

SANKALCHAND PATEL UNIVERSITY
VISNAGAR

Faculty of Science and Humanities



Structure, Teaching Scheme and Syllabus of
Bachelor of Science (Microbiology)

Program Code: SC102

With effect from: 2023-24

Semester- I

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Fundamental of Microbiology
Course Code:	11-MIM201-1C
Pre-requisite Course:	

Course Objectives:

- To understand the importance of microbiology and microorganisms in the living world.
- To study the major cell organelles of microorganisms
- Students will learn the historical perspectives associated with the subject of microbiology.
- Students will learn the fundamental aspects of Staining, Microscopy, Isolation, Pure Culture & Preservation Techniques.
- This course will make the student familiar with basic microbiological techniques and processes that will help them understand the prokaryotic processes in a much better way.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Total Hours	Weightage
1	History of Microbiology: • Introduction to Microbiology and applied fields of Microbiology • Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. • Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W Beijerinck, Sergei Winogradsky, Selman A Waksman, Paul Ehrlich, EleiMetnikoff, Edward Jenner, • Role of microorganisms in fermentation (Germ Theory of Fermentation), Germ theory of disease	15	33%
2	Prokaryotic Cell Organization • Shape, size, and arrangement of bacterial cell Structure of bacterial cell • Surface appendages of bacteria: General nature, arrangement, structure and role of flagella, General nature, and significance of pili, prosthecae and stalks • Surface layers of bacteria: General nature and significance of capsule and slime layer, cell wall, cell membrane and Mesosomes • Bacterial cytoplasm and cell organelles: Cytoplasm, cytoplasmic inclusions, nuclear material • Bacterial endospore : Spore structure, sporulation and spore germination	15	33%
3	Isolation, Pure Culture and Preservation Techniques for Microorganisms Isolation of Bacteria:	15	34%

	• Definitions of Terms: Isolation, Pure Culture, Axenic Culture, Colony, Clone • Methods for isolation and Cultivation of Bacteria (aerobic and anaerobic) Preservation of Microorganisms and Culture collection centers: Principles of Staining Techniques & Microscopy Types of Stains & Staining techniques: • Dyes & Stains, • Role of Primary Stains, Counter Stains, Mordants, Decolorizers, Accentuators with suitable examples. • Simple, Differential (Grams' Staining & Acid-Fast Staining), Negative, Structural staining techniques (Spore, Capsule, Flagella, Cell Wall, Metachromatic Granules, etc.) • Principles of Microscopy: Magnification and resolution ,simple& compound, Bright field.		
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Microbiology Practicals :

1. Safety precautions to work in Microbiology Laboratory
2. Preparation of Culture Media: Solid & Liquid
3. Isolation of Bacteria by Streak Plate Method (using Direct & Sector Streaking Methods)
4. Pour Plate Technique for Quantitative Bacteriological Analysis of Given Samples
5. Microscopic observation of bacteria for Morphological characters by Simple (Monochrome & Negative) Staining
6. Differential Staining Technique: Grams' Staining
7. Preservation of Bacterial Cultures

Text Books:

1. Dubey, R. C. and D. K. Maheshwari (2000). "General Microbiology". S. Chand Publications, New Delhi.
2. Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). "Microbiology" 5th Edition, Tata McGraw Hill Publishing co. Ltd., New Delhi.
3. H.A.Modi "Elementary Microbiology"

Reference books:

1. Prescott, M. J., Harley, J.P. and D.A. Klein (2002). "Microbiology", 5th Edition, WCB McGrawHill, New York.
2. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
3. Atlas, R.M. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
4. Patel, R. J. "Experimental Microbiology Volume-1 & 2" Aditya publication, Gujarat (2016)

List of Open-Source Software/learning website:

<http://ecoursesonline.iasri.res.in/course/resources.php?id=419>
<https://www.coursera.org>
<https://onlinecourses.nptel.ac.in>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn the multifaceted existence of microorganisms.	1 Remember 2 Understand 3 Apply
CLO2	Discuss various cell organelle and its role	2 Understand 3 Apply 4 Analyze 5 Evaluate
CLO3	Learn about the discovery of microbial world and basics of microscopy which can be applied for visualizing microbes.	1 Remember 2 Understand 3 Apply
CLO4	Gain awareness regarding the development of pure culture and preservation techniques of microbes	1 Remember 2 Understand 3 Apply
CLO5	Gain understanding regarding dyes and stains Students will learn the theory and technique of staining bacteria.	1 Remember 2 Understand 3 Apply
CLO6	Able to identify, judge and conclude the morphological characters of bacteria using various staining techniques and microscope.	1 Remember 2 Understand 3 Apply 4 Analyze 5 Evaluate

Mapping of CLO s with Pos & PSOs

Course Learning Outcomes	Programme Outcomes (Pos)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1			1				1								3	1
CLO2	1	2			1												3	2
CLO3	1	3			2												3	3
CLO4	1	3			2												3	3
CLO5	1	2	1		3	2											3	3
CLO6	1	3	1	1	3	3			3				1				3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Basics of Microbiology
Course Code:	11-MIM202-1C
Pre-requisite Course:	Basics Biology up to 12 th Science.

