Syllabus of 1st Year B. Sc. (Hons.) Biotechnology

As Per National Education Policy 2020 (NEP 2020)

UPL University of Sustainable Technology

SRICT Institute of Science & Research

AY-2025-2026

UPL University of Sustainable Technology, Ankleshwar				
SRICT-Institute of Science and Research (SRICT-ISR)				
B.Sc. (Hons.) - Biotechnology (1st Year)				
SEM	**TYPE OF COURSE**	**COURSE CODE**	**NAME OF SUBJECT**	**Credits**
1	Major Course	BIM200-1C	Fundamental of Biotechnology	4
	Major Course	BIM201-1C	Elemental Biochemistry	4
	Minor Course	MIE200-1C	Analytical Chemistry for Microbiologist	4
	MDC	MDCXXX-C	As per the subject Selected	4
	AEC	AECXXX-1C		2
	SEC	SECXXX-1C		2
	VAC	VACXXX-1C		2
Total Credits				22
2	Major Course	BIM202-1C	Concepts of cell biology	4
	Major Course	BIM203-1C	Basics of Microbiology	4
	Minor Course	MIE201-1C	Basic Chemistry for biologists	4
	MDC	MDCXXX-C	As per the subject Selected	4
	AEC	AECXXX-1C		2
	SEC	SECXXX-1C		2
	VAC	VACXXX-1C		2
Total Credits				22

B.Sc. (Hons.) - Biotechnology
B.Sc. SEM I
Teaching/Exam Scheme
(As per NEP-2020)

w.e.f.: July-2026

Sr. No.	Course Code	Category of course	Course title	Hour's Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	BIM200-1C	Major Course	Fundamental of Biotechnology	3	0	2	5	4	50	50	-	-	100
2	BIM201-1C	Major Course	Elemental Biochemistry	3	0	2	5	4	50	50	-	-	100
3	MIE200-1C	Minor Course	Analytical Chemistry for Microbiologist	3	0	2	5	4	50	50	-	-	100
4	MDC200-1C	MDC	Natural Hazards	3	1	-	4	4	50	50	-	-	100
5	MDC206-1C	MDC	Animal Biology	4	0	-	4	4	50	50	-	-	100
6	MDC201-1C	MDC	Basics of Biology	3	0	2	5	4	50	50	-	-	100
7	AEC200-1C	AEC	Functional Grammar and Composition	2	0	-	2	2	25	25	-	-	50
8	AEC201-1C	AEC	Practical English	0	0	4	4	2	25	25	-	-	50
9	SEC200-1C	SEC	Personality Development	2	0	-	2	2	25	25	-	-	50
10	SEC201-1C	SEC	Time Management	2	0	-	2	2	25	25	-	-	50
11	SEC202-1C	SEC	Public Speaking	2	0	-	2	2	25	25	-	-	50
12	VAC200-1C	VAC	Basics of Indian Knowledge System	2	0	-	2	2	25	25	-	-	50
			Total	22	0	0	22	22	275	275	-	-	550

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: BIM200-1C
Course Name: Fundamental of Biotechnology

(As per NEP-2020)

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Students enrolling in this course should have basic knowledge of Biology at higher secondary level. Understanding of fundamental concepts of Cell Biology, Genetics and Microbiology.

Rationale: Biotechnology is a multidisciplinary and rapidly advancing field with applications in health, agriculture, industry and environment. This course introduces students to the principles, scope and applications of biotechnology while providing a strong foundation in microbiology, biosafety and bioethics. It emphasizes both theoretical understanding and practical exposure aligned with NEP, preparing students for higher education, research, entrepreneurship and biotechnology-based careers.

Teaching and Examination Scheme

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Biotechnology** Introduction to biotechnology: Origin and definitions, history of biotechnology- ancient, classical and modern, major scientific discoveries in biotechnology, Branches of Biotechnology: Green, Red, White. Blue Biotechnology, Interdisciplinary nature of Biotechnology.	**10**
2	**Introduction to biotechnology techniques** Introduction and definition of techniques: DNA fingerprinting, cloning (DNA cloning, animal cloning), Transgenic plants and animals, in vitro fertilization, stem cell technology, Fermentation.	**10**

3	**Biotechnology in India and Global Trends** Biotechnology in India, ICGEB, Need for future development, Global scenario, Potential of modern Biotechnology, Achievement of Biotechnology, Biodiversity and its conservation, Gene bank and plant conservation. Major biotechnology institutes and companies in India.	**10**
SECTION - B		
4	**Applications of Biotechnology** Biotechnology and its application: Applications of biotechnology in Agriculture, medicine, environment, veterinary sciences, food industry, chemical industry, pharmaceutical industry forensic science.	**10**
5	**Microbiology and Techniques** History of Microbiology, Contributions of scientists, Types of microorganisms: Bacteria, Fungi, Algae, Viruses, Microscopes, Dyes and Staining.	**10**
6	**Emerging fields of biotechnology** Emerging fields of biotechnology: nanobiotechnology, bioinformatics, pharmacogenomics, regenerative medicine, therapeutic proteins, bio-robotics, biosensors; Brief account of safety guidelines and risk assessment in biotechnology; Ethical issues related to biotechnology.	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance, U: Understanding, A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. B.D. Singh. *Biotechnology: Expanding Horizons.* 4th edition. Kalyani Publishers. 2018.
2. U. Satyanarayana. *Biotechnology.* 1st edition. Books and Allied Pvt. Ltd. 2017.
3. R.C. Dubey. *A Textbook of Biotechnology.* 5th edition. S. Chand Publishing. 2014.
4. P.K. Gupta. *Elements of Biotechnology.* 2nd edition. Rastogi Publications. 2015.
5. Pelczar, Chan and Krieg. *Microbiology.* 5th edition. Tata McGraw Hill. 2008.

Reference Books:

1. Bernard R. Glick and Jack J. Pasternak. *Molecular Biotechnology: Principles and Applications of Recombinant DNA.* 4th edition. ASM Press. 2010.
2. S.B. Primrose and R.M. Twyman. *Principles of Gene Manipulation and Genomics.* 7th edition. Blackwell Publishing. 2006.
3. John E. Smith. *Biotechnology.* 5th edition. Cambridge University Press. 2009.
4. Prescott, Harley and Klein. *Microbiology.* 9th edition. McGraw Hill. 2013.

List of Practical's: (Online & Offline)

1. Preparation of temporary slides of fungi.
2. Cleaning and sterilization of laboratory glassware.
3. Demonstration of vaccine production process (online demonstration).
4. Observation of compost preparation or vermicomposting
5. Demonstration of Sterilization Techniques: Autoclave.
6. Isolation and Cultivation of Microorganisms from Soil sample.
7. Demonstration of Sterilization Techniques: Hot Air Oven.
8. Demonstration of Sterilization Techniques: Filtration Methods.
9. Preparation of temporary slides of algae.
10. Isolation and Cultivation of Microorganisms from Water Samples.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the principles, historical development, branches and interdisciplinary nature of biotechnology.	15
CO-2	Describe the scope and products of biotechnology including fermentation, biofertilizers, vaccines, monoclonal antibodies and diagnostics.	20
CO-3	Discuss biotechnology development in India and global trends, biodiversity conservation and gene banking.	18
CO-4	Illustrate applications of biotechnology in medical, agricultural, industrial and environmental sectors.	17
CO-5	Understand microbial diversity, microbial growth and factors affecting growth using basic biotech techniques.	15
CO-6	Apply concepts of biosafety, bioethics and intellectual property rights in biotechnology practices.	15

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: BIM201-1C
Course Name: Elemental biochemistry
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Sstudents enrolling in this course should have basic knowledge of Biology and Chemistry at higher secondary level. Understanding of biomolecules and fundamental chemical reactions.

Rationale: Biochemistry forms the molecular foundation of life sciences by explaining the structure, function and metabolism of biomolecules. This course provides a fundamental understanding of biological molecules, metabolic pathways, enzymes and vitamins, integrating chemistry with biological systems. It equips students with conceptual knowledge necessary for advanced studies in biochemistry, microbiology, biotechnology and allied disciplines, while supporting skill development envisioned under NEP.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Contents:

Sr. No.	Content	Total Hours
	SECTION – A	
1	**General introduction** Major elements of life and their importance, Chemical bonds – covalent, non-covalent, ionic, hydrogen and Vander waal's forces, Hydrophobic interactions acids, bases, electrolytes, pH and buffers, Henderson– Hasselbalch equation.	11
2	**Carbohydrates** Carbohydrates: Definition, classification, structure and biological functions of mono, di, oligo and polysaccharides (starch, glycogen, cellulose, dextrin, hyaluronic acid, keratin sulphate and chondroitin sulphate).	9

3	**Protein & Amino acid** Amino acids: General introduction, classification, Biological, Functions, properties of amino acids: physical & chemical, non-standard amino acid. Zwitter ion and isoelectric point, Proteins: General Introduction, Classification, Structure - Primary, secondary, tertiary and quaternary structure of proteins.	**10**
SECTION – B		
4	**Nucleic acid and Water** Nucleic acids: DNA and RNA. Composition, structure, types and Biological importance. Denovo synthesis of Nucleic acids. Water: structure and properties of water molecule, water as an universal solvent.	**12**
5	**Lipids** Lipids: biological significance, nomenclature and classification. Simple lipids; Fatty acids and their properties, triglycerides, waxes, steroids and prostaglandins. Compound lipids: Phospholipids, sphingolipids and glycolipids. Lipoproteins.	**9**
6	**Enzymes & Vitamins** Nomenclature & classification of enzymes, cofactors, coenzymes, Specificity of enzymes, mechanism of enzyme action. Vitamins: water soluble and fat soluble and its significance and diseases associated with vitamin.	**9**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**30**	**10**	**15**	**10**	**10**

Legends: R: Remembrance, U: Understanding, A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. U. Satyanarayana and U. Chakrapani. *Biochemistry.* 5th edition. Elsevier. 2017.

