year – NHEQF Level- 4.5

Course Category	Semester-I				Semester-II			
	Subject	Paper	Credits		Subject	Paper	Credits	
			T	P			T	P
Discipline Specific core	DSC Subject-I (Major)	Biomolecules	2	2	DSC Subject-I (Major)	Introductory Biotechnology	2	2
	DSC Subject-II (Minor)	Biomolecules	2	2	DSC Subject-II (Minor)	Introductory Biotechnology	2	2
M.D/I.D-Subject-1	MD/ID-I	Basics of Biomolecular Interaction	2	2	MD/ID-II	Biotechnology for Human Welfare	2	2
M.D/I.D-Subject-2	M.D/ I.D-I	-	2	2	M.D/I.D-II	-	2	2
SEC/AEC	Field work/SEC/ Communication Skills Or AMSC/Field Work/SEC	SEC-Computers in Biotechnology or Communication Skills	2	-	AMSC/Field Work/SEC Or Field work/ SEC/ Communication Skills	SEC-Biotechnology Laboratory Concepts Or AMSC*/	2	-
VAC	Understanding and Connecting with Environment Or Life Skills & Personality development	Understanding and Connecting with Environment	2	--	Life Skills & Personality development Or Understanding and Connecting with Environment	Life Skills & Personality development	2	-
Total			12	8			12	8
NHEQF Level 4.5	Student on exit after successfully completing first year (i.e., securing minimum required 40 credits + 4 Credits in one Vocational Course/Skill-Enhancement Course of 4 credits) will be awarded "Undergraduate Certificate" of one year.							

- The student may opt for any one course from Field Work/ Skill Enhancement Course (SEC)/ Communication Skills in one semester, and any one course from Additional Multidisciplinary Skill Course (AMSC)/ Field Work/ Skill Enhancement Course (SEC) in the other semester.
- Field Work/Discipline Specific Skill Enhancement Course (SEC): Studeny may opt SEC/Field Work related to any discipline subject opted by her/him as a DSC in the first year.
- Field Work: In addition to providing students with practical, experience-based learning, field work aims to expose them to real-world socio-economic and societal challenges, allowing them to bridge the gap between theory and practice and develop effective solutions to real-life problems.
- *AMSC: Additional Multidisciplinary Skill Course (is offered as SEC)
  Following courses are offered under AMSC, University may add new courses under AMSC in future:
  1. Plant Nursery Development and Management
  2. Basic Yoga Practices
  3. Physical Education and Sports Management
  4. Regional Folklores and their Cultural Context
  5. Indian Traditional Music
  6. Tour and Travel Operations
- Communication Skills (AEC): 'Communication Skills' course will be offered in Hindi, English and Sanskrit Languages, student may opt any one language for studying the course
- Life Skill & Personality Development (VAC) Compulsory Course [Common University Syllabus]
- Understanding and Connecting with Environment (VAC)Compulsory Course [Common University Syllabus]

Note: Student can opt Biotechnology subject as only one from the following course category: Discipline Specific Major or Discipline Specific Minor or as Multidisciplinary/Interdisciplinary (MD/ID) Subject.

FOUR YEAR UNDERGRADUATE PROGRAMME (FYUP)

Syllabus (w.e.f. 2025-26)

B.Sc. (I Semester)

Subject: Biotechnology

DISCIPLINE SPECIFIC CORE (MAJOR)

SOLS/BT/DSC (Major)- I Biomolecules	**2 credits**

UNIT–I (Cr-0.5)
Introduction to biomolecules: Major types of biomolecules and their functions.
Concept of nucleic acids: Structure, Nucleoside and Nucleotide, Watson and Crick model.

UNIT–II (Cr-0.5)
Carbohydrates: Definition, structure and importance of monosaccharides and oligosaccharides. Homopolysaccharides and Heteropolysaccharides.

UNIT–III (Cr-0.5)
Amino acids: Structure, classification and Properties of Amino Acids, Peptide bond.
Protein Structure: Primary, Secondary, Tertiary and Quaternary Structure.

UNIT–IV (Cr-0.5)
Lipids: Structure, and properties. Types of fatty acids.
Vitamins: Water and fat soluble vitamins, functions and deficiency symptoms.

