UPL University of Sustainable Technology

SRICT Institute of Science & Research

B.Sc (Hons) – MICROBIOLOGY

B.Sc. SEM I

Teaching/Exam Scheme

(As per NEP-2020)

w.e.f.: August-23

Course Code	Title of the Paper	Duration in Hrs.		Credit	Max. Marks CCE	Max. Marks SEE	Total Marks
		Theory	Practical				
MIM200-1C	Introduction to Microbiology	45	30	4	50	50	100
MIM201-1C	Microbial Techniques	45	30	4	50	50	100
MIE200-1C	Analytical Chemistry for Microbiologist	45	30	4	50	50	100
MDCXXX-1C	MDCXXX-1C	As per the subject selected		4	50	50	100
AECXXX-1C	AECXXX-1C			2	25	25	50
SECXXX-1C	SECXXX-1C			2	25	25	50
VACXXX-1C	VACXXX-1C			2	25	25	50
	Total	270	120	22	275	275	550

- CCE - Continuous and Comprehensive Evaluation.
- SEE – Semester End Evaluation.

Multi-Disciplinary Courses	1. MDC200-1C: Natural Hazards 2. MDC201-1C: Basics of Biology 3. MDC202-1C: Multivariable Calculus
Ability Enhance Course	1. AEC200-1C: Functional Grammar and Composition. 2. AEC201-1C: Practical English
Skill Enhancement Courses	1. SEC200-1C: Personality Development 2. SEC201-1C: Time Management 3. SEC202-1C: Public Speaking

Value Added Courses	1. VAC200-1C: Basics of Indian Knowledge System-I(IKS)

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIM200-1C

Course Name: Introduction to Microbiology

Semester: I

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of basic biology, bacteria and other micro-organisms.

Rationale: At the end of the course, students will have knowledge about microbiology, microscope, staining techniques and methods to control microorganisms.

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	**History of microbiology** Scope of microbiology, Development of microbiology as a discipline, spontaneous generation vs biogenesis, spontaneous generation controversy, contribution of renowned scientists in the field of microbiology	7
2	**Classification of micro-organisms** Concept of classification and position of microorganisms in the living world. kingdom classification of microorganisms, definition of	8

	microorganisms, microbial classification, nomenclature, identification: numerical and genetic- based taxonomy, introduction to Bergey's manual, major groups of microorganisms, distribution of microorganisms in nature, applied areas of microbiology	
3	**Cytology of microorganisms** Bacteria: major cell morphologies, cell size and significance of smallness, surface area to volume ratio and its significance, basic structure of bacterial cell, structure and functions of cell wall of Gram positive and Gram negative bacteria, capsule, slime layers, flagella, pili, fimbrae, ribosome, nucleoid, cytoplasmic inclusions and endospore, mesosome, plasmid, fungi and its types, protozoa and its types, algae and its types	8
SECTION - B		
4	**Acellular microorganisms** Characteristic features of viruses, prions and bacteriophage, ultrastructure of phage, types and structure of viral genomes, animal and plant viruses, cultivation of viruses and bacteriophage, replication of bacterial viruses: lytic and lysogeny cycle of λ phage.	8
5	**Microbes in extreme environment** Nature, cell walls of archaea, special features of the thermophilic, methanogenic and halophilic archaea; photosynthetic bacteria, cyanobacteria; some archaea which live in extreme conditions like cold, and space.	4
6	**Applied microbiology** Beneficial microbes: bio-fertilizers, microbial bioremediation, role of microbes in nature, antibiotics producing microbes and other industrially useful microbes [name of the industrially useful product and producing microbes]. Pathogenic Micro-organisms: list of common bacterial, fungal and viral diseases of human beings [Name of the disease, causative pathogen, parts affected], Applied areas of microbiology: medical, agricultural, soil, veterinary, food, dairy, industrial, space microbiology	7

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. D.K. Maheshwari , R.C. Dubey, *A Textbook of Microbiology*, reprint 1st edition, S. Chand Publishing, 1999.

2. M. J. Pelczar , E.C.S. Chan & N.R. Kreig, *Microbiology* 5th ed., Tata McGraw-Hill, 2012.

3. P.S. Verma, V.K. Agarwal, *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, Edition illustrated, reprint, S. Chand Publishing, 2022.