2. Lehninger, D.L. Nelson and M.M. Cox. *Principles of Biochemistry.* 7th edition. W.H. Freeman. 2017.

3. Donald Voet and Judith Voet. *Biochemistry.* 4th edition. Wiley. 2011.

Reference Books:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. *Biochemistry.* 8th edition. W.H. Freeman. 2015.

2. David L. Nelson and Michael M. Cox. *Lehninger Principles of Biochemistry.* 8th edition. W.H. Freeman. 2021.

List of Practical's: (Online & Offline)

1. Preparation of normal and molar solutions.
2. Preparation of buffer solutions (any 4).
3. Qualitative analysis of carbohydrates.
4. Qualitative analysis of amino acids
5. Qualitative analysis of lipids and proteins.
6. Estimation of reducing sugar by DNS method.
7. Estimation of protein by Lowry's method.

Practical's to be performed through virtual mode

1. Structure of DNA https://biomanbio.com/HTML5GamesandLabs/LifeChemgames/dna-structure-model- page.html, 3D Animations - DNA molecule: DNA has Four Units - CSHL DNA Learning Center
2. Estimation of saponification value of fats/oils. https://vlab.amrita.edu/?sub=3&brch=63&sim=688&cnt=2
3. Determination of pH. https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain chemical basis of life including water, chemical bonds, pH, buffers and biomolecular interactions.	15
CO-2	Describe structure, properties and metabolism of carbohydrates and principles of bioenergetics.	15
CO-3	Analyze structure, properties and metabolic significance of amino acids and proteins.	20
CO-4	Understand structure and functions of nucleic acids and their biological significance.	20
CO-5	Explain classification, functions and metabolism of lipids.	15
CO-6	Discuss enzyme kinetics, regulation, vitamins and their biological importance.	15

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: MIE200-1C
Course Name: Analytical Chemistry for Microbiologist
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Minor Course

Prerequisite: Should have fundamental knowledge of basic analytical chemistry and its relevant properties.

Rationale: At the end of the course, students will have knowledge about analytical techniques, solution preparation, error in the analysis, instrument calibration and laboratory safety.

Teaching and Examination Scheme

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION – A	
1	**Sampling process** Definition of analyte & samples, Classification of samples, Sampling: definition, types and precautions, applications, Different techniques for sampling, Interferences, contamination, impurities	6
2	**Good laboratory practice - GLP** Good lab practices, lab safety, waste disposal and managements, method of storing chemicals, solvents and glassware-handling of chemicals, carcinogenic chemical, toxic and poisonous chemicals, list of hazardous chemicals, general procedure for avoiding accidents, clothing, PPEs and	7

	other precautions, first aid, fire and chemical burns, eye accident, cuts, poisons, gas poisoning, electric shock, material safety data sheet (MSDS).	
3	**Units of concentration** Definition of concentration, different units of concentration: molarity, normality, formality, molality, %w/w, %w/v, %v/v, mole concept, mole fraction, numericals	8
SECTION – B		
4	**Introduction of analysis** Introduction, qualitative and quantitative analysis, applications of instrumental and chemical methods of analysis, applications of analytical chemistry, sampling techniques and hazards involved, procedure for analysis, interferences, impurities, contamination.	8
5	**Volumetric titration** Primary standards and secondary standards, standardization of NaOH, $Na_2S_2O_3$, $KMnO_4$, buffer solution and indicators, calibration of weighing balance and glasswares, concept of auto-burette and auto-pipette.	8
6	**pH-meter and its working** Definition of pH, pH scale, different methods for finding the pH of the solution, pH-meter; principle & working, reference and working electrodes, calibration of pH-meter, calculation of pH.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	**20**	**20**	**20**	**15**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. R. A. Day & A. L. Underwood, *Quantitative Analysis*, 6th Edition, Prentice Hall of India Limited, 1967.

2. Douglas A. Skoog, Donald M. West, F. James, Holler, Stanley R. Crouch, *Fundamentals of Analytical Chemistry*, 9th Edition, Mary Finch, 2013.
3. Dr. B. K. Sharma, *Instrumental Methods of Chemical Analysis*, 24th Revised Edition, Krishna Prakashan Media Pvt. Ltd., 2011.
4. Gary Christian, Kevin A. Schug, & Purnendu Dasgupta, *Analytical Chemistry*, 7th Edition, Wiley Publishing House, 2013.

Reference Books:

1. Charles A. Lucy, *Introductory Chemical Analysis*, 7th Edition, India Pvt. Ltd., 2016.
2. F.W. Fifield and David Kealey, *Principles and Practice of Analytical Chemistry*, 5th Edition, Villiman Publishing House, 2000.
3. Larry G. Hargis, *Analytical Chemistry: Principles and Techniques*, 1st edition, Prentice-Hall, 1988.
4. R. D. Braun, *Introduction to Instrumental analysis*, 2nd Edition, Pharma Med Press, 2016.
5. D. C. Harris, *Quantitative Chemical Analysis*, 5th Edition, W. H. Freeman & Co. Ltd., 1998

List of Practicals: (Online & Offline)

1. Preparation of 0.1 N NaOH, 0.1 N HCl & 0.1 N $KMnO_4$ and its standardization.
2. Calibration of glass ware (burette, pipette, measuring flask, specific gravity bottle), weighing balance & pH-meter.
3. Volumetric titration between HCl and NaOH
4. Volumetric titration between H_2SO_4 and $NaHCO_3$
5. Volumetric titration between $H_2C_2O_4$ and KOH
6. Volumetric titration between $K_2Cr_2O_7$ and $FeSO_4$
7. Volumetric titration between $KMnO_4$ and $FeSO_4$

Practical's to be performed through virtual mode:

8. Volumetric Titration: To determine acid neutralizing capacity of given water sample. https://ee1-nitk.vlabs.ac.in/exp/determination-of-alkalinity/procedure.html

9. To determine the pH of soil.
   https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=1549&cnt=1
10. To determine the specific conductivity of soil.
    https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=1315&cnt=1

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe different units of concentration to define a solution.	10%
CO-2	Describe the qualitative, quantitative, instrumental and chemical analysis of the sample.	15%
CO-3	Identify and minimize error, rounding of the data and its significance.	20%
CO-4	Analyze the standardization procedure for the solutions and calibration of instruments.	20%
CO-5	Determine method for the identification and calculation of pH.	20%
CO-6	Outline the lab precautions and material safety data sheet.	15%

List of Open Source Software/learning website:

- https://www.library.qmul.ac.uk/subject-guides/chemistry/useful-websites/
- https://blog.feedspot.com/chemistry_websites/
- https://www.rsc.org/periodic-table

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: MDC200-1C
Course Name: Natural Hazards
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Multidisciplinary Course

Prerequisite: Should have Fundamental knowledge of Natural calamities like Floods, Earthquakes, Landslide, and Pandemic etc.

Rationale: At the end of the course, students will get in-depth knowledge of Natural Hazards, their causes, types, and mitigation strategies.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	1	0	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION – A	
1	**Introduction of natural hazards** Definition, Classification of Natural Hazards (Hydrological, Meteorological and Geological, Biological), difference between Natural Hazards and Disaster, Risk and Vulnerability assessment	6
2	**Geological hazards** a) Earthquakes: Causes, effects and measuring magnitude. b) Volcanic eruption: Type, warning signs and impacts.	8

	c) Tsunami: Formation, propagation and impact mitigation. d) Landslides: Types, Causes, Mitigation and Prevention.	
3	**Biological hazards** Pandemic and Epidemic: Causes, Spread, containment. Pest infestations and crop diseases impact on agriculture and eco system	8
SECTION – B		
4	**Meteorological and hydrological hazards** Meteorological hazards: Hurricane, Tornado and Thunderstorms- Causes and Effects. Hydrological hazards: Floods, Droughts and Cyclones - Causes and Effects.	7
5	**Man-made hazards** Oil and chemical spill, Terrorism, Wars, Human Acerated Hazards, Nuclear accident. Disaster management system in India.	8
6	**Climate change and hazards** Relation between climate change and Hazard intensity, Strategy to reduce vulnerability to climate related hazards, future challenges –(a) Integrating scientific knowledge, policy and public awareness, (b) Natural hazards due to urbanization and technological advancement. Case studies: Recent incidence.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**35**	**20**	**10**	**05**	**05**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. D. Hyndman, D. Hyndman, *Natural Hazards and Disasters*, 5th Edition, Brooks/Cole, 2016.
2. P. L. Abbott, *Natural Disasters*, 1st Edition, McGraw-Hill Higher Education, 2008.

Reference Books:

1. P. Coppola Damon, *Introduction to International Disaster Management*, 3rd Edition, Elsevier Science (B/H), London, 2007.
2. S. Vaidyanathan, *An Introduction to Disaster Management Natural Disasters and Man Made Hazards*, 1st Edition, CBS Publishers and Distributors Pvt. Ltd., 2023
3. E. A. Keller, Duane E. DeVecchio, Natural Hazards: Earth's Processes as Hazards, Disasters and Catastrophes, 4th Edition, Pearson Benjamin Cummings, 2014.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Discuss and classify natural hazards.	20%
CO-2	Explain the geographical hazards effect and causes.	15%
CO-3	Outline the different types of biological hazards.	15%
CO-4	Describe the meteorological and hydrological hazards and how to overcome them.	20%
CO-5	Discuss the disaster management system in India.	10%
CO-6	Describe the ways that social and individual are responds to climate change	20%

List of Open-Source Software/learning website:

- www.GIS. Development.net
- www.iirs.nrsa.org
- http://quake.usgs.gov
- www.nidmindia.nic.in

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: MDC201-1C
Course Name: Basics of Biology
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Multidisciplinary Course

Prerequisite: Should have fundamental knowledge of basic biology, cell, and microscopy