Recommended books:

1. Satyanarayana, U.: Biochemistry, 6th ed., Elsevier Health Sciences, 2021.
2. Nelson D.L., Cox M.M., Hoskins A.A. Lehninger Principles of Biochemistry. 8th ed. W.H. Freeman. 2021.
3. Das, D.: Biochemistry, 10th ed., Academic Publishers, 2019.
4. Conn E., Stumpf P. Outlines of Biochemistry. 5th ed. John Wiley & Sons. 2009.

SOLS/BT/DSC (Major)- I(P) Biomolecules (Practical)	**2 credits**

Practicals:
1. Preparation of buffers.
2. Qualitative tests for carbohydrates.
3. Qualitative tests for lipids.
4. Qualitative tests for amino acids.

Any other related practical based on the facility

<u>B.Sc. (I Semester)</u>

<u>Biotechnology</u>

DISCIPLINE SPECIFIC CORE (MINOR)

SOLS/BT/DSC (Minor)- I Biomolecules	**2 credits**

UNIT–I (Cr-0.5)

Introduction to biomolecules: Major types of biomolecules and their functions.
Concept of nucleic acids: Structure, Nucleoside and Nucleotide, Watson and Crick model.

UNIT–II (Cr-0.5)

Carbohydrates: Definition, structure and importance of monosaccharides and oligosaccharides. Homopolysaccharides and Heteropolysaccharides.

UNIT–III (Cr-0.5)

Amino acids: Structure, classification and Properties of Amino Acids, Peptide bond.
Protein Structure: Primary, Secondary, Tertiary and Quaternary Structure.

UNIT–IV (Cr-0.5)

Lipids: Structure, and properties. Types of fatty acids.
Vitamins: Water and fat soluble vitamins, functions and deficiency symptoms.

Recommended books:

1. Satyanarayana, U.: Biochemistry, 6th ed., Elsevier Health Sciences, 2021.
2. Nelson D.L., Cox M.M., Hoskins A.A. Lehninger Principles of Biochemistry. 8th ed. W.H. Freeman. 2021.
3. Das, D.: Biochemistry, 10th ed., Academic Publishers, 2019.
4. Conn E., Stumpf P. Outlines of Biochemistry. 5th ed. John Wiley & Sons. 2009.

SOLS/BT/DSC (Minor)- I(P) Biomolecules (Practical)	**2 credits**

Practicals:

1. Preparation of buffers.
2. Qualitative tests for carbohydrates.
3. Qualitative tests for lipids.
4. Qualitative tests for amino acids.

Any other related practical based on the facility

B.Sc. (I Semester)

Subject: Biotechnology

MULTIDISCIPLINARY/INTERDISCIPLINARY COURSE

SOLS/BT/MD/ID-I Basics of Biomolecular Interaction	2 credits

UNIT–I (Cr-0.5)

Water and biomolecular interaction: Chemical structure and Properties of water; Hydrophobic and hydrophilic interactions of water, and Role of water in biological systems.

UNIT–II (Cr-0.5)

Chemical bonds in biological systems: Covalent bonds, ionic bonds, H-bonds, Van der Waals interactions and importance of weak interaction in biological systems.

UNIT–III (Cr-0.5)

Biomolecular recognition: Specificity and affinity in biomolecular interactions, Enzyme-substrate interactions, receptor-ligand binding and antigen-antibody interactions.

UNIT–IV (Cr-0.5)

Acids, bases, and buffers in biological systems: Concept of acids and bases, pH and pKa – definitions and their significance in biological systems, buffer systems in biological fluids and their importance.

Recommended books:

1. Satyanarayana, U.: Biochemistry, 6th ed., Elsevier Health Sciences, 2021.
2. Nelson D.L., Cox M.M., Hoskins A.A. Lehninger Principles of Biochemistry. 8th ed. W.H. Freeman. 2021.
3. Das, D.: Biochemistry, 10th ed., Academic Publishers, 2019.
4. Conn E., Stumpf P. Outlines of Biochemistry. 5th ed. John Wiley & Sons. 2009.

SOLS/BT/MD/ID-I(P) Basics of Biomolecular Interaction (Practical)	2 credits

Practicals:

1. Observation of hydrophilic and hydrophobic substances
2. To visualize different types of chemical bonds in biological systems
3. Use of pH meter and its calibration
4. Preparation of buffers

Any other related practical based on the facility.