Reference Books:

1. H.A. Modi, *A Handbook of Elementary Microbiology*, 1st edition, Shanti Prakashan, 2019.
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, Science, 2000.
4. J.M. Willey, L.M. Sherwood and C.J. Woolverton, *Prescott's Microbiology*, 10th Edition McGraw – Hill Education, 2017.

List of Practicals: (Online & Offline)

1. Study of basic instrumentations used in microbiology.
2. Microscopic examination of living microorganisms: Hay infusion by wet mount technique
3. Simple staining (positive staining).
4. Microscopic examination of microorganism- algae
5. Gram's staining to differentiate between Gram positive and Gram negative bacteria

6. Contribution of various scientists in microbiology: Robert Koch, Louis Pasteur, Edward Jenner, Antony Van Leeuwenhoek, Joseph Lister, Alexander Fleming.
7. Study of bacteria from permanent/temporary microscopic slides

Practicals to be performed through virtual mode

8. To study the different parts of a compound microscope. https://amrita.olabs.edu.in/?sub=79&brch=17&sim=436&cnt=1
9. Study the morphology of representative types of bacteria, fungi and different plant groups. https://amrita.olabs.edu.in/?sub=79&brch=17&sim=447&cnt=1
10. Demonstration of Winodgradsky column experiment. LAb stimulation#8 - Lab Stimulation Purpose: The Virtual Winogradsky column, can be used to explore - Studocu

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the scope, development and contribution of renowned scientists	20%
CO-2	Describe the microbial classification and applied aspects of microbiology field	15%
CO-3	Explain the morphology and organelles of bacteria and other microorganisms	15%
CO-4	Identify as well as describe various viruses, its culturing and replication	20%
CO-5	Summarize the archea bacteria and photosynthetic cyanobacteria	15%
CO-6	Outline various applications in microbiology	15%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- National Programme on Technology Enhanced Learning https://www.youtube.com/user/nptelhrd

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIM201-1C

Course Name: Microbial Techniques

Semester: I

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Major Course.

Prerequisite: Should have fundamental knowledge of microbes and its structure.

Rationale: At the end of the course, students are expected to gain knowledge about the media preparation, its sterilization, microscopy and staining process of microbes and basic knowledge about centrifugation as well as spectroscopy.

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	**Concept of Sterilization** Definition of sterilization, dry and moist heat, pasteurization, tyndallization; radiation, ultrasonication, filtration. Physical and chemical methods of sterilization; disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient of disinfectant.	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), Maintenance and preservation of pure culture, Cultivation of anaerobic bacteria.	
3	**Microscopy** Structure of simple and compound microscope, concept of magnification, resolution and contrast in microscopy, Introduction to microscope, principle, types and application of bright field microscope, dark field microscope, phase contrast microscope, fluorescence microscope, confocal microscope, scanning and transmission electron microscope	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	**Spectroscopy and centrifugation** Beer-Lambert law and its application, single and double beam spectrophotometer, colorimeter and UV-visible spectrophotometer, centrifuge	7
6	**Pasteurization and fermentation** Introduction to pasteurization, techniques, types and industrial application of pasteurization, fermentation: definitions of fermentation, types of fermentation: ethanol and lactic acids, industrial fermentation, solid state fermentation, submerged fermentation: applications of fermentation.	7

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. D. K. Maheshwari , R.C. Dubey, *A Textbook of Microbiology*, reprint 1st edition, S. Chand Publishing, 1999.
2. M. J. Pelczar, E.C.S. Chan, N. Krieg, *Microbiology - Concepts and Applications*, International ed, McGraw Hill., 1993.

Reference Books:

1. D. L. Nelson, and M. M. Cox, *Lehninger Principles of Biochemistry*, 5th edition Elsevier Publ. 2000.
2. J. M. Willey, L.M. Sherwood and C.J. Woolverton, *Prescott's Microbiology*, 10th Edition McGraw – Hill Education, 2017.
3. M. T. Medigan, *Brock Biology of Microorganisms*, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7), 2015.