Rationale: At the end of the course, students are expected to know about cell structure through microscopy, staining processes, and various techniques of sterilization.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Cell-the basic unit of life** Introduction to the cell, cell size and shape, concept of cell theory, types of cells, introduction to prokaryotic cells: characteristics and internal organization of prokaryotic and eukaryotic cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cells.	8
2	**Cell-organelles** Introduction to cell organelles, types, distribution, ultra-structure, composition and functions of cell organelles, mitochondria, golgi body, endoplasmic reticulum, chloroplast, nucleus, plasma membrane, various	7

	models: Fluid mosaic model, (ultrastructure, chemical composition; functions of plasma membrane).	
3	**Introduction to microbiology** Historical perspectives of microbiology, scope of microbiology, contribution of scientist in various field of microbiology: Antony Van Leeuwenhoek, Robert Koch, Louis Pasteur, Joseph Lister, Edward Jenner, Alexander Fleming, microbes and their current position in living world.	7
SECTION - B		
4	**Microbiological world through microscope** Introduction to microscopy, resolving power, numerical aperture, types of microscope, simple and compound microscope, working principle and their uses, confocal microscopy, scanning electron microscopy, transmission electron microscopy.	8
5	**Staining techniques in microbiology** Introduction to stains, types of stain, mechanism of staining: simple staining, negative staining, differential stain: Gram staining, method of Gram staining, capsule staining, endospore staining.	7
6	**Sterilization techniques** Introduction to techniques used in microbiology labs, sterilization, methods of sterilization, preservation, pasteurization, types and industrial application of pasteurization, sanitization. concept of antiseptic and disinfectant.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
25	**20**	**20**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. M. J. Pelczar , E.C.S. Chan & N.R. Kreig, *Microbiology* 5th ed., Tata McGraw-Hill, 2012.
2. PS Verma, VK Agarwal, *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, Edition illustrated, reprint, S. Chand Publishing, 2004.

Reference Books:

1. S. Chandra and K. K. De, *Cell Biology*, 2nd reviewed edition, New Central Book Agency, 2005.
2. J. G. Cappuccino, *Microbiology: A Laboratory Manual*, 11th ed., Pearson Education Pvt. Ltd, Singapore, 2012.
3. J. Lederberg, W. C. Summers; M. Alexander, B. R. Bloom, *Encyclopedia of Microbiology*, Elsevier Science, 2000.

List of Practicals: (Online & Offline)

1. Introduction to microscope.
2. To study the principle and working of various lab apparatus.
3. To study the nucleus and nucleolus in onion peel.
4. Microscopic examination of water infusion.
5. Positive and negative staining technique.
6. Contribution of various scientists in the field of microbiology.
7. Study of permanent slides as per theory.

Practicals to be performed through virtual mode

8. Gram staining technique https://vlab.amrita.edu/?sub=3&brch=73&sim=208&cnt=1
9. Isolation of mitochondria https://vlab.amrita.edu/?sub=3&brch=187&sim=327&cnt=1
10. Study of mitosis in onion root tip https://amrita.olabs.edu.in/?sub=79&brch=18&sim=237&cnt=1

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Define various types of cells and its characteristics	20%
CO-2	List the types of organelles in the cell and its functions	15%
CO-3	Describe the history and scope of microbiology and the contributions of renowned scientists	15%
CO-4	Explain the principles, types and concept of microscopy.	20%
CO-5	Illustrate the types, principle and mechanism of staining.	15%
CO-6	Summarize the sterilization methods and types in the field of microbiology	15%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- OpenStax- Unique Characteristics of Eukaryotic Cells - Microbiology | OpenStax
- Microbiology - Biology LibreTexts

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: MDC206-1C
Course Name: Animal Biology
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Multidisciplinary Course.

Prerequisite: Sstudents enrolling in this course should have basic knowledge of biology at higher secondary level. Fundamental understanding of cell structure and biological organization.

Rationale: Animal Biology provides a foundation for understanding the diversity, organization, structure and functions of animals. This course introduces students to animal classification, anatomy, physiology, histology and developmental biology. It builds conceptual knowledge of animal systems and evolutionary relationships while preparing learners for advanced studies in zoology, biotechnology, physiology and allied biological sciences in alignment with NEP objectives.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Content

Sr. No.	Content	Total Hours
SECTION - A		
1	**Introduction to animal biology** Definition and scope of animal biology Animal cell, function and structure Levels of organization Cellular, Tissue level.	6
2	**General characters** Classification of Kingdom Animalia, Difference between Chordates and Non-Chordates Levels of organization. Symmetry: radial & bilateral, Body cavity (acoelomate, pseudocoelomate, coelomate).	6
3	**Basic Classification** Protozoa, Porifera, Coelentrata, Platyhelminthes, Nementhelminthes, Annilida, Arthropoda, Mollusca Echinodermata and Chordata.	8

	SECTION - B	
4	**Anatomy and Physiology** Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system, Reproductive system and Endocrine system.	8
5	**Histology** Tissue system: Study of various tissue types, their structure, function and location Epithelial tissue, Connective tissue, Nervous tissue, Muscular tissue.	9
6	**Reproduction & Development** Asexual and sexual reproduction, Gametogenesis, Fertilization, Embryonic development.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**25**	**25**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. R.L. Kotpal. *Modern Textbook of Zoology: Invertebrates.* 10th edition. Rastogi Publications. 2012.

2. R.L. Kotpal. *Modern Textbook of Zoology: Vertebrates.* 9th edition. Rastogi Publications. 2012.

3. P.S. Verma and V.K. Agarwal. *Chordate Zoology.* 14th edition. S. Chand Publishing. 2018.

4. P.S. Verma and V.K. Agarwal. *Invertebrate Zoology.* 12th edition. S. Chand Publishing. 2016.

5. E.L. Jordan and P.S. Verma. *Animal Biology.* Revised edition. S. Chand Publishing. 2014.

Reference Books:

1. C.P. Hickman, L.S. Roberts, S.L. Keen et al. *Integrated Principles of Zoology.* 17th edition. McGraw Hill. 2017.
2. Stephen A. Miller and John P. Harley. *Zoology.* 9th edition. McGraw Hill. 2010.
3. Cleveland P. Hickman. *Animal Diversity.* 8th edition. McGraw Hill. 2016.
4. William S. Hoar. *General and Comparative Physiology.* 3rd edition. Prentice Hall. 1983.
5. Junqueira and Carneiro. *Basic Histology.* 13th edition. McGraw Hill. 2013.

6. Gilbert S.F. *Developmental Biology.* 10th edition. Sinauer Associates. 2014.

Course Outcomes: After completing this course, student will be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Explain scope of animal biology, animal cell structure and levels of biological organization.	10%
CO-2	Describe general characteristics and classification of Kingdom Animalia including chordates and non-chordates.	20%
CO-3	Understand diversity and basic classification of major animal phyla.	10%
CO-4	Explain structure and functions of major organ systems in animals.	20%
CO-5	Analyze histological organization and functions of different tissues.	20%
CO-6	Understand principles of reproduction, fertilization and embryonic development in animals.	20%

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: AEC200-1C
Course Name: Functional Grammar and Composition
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Ability Enhance Course

Prerequisite: Zeal to learn the subject.

Rationale: At the end of the course, students will have knowledge of English language. It also targets the understanding of grammar, focusing on comprehension, and reading, speaking and writing skills.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Parts of Speech and Word formations:** Recognition and review of Nouns, Pronouns, Verbs, Adverbs, Adjectives, Prepositions. Conjunctions & Interjections. Word formations**:** Affixes - Prefixes and Suffixes**,** Change of one part of speech to the other: from Verbs to Nouns, Nouns to Verbs, Adjectivesto Nouns, Nouns to Adjectives.	10
2	**Prepositions of Time and Place:** Contextual teaching of prepositions of time - on, in, at, since, for, ago, before, to, past, from, till/until, by.	5

	Prepositions of place: in, at, on, by, next to, beside, near, between, from, behind, in front of, under, below, over, above, across, though, to, into, towards.	
SECTION - B		
3	**Phrases and Clauses and Sentence types and transformation**: Basic definitions of clauses and phrases, difference between clauses and phrases, types of clauses. Sentence types and transformation: Assertive sentences,Exclamatory sentences, Interrogative sentences, Negative sentences.	8
4	**Paragraph Writing** & **Punctuation:** Descriptive Paragraph on related topic Use of the comma, full stop, semi-colon, colon, apostrophe,exclamation mark, question mark and quotation marks.	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. S. Kumar & P. Lata, *Communication Skills*, 2nd Edition, Oxford University Press, New Delhi, 2015.

Reference Books:

1. R. Murphy, *Essential English Grammar with Answers*, 2nd Edition, Cambridge University Press, 2000.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Present basic sentences in English.	20%
CO-2	Construct grammatically correct sentences in English	15%
CO-3	Apply grammatically correct English sentences in everyday situations.	15%
CO-4	Connect with varied English vocabulary in everyday situations confidently	20%
CO-5	Prepare themselves orally using simple English.	10%
CO-6	Assess reading and validate lifelong learning in English	20%

List of Open-Source Software/learning website:

- http://www.free-english-study.com/
- http://www.english-online.org.uk/course.htm

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: AEC201-1C
Course Name: Practical English
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Ability Enhance Course.

Prerequisite: Zeal to learn the subject.

Rationale: At the end of the course, students will acquire the LSRW (Listening, Speaking, Reading, and Writing) skills, Develop their ability as critical readers and writers.

Teaching and Examination Scheme

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Receptive skills: Reading skill** Comprehension passages (Skimming and Scanning) Picture reading, Read the passage, Identify the theme and suggest a title	**7**
2	**Receptive skills: Listening skill** Listening vs. Hearing, Types of listening Listening Activities (could be through reading aloud in class or prerecorded inputs)	**8**
	SECTION - B	
3	**Productive skills: Speaking skill** Introducing oneself, Introducing others**,** Requests, Offering help, Congratulating, Enquiries and Seeking permission. Giving instructions to do a task and to use a device	**8**

4	**Productive skills: Writing skill** Kinds of Sentences, Punctuation Dialogue writing, Story writing – Outline expansion	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. P. Prasad, *The functional aspect of Communication Skills,* S.K. Kataria & Sons, 6th Edition, 2015.