Course Objectives:

- To introduce various microorganisms, present in the ecosystem and acquaint with Common equipment used in routine microbiology laboratory.
- To provide knowledge of the classification and grouping of living organisms are dealt with. The students will come to know of the classification of microorganisms.
- To provide the students with the different methods of sterilization and disinfection that are required in the field of microbiology.
- It deals with methods using physical means such as moist heat, dry heat, filtration, radiation etc and chemical means. Further, desirable properties of antimicrobial agents, different classes of antimicrobials and their mode of action are also covered in this course.
- The practical laboratory exercises are designed to give the basic safety and handling protocol in a microbiology laboratory; hands on training on staining techniques, sterilization and disinfection principles and practice; Enumeration and isolation techniques of bacteria and fungi.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	-	25	100

Subject Contents:

Unit	Content	Total Hours	Weightage
1	Introduction to Bacterial Taxonomy and Nomenclature - Basic principles of Bacterial Taxonomy & Nomenclature: concept of species, taxa, type strain. - Introduction to different systems of Bacterial classification & Nomenclature - Methods for the Classification of Microorganisms: Intuitive Method, Numerical Taxonomy, Genetic Methods for the Classification of Microorganisms (DNA Homology Experiment & 16S rRNA Oligonucleotide Cataloguing Method) - Introduction to Bergey's Manual of Systematic Bacteriology The Past, Present & Future Status of Bacterial Classification & Nomenclature	15	33%
2	Principles of Microbial Control -1 - General principles: Control by killing, inhibition and removal - Definition of Terms: Bactericidal, Bacteriostatic, MIC, MLD, LD50, Chemotherapy, Antibiotic, Growth Factor Analogue - Characteristics of an Ideal Antimicrobial Agent. Antibiotics: - Antibiotics that Inhibit Cell wall synthesis: β-Lactam Group of	15	33%

	Antibiotics (Penicillin, Cephalosporin) • Antibiotics that Inhibit Protein synthesis: (Streptomycin, Tetracyclines, Chloramphenicol) • Antibiotics that Effect cell membrane • Antibiotics that interferes with Nucleic acid • Growth Factor Analogues: Mode of Action of Sulfa Drugs		
3	Principles of Microbial Control – 2 • Definition of Terms: Sterilization, Disinfection, Antisepsis. • Principles and methods of sterilization Physical: Hot Air Oven, Pressure Cooker, Autoclave, Laminar Air Flow • Chemical: Alcohol, Aldehyde, Phenol, Halogen, Hypochlorite, Fumigants, Surfactants, Dyes, Heavy Metals & Gaseous Sterilizing Agents. • Phenol coefficient Method • Radiation methods: UV rays, gamma rays, ultrasonic methods • Physical agents of microbial control : Osmotic Pressure, Filtration(HEPA filters)	15	34%

List of experiments

1. Techniques for Cultivation of Microorganisms
2. Study of pigmented bacteria: *S. aureus*, *S. epidermidis*, *M. luteus*, *S. marcescens*, *P. aeruginosa*
3. Study of bacterial structure by structural staining: Spore, Capsule, Cell Wall
4. Special staining: Spirochete by Fontana's method
5. Effect of temperature and pH on growth of bacteria
6. Study of effect (Bacteriostatic & Bactericidal) of chemicals on bacterial growth: heavy metals, phenol, mercuric chloride, crystal violet, antibiotics by different methods: paper disc method, agar ditch method, agar cup method.
7. Morphological and biochemical characteristics of selected bacterial genera: *Escherichia*, *Bacillus*, *Pseudomonas*, etc.

Text Books:

Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). "Microbiology" 5th Edition, Tata McGraw Hill Publishing co. Ltd., New Delhi.

Presscott, M. J., Harley, J.P. and D.A. Klein (2002). "Microbiology", 5th Edition, WCB McGrawHill, New York.