List of Practicals: (Online & Offline)

1. Demonstration of autoclaving process
2. Comparison of different disinfectants
3. Preparation of solid and liquid media.
4. Endospore staining of bacteria
5. Isolation of pure culture of bacteria.
6. MIC calculation using given experimental data (experiment not to be performed, data can be hypothetical)
7. Making of spread plate and streak plate of bacteria

Practicals to be performed through virtual mode

8. Prepare a smear slide. https://www.learnsci.com/resources/prepare-a-smear-slide
9. Demonstration of working of UV-Visible spectrophotometer https://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1
10. Capsule staining of bacteria. https://vlab.amrita.edu/?sub=3&brch=73&sim=1338&cnt=1

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the pasteurization and various sterilization processes in microbiology	20%
CO-2	Outline the good lab practices in microbiology laboratory and have the understanding to obtain pure culture of bacteria	15%
CO-3	Explain various aspects of observing microorganisms by microscopic techniques	15%
CO-4	Describe the mechanism of differential stains and various other stains	20%
CO-5	Paraphrase the basics of Beer Lambert law, spectrophotometer and centrifuge for separation of molecules	10%
CO-6	Discuss the pasteurization and different types of fermentation techniques	10%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- National Programme on Technology Enhanced Learning https://www.youtube.com/user/nptelhrd

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIE200-1C

Course Name: Analytical Chemistry for Microbiologist

Semester: I

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MD-C204-1C

Course Name: Natural Hazards

Semester: I

(As per NEP-2020)

w.e.f.: August 2023

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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MDC201-1C

Course Name: Basics of Biology

Semester: I

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MDC202-1C

Course Name: Multivariable Calculus

Semester: I

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Multidisciplinary Course.

Prerequisite: Should have fundamental knowledge of calculus.

Rationale: At the end of the course, students will have knowledge about problem solving skill, creative talent and translate information into mathematical form using appropriate mathematical formula and techniques.

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	**D'Movier's Theorem and its applications** D' Moivre's theorem and its applications, Trigonometric functions for multiple arguments.	6
2	**Indeterminate forms** L'Hospital's Rule, Indeterminate Forms: $\frac{0}{0}, \frac{\infty}{\infty}, \infty * 0, \infty - \infty, 1^{\infty}, 0^{0}, \infty^{\infty}$.	6
3	**Improper integrals**	8

	Improper Integrals, Improper Integrals of 1st kind, Improper Integrals of the 2nd kind	
	SECTION - B	
4	**Partial derivatives** Functions of two or more variables, Limit and continuity of functions of several variables, Partial Derivatives, Higher order Partial Derivatives, Total Derivatives, Implicit Differentiation, Euler's Theorem	8
5	**Applications of partial derivatives** Tangent Plane and Normal to a surface, Linear approximation or Linearization, Maximum and Minimum Values by 2nd Derivative Test, Method of Lagrangian Multipliers, Jacobians.	9
6	**Multiple integrals** Double Integrals over Rectangle, Change of Order of Integration, Double Integration in Polar Coordinates.	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)

Reference Books:

1. R. R. Singh, *Calculus*, McGraw Hill Education (INDIA) Private Limited, 2018.
2. Shantinarayan, *Integral Calculus*, S.Chandand Co. New Delhi.
3. M. R. Spiegel, Theory and Problems Calculus, Schaum's publishing Co. New York.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Examine exponential Trigonometry and hyperbolic function	10%
CO-2	Solve Indeterminate Forms	20%
CO-3	Explain types of improper integrals	10%
CO-4	Classify the types of Second order Linear Partial Differential Equation.	20%
CO-5	Evaluate equation of tangent plane, Normal line	20%
CO-6	Calculate the area using Double integrals.	20%

List of Open-Source Software/learning website:

- https://www.mathplanet.com/education/algebra-1
- https://ocw.mit.edu/courses/mathematics/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: AEC200-1C

Course Name: Functional Grammar and Composition

Semester: I

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: AEC201-1C

Course Name: Practical English

Semester: I

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: SEC200-1C

Course Name: Personality Development

Semester: I/II

(As per NEP-2020)

w.e.f.: August 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/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: SEC202-1C

Course Name: Public Speaking

Semester: I/II

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: SEC201-1C

Course Name: Time Management

Semester: I/II

(As per NEP-2020)

w.e.f.: August 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**	7

	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	
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
4	**Approach and Application of Time Management** The efficiency approach, the effective approach, the excellence approach and 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: VAC200-1C