Reference Books:

1. T. Lynch, K.Anderson, *Study Speaking*: A Course in *Spoken* English for Academic *Purposes*, Cambridge University Press, Cambridge, 1992.
2. J. Mohanraj, *Speak Well*, 6th Edition, Orient *Black Swan*, 2012.

Course Outcomes: After completing this course, student will be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Acquire the LSRW (Listening, Speaking, Reading, Writing) skills	20%
CO-2	Design grammatically correct sentences in English	15%
CO-3	Apply grammatically correct English sentences in everyday Situations.	15%
CO-4	Connect with varied English vocabulary in everyday situations confidently	20%
CO-5	Prepare themselves orally using simple English.	10%
CO-6	Assess reading and validate lifelong learning in English	20%

List of Open-Source Software/learning website:

- http://www.free-english-study.com/
- http://www.english-online.org.uk/course.htm
- https://www.grammar-quizzes.com/noun-forms.html

B.Sc. (Hons.) - Biotechnology
Semester-I/II
Course Code: SEC200-1C
Course Name: Personality Development
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Skill Enhancement Course (SEC).

Prerequisite: Students should have basic knowledge of discipline, manners and normal attires.

Rationale: This course makes the students groom their personality as an individual or in-group class presentations

Teaching and Examination Scheme

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content:

Sr. No.	Content	Total Hours
	SECTION – A	
1	**Introduction to personality development** Personality, psychology of personality development, personality development as a process, significance of personality development, attributes that add to good personality, advantages of good personality	7
2	**Attitude & Etiquettes** Attitude, factors affecting attitudes, positive and negative attitude, ways to develop positive mind set, grooming the self, dress code for men and women, etiquettes and manners, techniques to improve self-confidence, willpower, increasing the willpower for self-improvement	

SECTION – B		
3	**Self-Esteem** Introduction of self-esteem, Poor Self-Esteem vs. Healthy Self-Esteem, three faces and consequences of Low Self-Esteem, improving Self-esteem, do's and don'ts to develop positive self-esteem, benefits of self esteem	8
4	**Self-Analysis** SWOT analysis, attributes, importance of self-confidence, creativity out of box thinking, lateral thinking, Johari window. goal setting– short term, long term and life time goals, prioritizing work	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. John C. Maxwell, *Failing Forward: Turning Mistakes into Stepping Stones for Success*, 3rd Edition, Harper Collins Leadership, 2021.

Reference Books:

1. Dale Carnegie, *How to Win Friends and Influence People*, 17th Edition, Simon & Schuster Publisher, 1936.
2. David J. Schwartz, *The Magic of Thinking Big*, 3rd Edition, Vermilion Publishing House, 1959.
3. Stephen R. Covey's, *The 7 Habits of Highly Effective People*, International Edition, Free Press, 1989.
4. Maxwell Maltz & Matt Furey, *Psycho-Cybernetics - Updated & Expanded*, 2nd Edition, Tarcher Perigee, 1960.
5. Tony Robbins, *Awaken the Giant Within*, 3rd Edition, Simon & Schuster Publisher, 1991.
6. Kagan Jerome, *Personality Development*, Harcourt Brace, New York, 1969.
7. Kundu C.L., *Personality Development*, Sterling Bangalore, 1989.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Illustrate a personality development concepts in routine life.	15%
CO-2	Explain factors affecting on attitude and overcome from it.	15%
CO-3	Evaluate self-esteem and personal relational ship.	20%
CO-4	Demonstrate and learn body language and decision-making skills	15%
CO-5	Build leadership and qualities of a successful leader.	15%
CO-6	Describe proper dress code, good manners and etiquette for interview.	20%

List of Open Source Software/learning website:

- https://bigbluebutton.org/
- https://blog.feedspot.com/chemistry_websites/
- https://www.congrea.com/

B.Sc. (Hons.) - Biotechnology
Semester-I/II
Course Code: SEC202-1C
Course Name: Public Speaking
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Skill Enhancement Course.

Prerequisite: Students should have basic knowledge about public speaking.

Rationale: Students will gain knowledge in practical skill of public speaking, including techniques to lessen speaker anxiety, use of visual aids to enhance speaker presentations.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Communication Skill** (a) Definition and Process of Communication, (b) Essential of Effective communication, (c) Barriers to Communication, (d) Role of Communication in organizational Effectiveness.	8
2	**Public-speech:** (a) Principles, (b) Speech Delivering Skills, Group Discussion, Do's and Don'ts of GD's	7

	communication in Committees, Seminars and Conference delegation, (c) Non-Verbal Communication: Meaning, Types and Importance, (d) Listening: Difference between Listening and Hearing.	
SECTION - B		
3	**Different type of speech**: **(a)** Introductory Speech, (b) Informative Speech, (c) Persuasive Speech, (d) Special Ocassion Speech, (e) Final Speech.	8
4	**Advanced Move:** (a) Drafting of Notices, Agendas, Minutes, (b) Job Application Letters and preparation of Curricular Vitae.	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Dale Carnegie, *The Quick and Easy Way to Effective Speaking*, 1990.
2. Strunk, W. Jr., White, E. B., & Roger, A., *The elements of style: A style of gender for writers (4th ed.).* New York: Longman,2004.
3. Cook, C., Line by line. New York: Longman, 2002.

Reference Books:

1. 2.O'Hair, Dan, Rob Stewart, and Hannah Rubenstein. *Speaker's Guidebook: Text and Reference*, 3rd ed, New York Bedford/St. Martin's, 2007.

2. Scott Berkun, *Confessions of a Public Speaker*, 2009.
3. James C. Homes, *Speak like Churchill, stand like Lincoln*, Tantor audio, 2011.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
1.	Define the communication process for organizational effectiveness.	20%
2.	Illustrate the principles of public speech.	20%
3.	Paraphrase the barrier of communication.	20%
4.	Classify different type of speech for effective communication.	10%
5.	Explain the special occasional speech and final speech.	10%
6.	Apply public speech skill in GD, non-verbal communication, notices, and minutes.	20%

List of Open-Source Software/learning website:

- https://alison.com/course/video-presentations-and-public-speaking
- https://www.youtube.com/watch?v=dVM_8eV-hoE
- https://www.youtube.com/watch?v=i5mYphUoOCs
- https://www.youtube.com/watch?v=83wYDzO3CzI

B.Sc. (Hons.) - Biotechnology
Semester-I/II
Course Code: SEC201-1C
Course Name: Time Management
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Skill Enhancement Course.

Prerequisite: Students should have basic knowledge about time management and time wasters.

Rationale: At the end of the course, students will have knowledge to establish priorities based upon values and goals. The course helps to demonstrate self-management by setting reasonable boundaries and exposes the students to analyse and evaluate how they should spend their time.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Time Management** Meaning, The psychology of time management, think about your vision and mission, importance of time management, effective time management strategies, measures to improve time management skills	8
2	**Techniques for Time Management** Create a PERT chart, set clear goals for everyone, create your daily "To-Do" List, The ABCDE method, plan your work and work your plan, the Not-To-Do list, set clear priorities, The Pareto principle	7
	SECTION - B	
3	**Time Wasters and Time Savers** Causes of Time Wasters, controllable personal and official time wasters, uncontrollable personal and official time wasters, procrastination and remedies, various mode of time saving, daily planners, handheld PDAs, E-learning, work delegation	8
	Approach and Application of Time Management The efficiency approach, the effective approach, the excellence approach and	

4	the effectiveness approach, learning time management, creative time management ideas, time management for right brain thinkers, time management for left brain thinkers	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Rahul Iyer, *The Art of Creating Pareto Analysis: A Complete End-to-End Guide to Understand Pareto Charts and Easily Create them in Excel,* Advanced Innovation Group Pro Excellence, 2021.
2. Graham Roberts- Phelps, *Handbook of Time Management Working Smarter*, New Delhi, Crest Publishing House,2003.
3. Richard G Neal, *Time Wasters/Time Savers: 61 Ways to Beat the Clock,* Association of School Business Officials International, 2003.

Reference Books:

1. Dr. Jan Yager, *Creative Time Management for the New Millennium*, Mumbai, Jaico Publishing,2001.
2. Gary kroehnert, *Taming Time*, New Delhi, Tata McGraw Hill Publishing Company Ltd,2004.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	**CO statement**	**Marks % weightage**
1.	Demonstrate time management for vision and mission.	20%
2.	Identify To-Do and Not-To-Do list.	20%
3.	Explain the Pareto principle.	20%
4.	Illustrate different types of time savers and time wasters.	10%
5.	Outline weekly planning and goal settings.	10%

6.	Apply the time management tools in meeting, telephonic conversation.	20%

List of Open-Source Software/learning website:

- https://youtu.be/xItNGPRBQKg
- https://youtu.be/KJLHlOIdqA4
- https://youtu.be/QzhaziGs6lQ
- https://youtu.be/Ux69_UreKcU
- https://youtu.be/Ex0sQ8xaQ0M
- https://youtu.be/rUO8Qvcs7cY
- https://youtu.be/SHiSe6-mOiY
- https://youtu.be/mOM6XjY6NqE
- https://youtu.be/UA5hfZoV7QE

B.Sc. (Hons.) - Biotechnology
Semester-I
Course Code: VAC200-1C
Course Name: Basics of Indian Knowledge System-I (IKS)
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Value Added Course

Prerequisite: Should have fundamental knowledge of ancient Indian practices developed by Indians over the centuries.