B.Sc. (I Semester)

Biotechnology

SKILL ENHANCEMENT COURSE (SEC)

SOLS/BT/SEC- I Computers in Biotechnology	**2 credits**

UNIT–I (Cr-0.5)

Overview of computers: Basic components of computer, input and output devices. Hardware specifications; Types of computers: Desktops and laptops etc.

UNIT–II (Cr-0.5)

Introduction to software: Types of software and operating systems (Windows, Linux).
Internet: World Wide Web, web browsers and uses of internet.

UNIT–III (Cr-0.5)

Application system softwares: Introduction and uses of word processing, spreadsheets, database management systems, and PowerPoint presentations. Tabulation and graphical representation of data.

UNIT–IV (Cr-0.5)

Computational tools in biotechnology: Overview of major biological databases (NCBI, UniProt). Accessing and retrieving data from databases.

Recommended books:

1. Pathak, P. D., Raut, R., Jaramillo-Isaza, S., Borkar, P., & Jhaveri R. H. Computational Approaches in Biotechnology and Bioinformatics (1st ed). CRC Press. 2024.
2. Ismail, H. D. Bioinformatics: A Practical Guide to NCBI Databases and Sequence Alignments (1st ed.). Chapman and Hall/CRC Press. 2022.
3. Humphrey, M. L. (2020). Microsoft Office for Beginners (1st ed.). M.L. Humphrey.
4. Chambers, J. M. Graphical Methods for Data Analysis (1st ed.). Chapman and Hall/CRC Press. 2018.
5. Sinha, P., & Sinha, P. K. Computer Fundamentals (8th ed). BPB Publications. 2004.

B.Sc. (II Semester)

Subject: Biotechnology

DISCIPLINE SPECIFIC CORE (MAJOR)

SOLS/BT/DSC (Major)- II Introductory Biotechnology	**2 credits**

UNIT–I (Cr-0.5)

Fundamental of biotechnology: History, definition & scope of Biotechnology, introduction to nucleic acids and proteins and Central Dogma.

Principles of Genetic engineering & Bioprocess technology.

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UNIT–II (Cr-0.5)

Industrial applications of biotechnology: Basic process of the production of alcoholic beverages, antibiotics & enzymes, and Biofuels.

Basic introduction to the applications of biotechnology in diagnostics and therapeutics.

UNIT–III (Cr-0.5)

Biotechnology in agriculture: Introduction to the Genetically Modified (GM) crops and their applications. Bio-fertilizers and bio-pesticides.

UNIT–IV (Cr-0.5)

Marketing of biotechnological products: Biotechnological Products in India, Quality parameters, and quarantine procedures of export and market integration, safety and licensing for import and export of biotechnological products.

Recommended books:

1. Brown, T.A.; Gene Cloning & DNA Analysis-An Introduction (8^{th} Edition); Wiley Blackwell, 2020
2. Arumugam,N; Kumaresan, V; Fundamentals of Biotechnology; Saras Publication,2016
3. Dubey, R.C.; Advanced Biotechnology; S. Chand & Company Ltd, 2014
4. Singh, B.D.; Biotechnology-Expanding Horizons; Kalyani publishers, 2012

SOLS/BT/DSC (Major)- II(P) Introductory Biotechnology (Practical)	**2 credits**

Practicals:

1. Demonstration of laminar air flow, and autoclave, etc.
2. Survey and listing of important biotechnology products available in the market.
3. Demonstration of agarose gel electrophoresis.
4. Study of fermentation process

Any other related practical based on the facility.

B.Sc. (II Semester)

Subject: Biotechnology

DISCIPLINE SPECIFIC CORE (MINOR)

SOLS/BT/DSC (Minor)- II Introductory Biotechnology	**2 credits**

UNIT–I (Cr-0.5)
Fundamental of biotechnology: History, definition & scope of Biotechnology, introduction to nucleic acids and proteins and Central Dogma.
Principles of Genetic engineering & Bioprocess technology.
.
UNIT–II (Cr-0.5)
Industrial applications of biotechnology: Basic process of the production of alcoholic beverages, antibiotics & enzymes, and Biofuels.
Basic introduction to the applications of biotechnology in diagnostics and therapeutics.