Course Name: Basics of Indian Knowledge System-I (IKS)

Semester: I

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

B.Sc (Hons) – MICROBIOLOGY

B.Sc. SEM II

Teaching/Exam Scheme

(As per NEP-2020)

w.e.f.: August-23

Course Code	Title of the Paper	Duration in Hrs.		Credit	Max. Marks CCE	Max. Marks SEE	Total Marks
		Theory	Practical				
MIM202-1C	Biomolecules	45	30	4	50	50	100
MIM203-1C	Microbial physiology and Metabolism	45	30	4	50	50	100
MIE201-1C	Basic chemistry for Biologists	45	30	4	50	50	100
MDCXXX-1C	MDCXXX-1C	As per the subject selected		4	50	50	100
AECXXX-1C	AECXXX-1C			4	50	50	100
SECXXX-1C	SECXXX-1C			2	25	25	50
VACXXX-1C	VACXXX-1C			2	25	25	50
	Total	270	120	22	275	275	550

- CCE - Continuous and Comprehensive Evaluation.
- SEE – Semester End Evaluation.

Multi-Disciplinary Courses	1. MDC203-1C: Nanotechnology: Fundamentals and Applications 2. MDC204-1C: Biochemistry 3. MDC205-1C: Numerical Analysis
Skill Enhancement Courses	1. SEC200-1C: Personality Development 2. SEC201-1C: Time Management 3. SEC202-1C: Public Speaking
Ability Enhance Course	1. AEC203-1C: Creative Writing Essential 2. AEC204-1C: Corporate Communication in English
Value Added Courses	1. VAC201-1C: Human Values and Ethics

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIM202-1C

Course Name: Biomolecules

Semester: II

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of cell and basic chemistry concepts

Rationale: At the end of the course, students are expected to have fundamental knowledge in macromolecules like proteins, carbohydrates, lipids, vitamins and enzymes.

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	**Carbohydrates as macromolecules** Definition, classification, structure and properties, carbohydrates metabolism: glycolysis, Kreb's cycle, electron transport chain (ETC)-chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, fermentation, pentose phosphate pathway (PPP), gluconeogenesis, bioenergetics, High energy compounds : classification, structure and significance, ATP as energy currency	8
2	**Amino acids and proteins**	7

	Classification, structure and properties of amino acids, structure and classification of proteins: primary, secondary, tertiary, quaternary structure of proteins, salient features, α helix, β sheet, β turn, tertiary and quaternary - human hemoglobin as an example. Forces involved in protein folding, denaturation	
3	**Nucleic acids** Definition of nucleic acids, its structures, purines, pyrimidines, double helical structure of DNA, types of DNA: A, B, Z. Physico-chemical properties of DNA, RNA and its types: rRNA, mRNA, tRNA.	7
SECTION - B		
4	**Lipids and fats** Definition, classification, structure, properties and importance of lipids, fatty acids: types and classification, beta oxidation of fatty acids, significance of ketone bodies	8
5	**Enzymes** Definition of enzymes, nomenclature & classification of enzymes, cofactors, coenzymes, specificity of enzymes, mechanism of its action, inhibition types, factors affecting enzymes	7
6	**Vitamins** Introduction to vitamins: water soluble and fat soluble and its significance and diseases associated with it.	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. J. L. Jain, S. Jain, N. Jain, *Fundamentals of Biochemistry*, 7th edition S. Chand Publishing, 2004.
2. U Satyanarayana, *Biochemistry*, 4th Edition, revised, Elsevier Health Sciences, 2013.

Reference Books:

1. M.L.A. Nelson, David L. (David Lee), 1942-. *Lehninger Principles of Biochemistry*, 4th edition, New York: W.H. Freeman, 2005.
2. D. Voet, J.G. Voet, *Biochemistry*, 4th Edition, Wiley, Hoboken., 2010
3. L. Stryer, *Biochemistry*, 4th Edition, W. H. Freeman and Company, New York, 1995
4. Rodwell, Victor W., Robert K. Murray, Rodwell VW, Bender DA, Botham KM, Kennelly PJ, Weil P. Rodwell V.W., & Bender D.A., & Botham K.M., & Kennelly P.J., & Weil P(Eds.), *Harper's Illustrated Biochemistry*, 31st edition, McGraw Hill / Medical ,2018.
5. T. Bonner P. L. R., *Enzymes: biochemistry biotechnology and clinical chemistry* (2nd ed.). Woodhead Publishing, 2007