Rationale: At the end of the course, students are expected understand the concepts of the ancient Indian practices in science developed by Indians over the centuries. Students can able to understand the contributions of ancient and medieval Indians in the area of chemistry and metallurgy, ecology and environment.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	C	CCE Marks	SSE Marks	
2	-	-	2	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Bharatiya civilization** Genesis of the land, antiquity of civilization, on the trail of the lost river, discovery of the Saraswati river, the Saraswati-Sindhu civilization **Development of knowledge system**	**8**

	Traditional knowledge system, the vedas, main schools of philosophy (6+3), ancient education system, the takṣasila university, the nalanda university, alumni, knowledge export from bharata	
2	**Literature and scholars** Literature, life and works of Agastya, Lopamudra, Ghoṣa, Valmiki, Patanjali, Vedavyasa and Yajnavalkya	**7**
SECTION - B		
3	**Science, Engineering & Technology** Concept of matter, life and universe, gravity, sage agastya's model of battery, velocity of light, vimana: aeronautics, vedic cosmology and modern concepts, bharatiya kala-gaṇana Pre-harappan and sindhu valley civilization, laboratory and apparatus, juices, dyes, paints and cements, glass and pottery, metallurgy, engineering science and technology in the vedic age and post-vedic records	**8**
4	**Life & environment:** Ethnic studies, life science in plants, anatomy, physiology, agriculture, ecology and environment	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**25**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. B. C. Chauhan, *A Textbook on The Knowledge System of Bharata*, ISBN-13- 979-8885750882, Garuda Prakashan, 2023.
2. S. Raha, *Histrory of Science in India*, Vo.1, National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata, 2014.

Reference Books:

1. P. Kohle, *Pride of India- A Glimpse of India's Scientific Heritage*, Samskrit Bharati, Publishers, 2006.
2. K. D. Verma, *Vedic Physics*, 1st edition, Motilal Banarsidass Publishers, 2012.
3. S. Soni, *India's Glorious Scientific Tradition*, Ocean Books Pvt. Ltd., 2010.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the concepts of Indian civilization	15%
CO-2	Describe the development of Indian knowledge system	15%
CO-3	Summarize various developments in literature	20%
CO-4	Discuss developments science	15%
CO-5	Discuss the developments in engineering & technology	15%
CO-6	Demonstrate the knowledge of life & environment.	20%

List of Open-Source Software/learning website:

- https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004120632194475nishi_Indian_Knowledge_Systems.pdf.
- https://www.cuhimachal.ac.in/admin/assets/uploads/courses_offered_archive/IKS-Syllabus-PG-2Cr.pdf
- https://nitc.ac.in/imgserver/uploads/attachments/Ed_fed28a49-099b-452d-a676-5934d729cf98_.pdf
- https://iksindia.org/
- https://onlinecourses.swayam2.ac.in/imb23_mg53/preview

B.Sc. (Hons.) - Biotechnology
B.Sc. SEM II
Teaching/Exam Scheme
(As per NEP-2020)

w.e.f.: July-2026

Sr. No.	Course Code	Category of course	Course title	Hour s Per week			Total con. hrs.	Credits	E	M	I	V	Total Marks
				L	T	P							
1	BIM202-1C	Major Course	Concepts of cell biology	3	0	2	5	4	50	50	-	-	100
2	BIM203-1C	Major Course	Basics of Microbiology	3	0	2	5	4	50	50	-	-	100
3	MIE201-1C	Minor Course	Basic Chemistry for biologists	3	0	2	5	4	50	50	-	-	100
4	MDC203-1C	MDC	Nanotechnology – Fundamentals and Applications	3	0	2	5	4	50	50	-	-	100
5	MDC-207-C	MDC	Basic Instrumentation and Techniques	3	0	2	5						
6	MDC-208-C	MDC	Plant Biology	4	0	-	4	4	50	50	-	-	100
7	AEC203-1C	AEC	Creative Writing Essential	2	0	-	2	2	25	25	-	-	50
8	AEC204-1C	AEC	Corporate Communication in English	2	0	-	2	2	25	25	-	-	50
9	SEC200-1C	SEC	Personality Development	2	0	-	2	2	25	25	-	-	50
10	SEC201-1C	SEC	Time Management	2	0	-	2	2	25	25	-	-	50
11	SEC202-1C	SEC	Public Speaking	2	0	-	2	2	25	25	-	-	50
12	VAC201-1C	VAC	Human Values and Ethics	2	0	-	2	2	25	25	-	-	50
			Total	22	0	0	22	22	275	275	-	-	550

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: BIM202-1C
Course Name: Concepts of cell biology
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: **S**tudent's enrolling in this course should have basic knowledge of Biology at higher secondary level. Fundamental understanding of cell structure and biomolecules.

Rationale: Cell Biology is a fundamental discipline that explains the structural and functional organization of living cells. This course introduces students to cell architecture, membrane transport, organelles, cell cycle regulation, signaling mechanisms and programmed cell death. It provides a conceptual foundation for advanced studies in genetics, molecular biology, microbiology, biotechnology and biomedical sciences, aligned with the multidisciplinary approach of NEP.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Cell Biology** History and scope of cell biology, Cell theory (classical & modern), Prokaryotic vs Eukaryotic cells, Cell size, shape, and diversity.	8
2	**Plasma Membrane & Transport** Structure of plasma membrane, Fluid Mosaic Model, Passive & active transport, Cell junctions.	7

3	**Cell Organelles** Structure and Functions of Nucleus, Structure and Functions of ER, Golgi apparatus, Structure and Functions of Lysosomes, peroxisomes, Structure and Functions of Mitochondria & chloroplast, Cytoskeleton.	7
	SECTION - B	
4	**Cell Cycle & Cell Division** Cell cycle phases: Prophase, Meta phase, anaphase, telophase, Mitosis, Meiosis & Regulation.	8
5	**Cell Signaling & Communication** Introduction to cell signaling, Types of signaling:Autocrine, Paracrine, Endocrine, Receptors (cell surface & intracellular), Signal transduction pathways (basic idea), Second messengers (cAMP, Ca^{2+}).	7
6	**Apoptosis & Cell Death** Definition of apoptosis, Necrosis vs apoptosis, Morphological changes in apoptosis, Mechanism (basic pathway idea), Importance in development & disease.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	**25**	**25**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Bruce Alberts, Alexander Johnson, Julian Lewis et al. *Molecular Biology of the Cell.* 6th edition. Garland Science. 2015.
2. Gerald Karp. *Cell and Molecular Biology: Concepts and Experiments.* 8th edition. Wiley. 2015.
3. De Robertis and De Robertis. *Cell and Molecular Biology.* 8th edition. Lippincott Williams & Wilkins. 2001.

Reference Books:

1. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick. *Molecular Biology of the Gene.* 6th edition. Benjamin Cummings. 2007.

2. Lodish, Berk, Kaiser et al. *Molecular Cell Biology.* 8th edition. W.H. Freeman. 2016.

3. Geoffrey M. Cooper and Robert E. Hausman. *The Cell: A Molecular Approach.* 7th edition. Sinauer Associates. 2018.

4. Harvey Lodish et al. *Molecular Cell Biology.* 7th edition. W.H. Freeman. 2013.

List of Practicals: (Online & Offline)

1. Observation of plant and animal cells using temporary slides.
2. Study of prokaryotic and eukaryotic cells.
3. Demonstration of osmosis and diffusion.
4. Study of mitosis using onion root tip.
5. Study of meiosis using prepared slides/models.
6. Observation of cell organelles through charts/models/micrographs.
7. Study of plasma membrane transport through simple experiments.

Practicals to be performed through virtual mode

1. Virtual cell structure exploration using 3D tools.
2. Simulation of membrane transport processes.
3. Virtual microscopy of mitosis and meosis.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain history, principles and basic concepts of cell biology including diversity of cells.	20%
CO-2	Describe plasma membrane structure, membrane transport and cell junctions.	15%
CO-3	Understand structure and functions of major cell organelles.	15%
CO-4	Analyze cell cycle events, mitosis, meiosis and their regulation.	20%
CO-5	Explain principles of cell signaling, communication and signal transduction.	15%
CO-6	Understand apoptosis, necrosis and significance of programmed cell death in development and disease.	15%

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: BIM203-1C
Course Name: Basics of Microbiology
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of Fundamental understanding of laboratory safety and basic scientific terminology. Elementary awareness of living organisms and their classification.

Rationale: Microbiology is a foundational discipline in life sciences that explores the diversity, structure, and function of microorganisms and their impact on human life, environment, and industry. This course introduces students to the historical development of microbiology, key discoveries, and essential laboratory techniques such as culture methods and media preparation.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Microbiology and its origin** Microscopy and discovery of microorganisms, Culture based methods of studying microorganisms, Microorganisms and disease, Koch's postulate, Immunology, Microbial ecology, Major fields in microbiology	7
2	**Media and pure culture techniques** Culture media: basic composition, solid and liquid media, synthetic and complex media, enriched and enrichment media, selective and differential	8

	media; isolation and culture of microbes, inoculation and incubation and maintenance of cultures and related instruments. Pure culture techniques (pour plate, spread plate, streaking and serial dilution), Cultivation of anaerobic bacteria.	
3	**Classification of Microbes** Numerical and molecular taxonomy, Fundamental characteristics employed in classification of : Bacteria – up to Order (with one example). Fungi, slime molds and water molds – up to Division (with one example). Algae – up to Division (with one example). Viruses – upto Family (with one example).	8
SECTION - B		
4	**Stains and staining techniques** Theories of staining, mechanism of Gram staining, stain vs dye, principle and applications of staining techniques, simple stain, differential stain, negative stain, flagella stain, endospore stain, nuclear stain, acid fast stain	8
5	**Microscopy** Lenses and banding of light, Light microscopes, Bright field microscope and microscope resolution, Dark field microscope, Phase contrast microscope, Differential interference contrast microscope, Fluorescence microscope, Confocal Microscopy, Preparation and staining of specimens.	6
6	**Electron microscopy** Transmission Electron Microscope, Scanning Electron Microscope, Electron cryotomography, Scanning probe microscopy.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	**30**	**25**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, *Brock Biology of Microorganisms*, 15th edition, Pearson Education, 2018.
2. Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, *Prescott's Microbiology*, 10th edition, McGraw-Hill Education, 2017.
3. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, *Microbiology: An Introduction*, 13th edition, Pearson Education, 2019.