UNIT–III (Cr-0.5)
Biotechnology in agriculture: Introduction to the Genetically Modified (GM) crops and their applications. Bio-fertilizers and bio-pesticides.

UNIT–IV (Cr-0.5)
Marketing of biotechnological products: Biotechnological Products in India, Quality parameters, and quarantine procedures of export and market integration, safety and licensing for import and export of biotechnological products

Recommended books:

1. Brown, T.A.; Gene Cloning & DNA Analysis-An Introduction (8^{th} Edition); Wiley Blackwell, 2020
2. Arumugam,N; Kumaresan, V; Fundamentals of Biotechnology; Saras Publication,2016
3. Dubey, R.C.; Advanced Biotechnology; S. Chand & Company Ltd, 2014
4. Singh, B.D.; Biotechnology-Expanding Horizons; Kalyani publishers, 2012

SOLS/BT/DSC (Minor)- II(P) Introductory Biotechnology (Practical)	**2 credits**

Practicals:
1. Demonstration of laminar air flow, and autoclave, etc.
2. Survey and listing of important biotechnology products available in the market.
3. Demonstration of agarose gel electrophoresis.
4. Study of fermentation process

Any other related practical based on the facility.

B.Sc. (II Semester)

Subject: Biotechnology

MULTIDISCIPLINARY/INTERDISCIPLINARY COURSE

SOLS/BT/MD/ID-II Biotechnology for Human Welfare	**2 credits**

UNIT–I (Cr-0.5)

Introduction to biotechnology: Definition and scope of Biotechnology, Interdisciplinary nature of Biotechnology. Basic concepts of chromosome and gene.

UNIT–II (Cr-0.5)

Introduction to genetic engineering: Basic concepts of gene cloning.
Genetically modified organisms and their applications.

UNIT–III (Cr-0.5)

Applications of biotechnology: Biotechnological innovations in diagnostics, therapeutics, vaccine development, agriculture, industries and environmental management.

UNIT–IV (Cr-0.5)

Ethics & biosafety in biotechnology: Social, moral and ethical issues related to Biotechnology. Concept of biosafety.

Recommended books:

1. Brown, T.A.; Gene Cloning & DNA Analysis-An Introduction (8^{th} Edition); Wiley Blackwell, 2020
2. Arumugam,N; Kumaresan, V; Fundamentals of Biotechnology; Saras Publication,2016
3. Dubey, R.C.; Advanced Biotechnology; S. Chand & Company Ltd, 2014
4. Singh, B.D.; Biotechnology-Expanding Horizons; Kalyani publishers, 2012

SOLS/BT/MD/ID-II(P) Biotechnology for Human Welfare (Practical)	**2 credits**

Practicals:

1. Observations of cells under microscope
2. Demonstration of good laboratory practices and disposal methods
3. Demonstration of agarose gel electrophoresis
4. Demonstration of basic equipments of biotechnology lab.

Any other related practical based on the facility.

B.Sc. (II Semester)

Biotechnology

SKILL ENHANCEMENT COURSE (SEC)

SOLS/BT/SEC- II Biotechnology Laboratory Concepts	2 credits

UNIT–I (Cr-0.5)

Basic introduction and use of common instruments in a biotechnology laboratory: Spectrophotometer, Hot Air Oven, Water bath, Autoclave, Laminar Air flow, Thermocycler, Centrifuge.

UNIT–II (Cr-0.5)

Decontamination methods: Concepts of contaminants; Decontamination through sanitization, disinfection and sterilization.

UNIT–III (Cr-0.5)

Solution preparation: Stock solutions and their importance; Units of concentration, serial dilution.

Common types of glass/plastic wares used in biotechnology experiments, micropipettes and their uses.

UNIT–IV (Cr-0.5)

General safety rules in biotechnology laboratory: Types of biohazards, Types of laboratory waste and their disposal methods.

Recommended books:

1. Nalawade, S; Tools and techniques in biology: A laboratory manual; VYD Publishers, 2024
2. Gaud, R.S; Gupta, G.D; Gokhle, S.B; Practical Biotechnology; Nirali Prakashan, 2018
3. Borah, D; Biotechnology Lab Practices; Global Vision Publishing House,2017
4. Arumugam,N; Kumaresan, V; Fundamentals of Biotechnology; Saras Publication,2016