List of Practicals: (Online & Offline)

1. Demonstration of pH meter
2. Detection of carbohydrates
3. Detection of amino acids by ninhydrin method
4. Detection of glucose by Benedict’s test
5. Detection and estimation of salivary amylase
6. Demonstration of spectrophotometer
7. Effect of temperature on enzyme kinetics

Practicals to be performed through virtual mode

8. Biochemical identification of bacteria; catalase https://vlab.amrita.edu/?sub=3&brch=73&sim=703&cnt=1
9. Biochemical identification of bacteria; coagulase https://vlab.amrita.edu/?sub=3&brch=73&sim=703&cnt=1
10. Structure of the nucleic acid: DNA

https://biomanbio.com/HTML5GamesandLabs/LifeChemgames/dna-structure-model-page.html

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Summarize the structure and metabolic pathways of carbohydrate in the cell	20%
CO-2	List the types, properties of amino acid and structure of proteins as well its denaturation	15%
CO-3	Describe the structure, types and function of DNA and RNA	15%
CO-4	Explain the classification, structure and properties of fatty acids and β-oxidation of fatty acids and ketone bodies	20%
CO-5	Illustrate the types, mechanism of enzyme and its action, factors affecting the enzyme, cofactors and coenzymes	15%
CO-6	Summarize the fat soluble and water soluble vitamins, its importance and diseases associated with it.	15%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- Biochemistry - Biology LibreTexts
- Biochemistry - Course (nptel.ac.in)

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIM203-1C

Course Name: Microbial physiology and Metabolism

Semester: II

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Major Course

Prerequisite: Should have fundamental knowledge of basic biology, bacteria and other micro-organisms.

Rationale: At the end of the course, students will have knowledge about growth of bacteria and its effect of temperature, pH etc, transport systems, autotrophic and lithotrophic bacteria, carbon and nitrogen metabolism and anaerobic respiration.

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	**Microbial growth and effect of environment on microbial growth** Introduction to bacterial growth, definitions of growth, batch culture, continuous culture, generation time and specific growth rate, effect of temperature and pH ranges of growth in bacteria, effect of solute and water activity on growth, effect of oxygen on growth, microorganisms on the basis of nutrition. Mathematical expression of bacterial growth.	7
2	**Nutrient uptake and transport**	8

	Definition of nutrients, macronutrients and micronutrients, Introduction to transport: active, passive and facilitated diffusion, primary and secondary active transport; concept of uniport, symport and antiport; group translocation, iron uptake.	
3	**Phototropy and autotropy** Phototrophic metabolism: Introduction, groups of phototrophic microorganisms, photosynthetic and accessory pigments, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria, lithotrophy.	8
SECTION - B		
4	**Carbon catabolism** Sugar degradation pathways: glycolysis, ED, pentose phosphate pathway, TCA cycle, electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors.	8
5	**Nitrogen metabolism** An overview of nitrogen cycle, biological nitrogen fixation, nitrification, nitrate reduction, denitrification, and anammox.	6
6	**Anaerobic respiration** Introduction to respiration: aerobic and anaerobic respiration, types of anaerobic respiration.	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. J. L. Jain, S. Jain, N. Jain, *Fundamentals of Biochemistry*, 7th edition S. Chand Publishing, 2004.
2. U. Satyanarayana, *Biochemistry*, 4th edition, revised, Elsevier Health Sciences, 2013.
3. M. J. Pelczar, E.C.S. Chan, N. Krieg, *Microbiology - Concepts and Applications*, International ed, McGraw Hill., 1993.

Reference Books:

1. M.L.A. Nelson, L. David, 1942-, *Lehninger Principles of Biochemistry*, 4th edition, New York: W.H. Freeman, 2005.
2. L. Stryer, J. Berg, J. Tymoczko, G. Gatto, *Biochemistry*, 9th Edition Macmillan Learning, 2019.

List of Practicals: (Online & Offline)

1. Study and plot the growth curve of E. coli by turbidometric method
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Biochemical identification of bacteria: catalase, oxidase.
4. Preparation of buffer
5. Effect of pH on bacterial growth
6. Effect of temperature on bacterial growth
7. Calculation of generation time and specific growth rate of bacteria.