Reference Books:

1. C. B. Powar, H. F. Daginawala, *General Microbiology*, 2nd edition, Himalaya Publishing House, 2010.
2. Ananthanarayan R., Paniker C. K. J., *Ananthanarayan and Paniker's Textbook of Microbiology*, 10th edition, Universities Press, 2017.

List of Practicals: (Online & Offline)

1. Study of compound microscope and its parts.
2. Preparation of simple stains (e.g., methylene blue staining).
3. Gram staining technique.
4. Preparation of different types of culture media (nutrient broth, agar).
5. Study of sterilization techniques (autoclave, hot air oven).
6. Isolation of microorganisms using streak plate method.
7. Isolation using spread plate and pour plate techniques.

Practical's to be performed through virtual mode

1. Scanning Electron Microscopy.
2. Transmission Electron microscopy.
3. Electron Cryotomography.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the origin and development of microbiology, including microscopy, discovery of microorganisms, and major fields within microbiology.	20%
CO-2	Demonstrate understanding of microbial cultivation techniques, including media types, preparation, isolation methods, and maintenance of pure cultures under aerobic and anaerobic conditions.	15%
CO-3	Describe the relationship between microorganisms and disease, including Koch's postulates, basic immunology, and microbial ecology.	15%
CO-4	Classify microorganisms using classical and molecular taxonomy, and identify key characteristics of bacteria, fungi, algae, and viruses up to specified taxonomic levels.	20%
CO-5	Explain the principles, mechanisms, and applications of staining techniques, including Gram staining, acid-fast staining, and other differential staining methods.	10%
CO-6	Compare and evaluate different types of microscopy techniques (light, phase contrast, fluorescence, confocal, and electron microscopy) and their applications in studying microbial structure and function.	10%

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: MIE201-1C
Course Name: Basic Chemistry for Biologists
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of Hydrocarbons and its phenomena.

Rationale: At the end of the course, students will have knowledge about structure, stability, and stereochemistry of organic molecules.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Nomenclature, structure and bonding** Introduction, hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van Der Waals interactions, hydrogen bonding.	8
2	**Paraffins, Olefins, and Acetylenes** Introduction, nomenclature, isomerism, synthesis, properties, chemical reactions and applications of paraffins, olefins, and acetylenes.	7
3	**Stereochemistry** Introduction, isomerism, optical activity, chiral and achiral molecules, optical isomerism of tartaric acid, enantiomers, diastereomers, meso	8

	compounds, resolution of enantiomers, inversion retention and racemization, sequence rules, CIP rules, D & L and R & S system of nomenclature, racemic mixture, stereochemistry of cycloalkane, conformation of cyclohexane, chair conformation, boat formation, half-chair formation.	
SECTION - B		
4	**Reactive intermediates** Introduction, homolytic and heterolytic fission, reactive intermediates: carbocations, carbanions, free radicals. Types of reagents, electrophiles, nucleophiles, resonance, introduction to aromaticity, inductive and field effects, electrometric effect, mesomeric effect, hyper-conjugation and their applications, dipole moment.	7
5	**Reaction mechanism** Introduction, types of reactions: addition, substitution, elimination, rearrangements, addition, and substitution with respect to electrophilic and nucleophilic reaction- SN^1, SN^2, E1 and E2. Markovnikov rule, Anti markovnikov rule and Zaitsev's rule. Mechanism of (i) addition reaction to alkenes and dienes (ii) substitution in benzene ring by nitration, sulfonation. Cyanohydrin and acetal formation, mechanism of Perkin, Hofmann and Cannizzaro reaction.	8
6	**Heterocyclic compounds** Introduction, nomenclature, classification, structure, physical and chemical properties, methods of synthesis, chemical reactions and applications of 5 & 6 membered heterocyclic compounds like pyrrole, furan, thiophene, pyridine, piperidine and pyran.	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**25**	**20**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. J. A. Joule, K. Mills, *Heterocyclic chemistry*, 5th edition, ISBN 978-1-4051-3300-5, John Wiley & Sons, Inc, 2010.
2. S. Sen gupta, *Basic stereochemistry of organic molecules*, 1st edition, ISBN: 978-0199451630, Oxford university press, 2014.
3. M. Balci, *Reaction Mechanisms in Organic Chemistry*, 1st edition, ISBN: 978-3-527-83459-4, John Wiley & Sons, Inc, 2021.
4. A. Bahl, B.S. Bahl, *Advanced Organic Chemistry*, 3rd edition, ISBN: 978-8121900614, S. Chand, 1987.
5. A. I. Vogel, *Vogel's Textbook of Practical Organic Chemistry*, 5th edition, ISBN-13. 978-8177589573, Pearson Education India, 1889.

Reference Books:

1. R.S. Dhillon, I. P. Singh, C. Baskar, *Stereochemistry*, ISBN: 978-81-8487-241-5, Narosa Publishing House, 2014.
2. A. George, O. A. Molnar, *Hydrocarbon Chemistry*, 2nd edition, Print ISBN: 9780471417828, Online ISBN: 9780471433484, John Wiley & Sons, Inc, 2003.
3. R. A. Moss, M. S. Platz, M. Jones Jr, *Reactive Intermediate Chemistry*, 1st edition, Print ISBN: 9780471233244, Online ISBN- 9780471721499, John Wiley & Sons, Inc, 2003.
4. D. Michael, P. Mingos, *Structure and Bonding*, 1st edition, ISSN: 0081-5993, Springer Nature Switzerland AG. Part of Springer Nature, 2021.
5. M. Boyd, Bhattacharjee, *Organic Chemistry*, 7th Edition, ISSB- 978- 8131704813, Pearson Education India, 2010.

6. F. A. Carey, R.J. Sundberg, *Advanced Organic Chemistry*, 5th Edition, ISSB- 978-0387683461, Part of Springer Nature, 1937.
7. Mann and Saunders, *Practical organic Chemistry*, 4th edition, ISBN-13: 978-8131727102, Pearson Education India, 2009.
8. V K. Ahluwalia, R. Aggarwal, *Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis*, ISBN-978- Sangam Books Ltd, 2001.
9. A. K. Nad, B. Mahapatra, A. Ghoshal, *An Advanced Course in Practical Chemistry*, ISBN, 8173813027, New central book agency Pvt. Ltd, 2022.

List of Practicals: (Online & Offline)

1. Purification of organic compounds by crystallization (solvents: Water, Alcohol, Alcohol-Water).
2. Determine melting point, boiling point, and solubility of various organic compounds.
3. Qualitative analysis of organic compounds bearing different functionl groups as shown below.
    4. Anilide/Amide
    5. Liquid
    6. Amine/Toludine
    7. Urea
    8. Acid
    9. Phenol
    10. Nitro compound

Practicals to be performed through virtual mode

11. Systematically identify the functional groups in the given organic compound and perform the confirmatory tests after identifying the functional groups. https://vlab.amrita.edu/?sub=2&brch=191&sim=345&cnt=1
12. To detect the halogens, nitrogen and sulphur in an organic compound https://vlab.amrita.edu/?sub=2&brch=191&sim=344&cnt=1
13. To obtain pure components from a mixture of organic compounds using steam distillation. https://vlab.amrita.edu/?sub=2&brch=191&sim=1547&cnt=1

Course Outcomes: After completing this course, students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe various phenomenon of structure and bonding	15%
CO-2	Discuss the concepts of primary aliphatic hydrocarbons	15%
CO-3	Summarize stereochemistry of organic molecules.	15%
CO-4	Define and understand the basic concepts of reactive intermediates	20%
CO-5	Define and understand the basic concepts of reaction mechanism	15%
CO-6	Outline chemical reactions & applications of hetero aromatic compounds	20%

List of Open-Source Software/learning website:

- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry01%3A
- https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch105-consumer-chemistry/
- https://www.britannica.com/science/heterocyclic-compound/Comparison-with-carbocyclic-compounds
- https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Organic-Chemistry-Volume-1/ATOOCV1-3-11-Generation-Structure-Stability-and-Reactivity-of-Carbocations-Carbanions-Free-Radicals-Carbenes-and-Nitrenes.pdf
- https://iscnagpur.ac.in/study_material/dept_chemistry/3.1_MIS_and_NJS_Manual_for_Qrganic_Qualitative_Analysis.pdf
- https://leah4sci.com/nucleophilic-substitution-and-beta-elimination-sn1-sn2-e1-e2-reactions/
- https://www.cliffsnotes.com/study-guides/chemistry/organic-chemistry i/stereochemistry/stereochemistry-defined

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: MDC203-1C
Course Name: Nano Technology: Fundamentals and Applications

(As per NEP-2020)

w.e.f.: July-2023

Type of course: Multidisciplinary Course

Prerequisite: Should have fundamental knowledge of nanoscience.