Practicals to be performed through virtual mode

8. Biochemical identification of bacteria; catalase
   https://vlab.amrita.edu/?sub=3&brch=73&sim=703&cnt=1
9. Biochemical identification of bacteria; coagulase
   https://vlab.amrita.edu/?sub=3&brch=73&sim=703&cnt=1
10. Antibiotic susceptibility test
    http://mvi-au.vlabs.ac.in/micro-biology-1/Antibiotic_Susceptibility_Testing/

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Illustrate the microbial growth and its effects on various parameters as well as mathematical expression of bacterial growth	20%
CO-2	List various types of transporters for nutrients intake	15%
CO-3	Summarize the concept related to autotrophy, pigments and lithotrophy	15%
CO-4	Paraphrase the basics of catabolism of carbon like glycolysis, kreb's cycle, electron transport chain and uncouplers.	20%
CO-5	Discuss the nitrogen metabolic pathways like nitrogen cycle and nitrogen fixation.	10%
CO-6	Outline aerobic and anaerobic respiration in microbial world	10%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- National Programme on Technology Enhanced Learning https://www.youtube.com/user/nptelhrd

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MIE201-1C

Course Name: Basic Chemistry for Biologists

Semester: II

(As per NEP-2020)

w.e.f.: August 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
	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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MDC203-1C

Course Name: Nano Technology: Fundamentals and Applications

Semester: II

(As per NEP-2020)

w.e.f.: August 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

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MDC204-1C

Course Name: Biochemistry

Semester: II

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Multidisciplinary course

Prerequisite: Should have fundamental knowledge of basic biology, cell and its organelles.

Rationale: At the end of the course, students will gain knowledge about basic molecules like carbohydrates, amino acids, proteins, lipids, vitamins, enzymes.

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	**Basic biochemical concepts** 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. Water: structure and properties of water molecule, water as an universal solvent, First and second laws of thermodynamics, concept of enthalpy, entropy, free energy change, standard free energy	8

	change, equilibrium constant and spontaneous reactions and coupled reactions	
2	**Carbohydrates as macromolecules** Definition, classification, structure and properties. Carbohydrates metabolism: glycolysis, Kreb's Cycle, electron transport chain (ETC)-chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, fermentation, pentose phosphate pathway (PPP), gluconeogenesis, bioenergetics: high energy compounds: classification, structure and significance, ATP as energy currency	8
3	**Amino acids and proteins** Definition, structure, classification and properties of amino acids, structure and classification of proteins: primary, secondary, tertiary, quaternary structure of proteins, salient features, α helix, β sheet, β turn, tertiary and quaternary - human hemoglobin as an example. Forces involved in protein folding, denaturation of proteins.	7
SECTION - B		
4	**Nucleic acids** Nucleic acids structures, purines pyrimidines, double helical structure of DNA, Types of DNA: A, B, Z. Physico-chemical properties of DNA, RNA types: rRNA, mRNA, tRNA.	7
5	**Lipids and fats** Definition, classification, structure, properties and importance of lipids; fatty acids: types and classification, beta oxidation of fatty acids, significance of ketone bodies, Porphyrins: definition, structure, properties and importance of chlorophyll, cytochromes and hemoglobin.	8
6	**Enzymes and vitamins** Nomenclature & classification of enzymes, cofactors, coenzymes, specificity of enzymes, mechanism of its action, inhibition types, factors affecting enzymes, vitamins: water soluble and fat soluble and its significance and diseases associated with it.	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. J.L Jain. *Biochemistry*, 7th edition S. Chand Publishing, 2004.
2. U. Satyanarayana, *Biochemistry*, 4th Edition, revised, Elsevier Health Sciences, 2013.

Reference Books:

1. M.L.A. Nelson, David L. (David Lee), *1942-*. *Lehninger Principles of Biochemistry*, 4th edition, New York: W.H. Freeman, 2005.
2. D. Voet, J.G Voet,, *Biochemistry*, 4th Edition, Wiley, Hoboken., 2010.
3. L. Stryer, *Biochemistry*, 4th Edition, W. H. Freeman and Company, New York, 1995.
4. W. Rodwell, K. Victor, M. Robert. V.W. Rodwell, D.A. Bender, K.M. Botham, P.J. Kennelly, *Harper's Illustrated Biochemistry*, 31st edition, McGraw Hill / Medical, 2018.
5. T. Palmer, and P. L. R. Bonner, *Enzymes: biochemistry biotechnology and clinical chemistry*, 2nd Edition, Woodhead Publishing, 2007.

List of Practicals: (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.

Practicals to be performed through virtual mode

8. 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
9. Estimation of saponification value of fats/oils.

   https://vlab.amrita.edu/?sub=3&brch=63&sim=688&cnt=2

10. 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	Summarize the basic concepts used in biological chemistry.	20%
CO-2	Describe the structure and metabolic pathways of carbohydrates.	15%
CO-3	Illustrate the properties of amino acids, alpha helix and beta sheet proteins' structure and function with hemoglobin as example.	15%
CO-4	Discuss the role and structure of hereditary materials like DNA and RNA.	20%
CO-5	Outline the structure and function of lipids and porphyrins.	10%
CO-6	Tabulate the vitamins and concepts of enzymatic studies and factors associated with it.	10%

List of Open-Source Software/learning website:

- MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
- National Programme on Technology Enhanced Learning https://www.youtube.com/user/nptelhrd

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: MDC205-1C

Course Name: Numerical Analysis

Semester: II

(As per NEP-2020)

w.e.f.: August 2023

Type of course: Multidisciplinary course

Prerequisite: Should have Calculate the Numerical scheme.

Rationale: At the end of the course, students will have knowledge about Properties of, Error estimation, Numerical solution of Algebraic and Transcendental Equations, Numerical Differentiation and Numerical Integration.

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	Error estimation: Errors and their computations, A general error formula.	6
2	Numerical solution of Algebraic and Transcendental Equations: Bisection Method, Iteration Method, Regula falsi Method and Secant Method, Newton-Raphson Method.	8
3	Forward Difference, Backward Difference, Central Difference, Newton's Forward and Backward Formulae.	8
SECTION - B		

4	Finite difference with unequal interval, Langrage's Interpolation Formula, Divided Differences, Newton's General Interpolation Formula.	8
5	Numerical Differentiation: 1st and 2nd order Derivatives based on Newton's forward and backward difference interpolation formula.	8
6	Numerical Integration: General Integration formula, Trapezoidal rule, Simpson's 1/3-Rule, Simpson's 3/8-Rule.	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)

Reference Books:

1. S. S. Sastry, *Introduction methods of Numerical an Analysis*, 4th Edition, Prentice-Hall of India Pvt.Ltd.
2. M. K Jain, lyenger, Jatin, *Numerical Methods for Scientific and Engineering Computations*, New Age International Ltd. 2012.
3. Goel, Mittal, *Numerical Analysis*, McGraw Hill Book Co, London, 2020.

Course Outcomes:

After completing this course, student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Classify error estimation and their computations	20%
CO-2	Solve the numerical solution of algebraic and transcendental equations	15%
CO-3	Calculate the interpolation with equal intervals by newton's forward and backward formulae.	15%

CO-4	Evaluate interpolation with unequal intervals by lagrange's interpolation formulas.	20%
CO-5	Examine numerical differentiation based on interpolation formulas.	10%
CO-6	Explain numerical integration and general formula of integration.	20%

List of Open-Source Software/learning website:

- https://www.mathplanet.com/education/algebra-1
- https://ocw.mit.edu/courses/mathematics/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: AEC203-1C

Course Name: Creative Writing Essential

Semester: II

(As per NEP-2020)

w.e.f.: August 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/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: AEC204-1C

Course Name: Corporate Communication in English

Semester: II

(As per NEP-2020)

w.e.f.: August 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/

UPL University of Sustainable Technology

SRICT Institute of Science & Research

Bachelor of Science (Hons) - Microbiology

Course Code: VAC201-1C

Course Name: Human Values and Ethics

Semester: II

(As per NEP-2020)

w.e.f.: August 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=PLJAQaaJgEtI2Cz3bz5pnqn5kLE03GaRbW
- https://jeevanvidya.org/wp-content/downloads/PDF/Jeevanvidyas-guidance-to-students.pdf