Rationale: The course will provide an overview over nanotechnology. It will show that the nano regime is so different from other regimes because unique properties synthesis, characterization, and applications, as they are already in use today or as they are planned for the future.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
SECTION - A		
1	**Crystal structure** Crystal structure, crystal orientation, crystal planes, Bravais lattice, Miller Indices, atomic packing density, crystal symmetry, ZnS, crystal structure of NaCl and diamond, melting point, coordination number, atomic bonding.	7

2	**Introduction to nanoscience** Role of particle size, spatial and temporal scale, exciton, strong and weak confinement with suitable examples, development of quantum structures, basic concept of quantum well, quantum wire and quantum dot, density of states of 1D, 2D & 3D structure, surface effect.	8
3	**Types of nanomaterials** Nanoclusters, solid solutions, thin film, metal oxide and polymer-based nanocomposites, core shell nanostructure, buckyballs, carbon nano tubes and, zeolites minerals, dendrimers, micelles, liposomes, metal nanocrystals, semiconductor nanomaterials.	8
SECTION - B		
4	**Synthesis of nanomaterials** Synthesis of metal nanocrystals by reduction, sol-gel, solvothermal, photochemical process, nanocrystals of semiconductors and other materials by arrested precipitation, thermolysis routes, liquid-liquid interface.	6
5	**Structural characterization techniques** Introduction to optical microscopy, scanning electron microscopy, transmission electron microscopy, scanning tunneling microscopy, x-ray diffraction (XRD) technique.	8
6	**Industrial application of nanomaterial** Nano capacitors, carbon nano-tube (CNC), graphene, sensors & nano-sensors, superconducting materials, solar energy, hydrogen energy and nano-materials.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**20**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Book:

1. B.S Murty, P. Shankar, Baldev Raj, and James Murday, *A Textbook of Nanoscience and Nanotechnologies*, 1st Edition, Sringer University Press, 2013

Reference Books:

1. W. D. Callister Jr., *Material Science & Engineering – An Introduction*, 9th Edition, Wiley, 2013.
2. V. Lu. Novikov & Vladimi Novikov, *Grain growth and control of microstructure and lecture in polycrystalline materials*, 1st Edition, CRC Press, 1996.
3. Marzan & Kamat, Nanoscale Materials- Liz 3rd Edition, Kluwer Academic Publishers, 2003.
4. C.P. Poole, Jr., Frank J. Owens Lee J. D., *Introduction to Nanotechnology*, *Concise Inorganic Chemistry*, 1st Edition, Wiley-Interscience, 2003.
5. Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th Edition, CBS Publishers, 2004.
6. A. Green, *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, 2nd Edition, World Scientific Publishing Co, 2011

List of Practicals: (Online & Offline)

1. Synthesis of TiO_2 nanoparticles by chemical method.
2. Synthesis of ZnO nanoparticles using plant extract.
3. Synthesis of silver nanoparticles by chemical method.
4. Synthesis of ZnO by chemical method.
5. Synthesis of Fe_2O_3 by chemical method.
6. Synthesis of silver nanoparticles using plant extract.
7. Synthesis of copper nanoparticles by chemical method.

Practicals to be performed through virtual mode:

8. Basics of Scanning Electron Microscopy: Secondary Electron and BSE imaging mode https://emb-iitk.vlabs.ac.in/exp/sem-basics/index.html
9. Basic operations of Transmission Electron Microscope (Imaging and Diffraction Pattern) https://emb-iitk.vlabs.ac.in/exp/transmission-electron-microscope/
10. Sample Preparation for TEM analysis (Bulk metal, Powder sample, Brittle material) https://emb-iitk.vlabs.ac.in/exp/tem-analysis/

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the crystal properties of nanomaterial.	15%
CO-2	Paraphrase of the different arrangements of nanomaterial.	10%
CO-3	Classify the types of nanomaterials.	15%
CO-4	Describe different methods of synthesis of nonmaterial.	20%
CO-5	Illustrate instrumental techniques for characterization of nanomaterials.	20%
CO-6	Demonstrate the applications of nano materials and associated technology in industrial sector.	20%

List of Open Source Software/learning website:

- http://www.nano.gov/you/nanotechnology-benefits

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: MDC207-1C
Course Name: Basic Instrumentation and Techniques
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Multidisciplinary course

Prerequisite: Should have Basic knowledge of biology, chemistry, laboratory safety, and fundamental scientific terminology.

Rationale: This course is designed to provide students with fundamental knowledge of basic laboratory instrumentation and microbiological techniques used in scientific laboratories. The course introduces essential sterilization methods, microscopy principles, microscope handling, and safety precautions required for laboratory practices. It helps students develop practical skills necessary for specimen observation, maintenance of aseptic conditions, and proper use of laboratory instruments. The course serves as a foundation for advanced studies in microbiology, biotechnology, environmental science, medical laboratory technology, and related disciplines. Teaching and Examination Scheme:

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
3	-	1	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Sterilization Techniques** Principles and importance of sterilization, Methods of sterilization: Dry heat sterilization, Moist heat sterilization, Tyndallization, Radiation sterilization, Filtrationm, Physical methods of sterilization. Chemical methods of sterilization. Disinfection: Definition, Types and applications of disinfectants. Sanitization and its significance. Antisepsis and antiseptic agents. Sterilants and their applications. Fumigation.	7

2	**Introduction to Microscope** Definition and importance of microscope, Principles of Microscopy: Magnification, Resolution, Contrast, Numerical aperture. Compound Microscope: Principle and working, Magnification and resolving power. Components of Microscope and Their Functions: Eyepiece (ocular lens) Objective lenses, Body tube, Revolving nosepiece, Stage and stage clips Condenser, Iris diaphragm, Mirror/Illuminator, Coarse adjustment knob Fine adjustment knob, Arm and base, Safety Precautions During Microscopic Examination.	8
3	**Staining Techniques** Introduction and importance of staining, Difference between stain and dye Theories of staining, Principles and applications of staining techniques, Types of Staining Techniques; Simple staining, Differential staining, Negative staining, Flagella staining, Endospore staining, Nuclear staining. Gram Staining: Principle and mechanism of Gram staining, Gram-positive and Gram-negative bacteria, Applications of Gram staining.	8
SECTION - B		
4	**pH and Buffer Solutions** Introduction to pH: Definition and concept of pH, Importance of pH in biological, environmental, and industrial systems, Hydrogen Ion Concentration and pH Scale: Acids, bases, and neutral substances, Relationship between hydrogen ion concentration and pH, pH scale and its interpretation, Buffer Solutions: Definition and principles of buffer action, Types of buffer solutions: Acidic buffers, Basic buffers, Mechanism of buffer action, Henderson–Hasselbalch equation, Preparation of buffer solutions, Applications of buffer solutions in laboratories and industries, Importance and Applications of pH Control.	8

5	**pH Measurement and pH Meter** Measurement of pH: Principles of pH measurement, Indicators and their limitations, pH Meter: Definition and principle of pH meter, Construction and working of pH meter, Components of pH Meter: Glass electrode, Reference electrode, Temperature compensation system. Calibration of pH Meter: Standard buffer solutions, Calibration procedure. Maintenance and Care of pH Meter: Cleaning and storage of electrodes. Sources of Error in pH Measurement and Their Control. Applications of pH Meter.	7
6	**Spectroscopy Techniques** Electromagnetic Waves; definition and concept, Beer-Lambert law and its application, single and double beam spectrophotometer, colorimeter and UV-visible spectrophotometer.	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	**20**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl. Brock Biology of Microorganisms. 15th Edition. Pearson Education, 2018.
2. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Microbiology: An Introduction. 13th Edition. Pearson Education, 2019.
3. Prescott Harley Klein. Microbiology. 10th Edition. McGraw-Hill Education, 2017.

Reference Books:

1. Ananthanarayan and Paniker. Textbook of Microbiology. 11th Edition. Universities Press, 2020.
2. C. P. Baveja. Microbiology. 6th Edition. Arya Publications, 2018.
3. Pelczar Chan Krieg. Microbiology. 5th Edition. McGraw-Hill Education, 2014..

List of Practical's: (Online & Offline)

1. Identification and demonstration of laboratory instruments and equipment.
2. Demonstration of dry heat sterilization using hot air oven.
3. Demonstration of moist heat sterilization using autoclave.
4. Study and handling of compound microscope.
5. Preparation of temporary wet mount slide.
6. Observation of microorganisms under microscope.
7. Simple staining of bacterial cells.

Practical's to be performed through virtual mode

8. Demonstration of filtration sterilization technique.
9. Preparation of permanent slide.
10. Gram staining and observation of Gram-positive and Gram-negative bacteria.

Course Outcomes: After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the principles, importance, and methods of sterilization used in laboratories and healthcare systems.	20%
CO-2	Differentiate between physical and chemical methods of sterilization, disinfection, sanitization, antisepsis, and fumigation.	15%
CO-3	Describe the principles of microscopy, magnification, resolution, and numerical aperture.	15%
CO-4	Identify various components of a compound microscope and explain their functions.	20%
CO-5	Demonstrate proper handling, focusing, and maintenance of microscopes for specimen observation.	10%
CO-6	Perform basic laboratory techniques including sterilization, slide preparation, and staining procedures while following laboratory safety practices.	10%

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: MDC208
Course Name: Plant Biology
(As per NEP-2020)

w.e.f.: July-2026

Type of course: Multidisciplinary course

Prerequisite: Students enrolling in this course should have basic knowledge of Biology at higher secondary level. Fundamental understanding of plant diversity and cell structure.

Rationale: Plant Science provides the foundation for understanding plant diversity, structure, physiology, reproduction and modern applications in biotechnology. This course introduces students to plant organization from cellular to organismal level, physiological processes essential for plant life, and emerging approaches in plant biotechnology. It supports multidisciplinary learning envisioned under NEP and prepares students for advanced studies in botany, agriculture, biotechnology and environmental sciences.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
4	-	-	4	50	50	100

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to Plant Biology** Scope and importance of plant biology. General characteristics of plants, Basics of plant classification, Study of major plant groups: Algae, Bryophytes Pteridophytes, Gymnosperms, Angiosperms, Economic importance of plant	6
2	**Plant Cell Structure and Organization** Structure of plant cell, Cell wall: structure and composition, Plastids (chloroplast, chromoplast, leucoplast), Vacuole: structure and function, Plasmodesmata and cell connections	8

3	**Plant Tissues and Anatomy** Meristematic tissues (apical, lateral, intercalary), Permanent tissues: Simple tissues (parenchyma, collenchyma, sclerenchyma), Complex tissues (xylem, phloem), Internal structure of: Root, Stem, Leaf.	8
SECTION - B		
4	**Plant Physiology** Photosynthesis (light & dark reactions – basic idea), Respiration in plants Transpiration, Water absorption and mineral nutrition, Plant hormones (auxin, gibberellin, cytokinin, ethylene, ABA).	8
5	**Plant Reproduction** Modes of reproduction: Vegetative reproduction, Asexual reproduction, Sexual reproduction, Structure of flower, Pollination (types and agents) Fertilization, Seed and fruit formation, Basic plant life cycles.	8
6	**Basics of Plant Biotechnology** Introduction to plant biotechnology, Plant tissue culture: Callus culture, Micropropagation, Somatic embryogenesis, Applications in agriculture, Crop improvement techniques, Disease resistance in plants.	7

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. P.C. Vashishta, A.K. Sinha and V. Kumar. *Botany for Degree Students.* 6th edition. S. Chand Publishing. 2018.

2. B.P. Pandey. *College Botany.* Vol. I & II. 22nd edition. S. Chand Publishing. 2019.

3. Pandey and Sinha. *Plant Physiology.* 6th edition. Vikas Publishing House. 2015.

Reference Books:

1. Plant Physiology and Development. 6th edition. Sinauer Associates. 2015.
2. Biotechnology. 1st edition. Books and Allied Pvt. Ltd. 2017.
3. Introduction to Plant Tissue Culture. 2nd edition. Oxford and IBH. 2003.
4. Plant Anatomy. Wiley India. Reprint edition.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain scope, diversity, classification and economic importance of plants.	20%
CO-2	Describe plant cell structure, organelles and cellular organization.	15%
CO-3	Understand plant tissues and internal anatomy of root, stem and leaf.	15%
CO-4	Explain major physiological processes in plants including photosynthesis, respiration and hormonal regulation.	20%
CO-5	Analyze modes of plant reproduction, fertilization and life cycles.	10%
CO-6	Understand basic principles and applications of plant biotechnology for crop improvement.	20%

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: AEC203-1C
Course Name: Creative Writing Essential
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Ability Enhance Course.

Prerequisite: Zeal to learn the subject.

Rationale: At the end of the course, students will have knowledge of English language. It also targets the understanding of grammar, focusing on comprehension, and reading, speaking and writing skills. This would be developed through balanced and integrated tasks.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Vocabulary building and Phonetics** Introduction to Word Formation. Types of word formation processes: Compounding, Clipping, Blending, Derivation, Creative respelling, Coining and Borrowing, Synonyms, Antonyms, and Standard Abbreviations. Phonetics: IPA, Transcription**,** Introduction to different accents.	8
2	**Identifying Common Errors in Writing** Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers,	7

	Articles, Modal auxiliaries, and Redundancies.	
SECTION - B		
3	**Basic Writing Skills** Sentence structures- simple, compound, complex. Use of phrases and clauses in sentences, importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents.	7
4	**Nature and Style of Writing and Writing Practices** Describing, Defining, Classifying, Writing introduction and conclusion. Writing practices: Comprehension, Précis writing, Letter writing, Email etiquettes.	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. M. Hemamalini, *Technical English*, Wiley. 2014

Reference Books:

1. Michael Swan, *Practical English Usage*, OUP, 1995.
2. F.T. Wood, *Remedial English Grammar for Foreign Students*, Macmillan, 2007.
3. Liz Hamp-Lyons and Ben Heasly, *Study Writing*, Cambridge University Press, 2006.
4. William Zinsser, *On Writing Well*, Harper Resource Book, 2001

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Recollect ideas using various forms of vocabulary in varied situations in oral and written communication.	20%
CO-2	Decode the phonetic symbols and the transcription pattern to learn correct pronunciation.	15%
CO-3	Apply the dynamics of various rules of grammar and check its validation while they speak and write language correctly.	15%
CO-4	Analyse grammar effectively to make themselves competent Listener, Speaker, Reader and Writer by exposing to various set of situations.	20%
CO-5	Relate to various formal and informal documents of day to day life and professional set up.	10%
CO-6	Evaluate the qualities of writing in diverse situation by using the nuances such as conciseness, clarity, accuracy, organization, and coherence.	20%

List of Open-Source Software/learning website:

- http://www.english-online.org.uk/

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: AEC204-1C
Course Name: Corporate Communication in English
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Ability Enhance Course.

Prerequisite: Zeal to learn the subject.

Rationale: At the end of the course, this paper teaches students the skills in the front desk Management. It introduces them to business English.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
SECTION - A		
1	**English for front desk management** 1. Greeting, Welcoming 2. Dealing with complaints, giving instructions or directions 3. Giving information: About Various Facilities, Distance, Area, Local Specialties, 4. Consultation and Solution of Problems 5. Accepting Praises and Criticism, Apologizing	8
2	**Fluency and etiquette** 1. Polite sentences and Words 2. Use of Persuading words 3. Intonation and Voice Modulation 4. Developing Vocabulary	7

SECTION – B		
3	**Business speeches** 1. Principles of Effective Speech and Presentations 2. Speeches: Introduction, Vote of Thanks, Occasional Speech, Theme Speech 3. Use of Audio- Visual Aids in Presentations	7
4	**Cross-cultural communication** 1. Dealing with Language Differences 2. Probing Questions to get information 3. Etiquette in Cross-cultural Communication	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**20**	**15**	**15**	**15**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. U. Rai and S.M. Rai, *Effective Documentation & Presentation*, Himalaya Publishing house, Mumbai, 2009.

Reference Books:

1. J. V. Vilanilam. *More Effective Communication: A Manual for Professionals*, Sage Publications, New Delhi, 2000.
2. R S N Pillai & Bagavathi, *Modern Commercial Correspondence*,, S Chand & Co, 2008.
3. Reuben Ray, *Communication Today*, Himalaya Publishing House, Mumbai, 2015.
4. Raymond *Lesikar*, *Business Communication: Making Connections in a Digital World*, 11th Edition, AITBS – Publishers Delhi, 2017.
5. Sushil Bahl, *Business Communication Today*, New Delhi: Response Books, *1996.*
6. Ron Ludlow, Fergus Panton, *The Essence of Effective Communication*, Prentice Hall, New York, 1992.

7. Pradhan, Bhende & Thakur, *Business Communication*, 5th Edition, Himalaya Publishing House, 2008.
8. N Krishnaswamy, Lalitha Krishnaswamy, *Mastering Communication Skills and Soft Skills*, Bloomsbury, New Delhi, 2015.
9. Krishna Mohan, Meera Banerji, *Developing Communication Skills*, Macmillan India Limited, 2000

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Recollect day to day communication at different places.	20%
CO-2	Express your thoughts and views to others.	15%
CO-3	Develop public speaking skills.	15%
CO-4	Distinguish between general communication and corporate communication.	20%
CO-5	Organize speech so one can easily understand.	10%
CO-6	Convince other to work together in corporate world.	20%

List of Open-Source Software/learning website:

- http://www.english-online.org.uk/

B.Sc. (Hons.) - Biotechnology
Semester-II
Course Code: VAC201-1C
Course Name: Human Values and Ethics
(As per NEP-2020)

w.e.f.: July-2023

Type of course: Value Added Courses

Prerequisite: None. Basics of universal human values (desirable)

Rationale: At the end of the course, it facilitate the development of a holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the human reality and the rest of existence.

Teaching and Examination Scheme:

Credits				Examination Marks		Total Marks
L	T	P	Total	CCE Marks	SSE Marks	
2	-	-	2	25	25	50

Content

Sr. No.	Content	Total Hours
	SECTION - A	
1	**Introduction to value education** Understanding value education, self-exploration as the process for value education, continuous happiness and prosperity–the basic human aspirations, right understanding, relationship and physical facility, happiness and prosperity-current scenario, method to fulfil the basic human aspirations.	**7**
2	**Harmony in the self**	**8**

	Understanding human being as the coexistence of the self and the body, distinguishing between the needs of the self and the body, the body as an instrument of the self, understanding harmony in the self, harmony of the self with the body, programme to ensure self-regulation and health	
SECTION - B		
3	**Harmony in the family & society** Harmony in the family- the basic unit of human interaction, values in human-to-human relationship, trust' - the foundational value in relationship, 'respect' – as the right evaluation. Understanding harmony in the society: resolution, prosperity, fearlessness (trust) and co-existence as comprehensive human goals, visualizing a universal harmonious order in society.	**8**
4	**Harmony in the nature/ existence** Understanding harmony in the nature, interconnectedness, self-regulation and mutual fulfilment among the four orders of nature, realizing existence as co-existence at all levels, the holistic perception of harmony in existence.	**7**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**25**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. R. R Gaur, R. Asthana, G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, ISBN 978-93-87034-47-1, 2019.

2. R. R. Gaur, R. Asthana, G. P. Bagaria, *Teachers' Manual for A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, ISBN 978-93-87034-53-2, 2019.
3. R. R. Gaur, R. Sangal, G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics"- Presenting a universal approach to value education through self-exploration*, 2nd Revised Edition, Anurag Jain for Excel BookExcel Books, New Delhi, ISBN 978-93- 87034-47-1, 2019.

Reference Books:

1. A. Nagraj, *Jeevan Vidya* - An *Introduction*, word press, 1997.
2. S. S. Wamanrao Pai, *Jeevan Vidya's Guidance to Students*, 3rd edition, Jeevanvidya Mission, 2001.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Relate themselves with the surroundings	20%
CO-2	Explain sustainable solutions with respect to problems, keeping in mind the correlation between human relationships and human nature.	20%
CO-3	Apply what they have learnt, into various day to day schedule	15%
CO-4	Distinguish between ethical and unethical practices and start working out the strategy in order to materialize a harmonious environment in the work place	15%
CO-5	Justify their commitment with respect to their understanding regarding human values, relationship and society.	15%
CO-6	Develop understanding of intricacy of the problem and design appropriate solution.	15%

List of Open-Source Software/learning website:

- https://www.uhv.org.in
- https://gyansanchay.csjmu.ac.in/wp-content/uploads/2022/09/UHVE-2.0-Class-Notes- Part-1-of-4-1.pdf
- https://www.scribd.com/document/563303468/UHVE-2-0-Class-Notes-Part-3-of-4
- https://atmiyauni.ac.in/public/file/HVPE%20Text%20Book.pdf
- https://vvce.ac.in/wp-content/uploads/2021/04/Realising-Aspirations-of-NEP2020- UHV.pdf
- https://www.youtube.com/watch?v=9RsiuDJzVD8&list=PLJAQaaJgEtI2Cz3bz5pnqn 5kLE03GaRbW
- https://jeevanvidya.org/wp-content/downloads/PDF/Jeevanvidyas-guidance-to-students.pdf