Reference books:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Stanier, RY, Ingram "General Microbiology"
3. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
4. Presscott, M. J., Harley, J.P. and D.A. Klein (2002). "Microbiology", 5th Edition, WCB McGrawHill, New York.
5. Atlas, R.M. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
6. Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). "Microbiology" 5th Edition, Tata McGraw Hill Publishing co. Ltd., New Delhi.
7. Dubey, R. C. and D. K. Maheshwari (2000). "General Microbiology". S. Chand Publications, New Delhi.
8. J.G. Black. (2005). "Microbiology: Principles and Explorations" John Wiley, USA.
9. Schlegel, H.G. (2010) General Microbiology, Wiley Publications.
10. Patel, R. J. "Experimental Microbiology Volume-1 & 2" Aditya publication, Gujarat (2016)

List of Open Source Software/learning website:

<http://ecoursesonline.iasri.res.in/course/resources.php?id=419>
https://onlinecourses.swayam2.ac.in/cec19_bt04
<https://archive.nptel.ac.in/courses/113/106/113106064/>
<https://www.digimat.in/nptel/courses/video/102104063/L12.html>
https://onlinecourses.nptel.ac.in/noc20_bt03/preview
<https://www.coursera.org>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	List the various rules of nomenclature and classification of bacteria, methods of control of microbes and antimicrobial agents	1 Remember
CLO2	Learn basic techniques to identify the bacteria and appropriate antimicrobial agent for the organism	1 Remember 2 Understand
CLO3	knowledge of the classification and grouping of living organisms which to judge and categorize the novel microbes	2 Understand 3 Apply 4 Analyse
CLO4	Learn to formulate bacteriological media for cultivation of different kind of microorganisms.	1 Remember 3 Apply
CLO5	Acquire knowledge on how to control microorganisms and their growth by using a variety of physical, chemical and gaseous sterilizing agents.	3 Apply 4 Analyse
CLO6	The basic knowledge role of antibiotics and various antimicrobial agent which would allow compare and design novel antimicrobial agents.	3 Apply 4 Analyse 5 Evaluate 6 Create

Mapping of CLOs with Pos & PSOs

Course Learning Outcomes	Programme Outcomes (Pos)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1				3	1											1	1
CLO2	2				3	1											2	1
CLO3	3				3	2											3	2
CLO4	1		2		2	2											3	3
CLO5	3	2			3	3											3	1
CLO6	3	3	3		3	3											3	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Cell Biology
Course Code:	11-BIE201-1C
Pre-requisite Course:	Basics Biotechnology up to 12 th Science.

Course Objectives:

- To understand intra and inter-cellular organization, structure and functions of different organelles of cells.
- To understand the basics of cellular organelles.
- To understand the functions and their significance in living systems.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	Eukaryotic cell structure: The cell envelope (boundary layer): cell wall, cell membrane (Structure of Plasma membrane: Fluid Mosaic Model and Various Models, Functions of Cell Membrane: Transport of small molecules, Endocytosis and exocytosis) Cell communication (cell matrix interactions/Cell-Cell Interactions – adhesion junctions, tight junctions, gap junctions, and plasmodesmata) Endoplasmic Reticulum – Structure and function Golgi Apparatus: Structure (Organization) and functions Structure and function of Lysosomes, micro bodies (Glyoxysome and Peroxisome), Mitochondria, Chloroplasts	18	40%
2	Nucleus: Structure, function Chromosome: Size, shape, types and basic structure of chromosome, euchromatin and heterochromatin, karyotyping, Chromatin – Molecular organization Giant Chromosome: Polytene chromosome and lamp brush chromosome Nucleolus Cell cycle: Cell cycle and its regulation Mitosis and meiosis	12	30%
3	Introduction to Biotechnology: Branches of biotechnology/ Domains of biotechnology Applications and future prospectus of biotechnology in various fields Biotechnology in India: (i) Exams (ii) schemes- i.e. IBTP, JRF etc. (iii) Major research labs across country Cell: classification of organisms by cell structure & Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic Prokaryotic cell structure: Morphology of Bacterial cell: Size, shape and arrangement of bacterial cells External cell Structures: Flagella, cell wall Internal cell structures: Mesosome, inclusion bodies Dormant forms: Spores and cyst	15	30%

Text Books: Elementary Microbiology by H. A. Modi (Unit-1)

Cell Biology by Verma & Agrawal (Unit-2 &3)

Reference Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Powar C. B. 1983 Cell Biology, Himalaya Publishing House, Mumbai, India

List of Open Source Software/learning website:

<https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-bt17/>
<https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-bt18/>
<https://archive.nptel.ac.in/courses/102/103/102103091/>
<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==>

List of Experiments:

1. Cell division in onion root tip/ insect gonads. (Preparation & study of permanent slides showing different stages of cell division – Meiosis and Mitosis)
2. Staining techniques: Simple-Monochrome and Negative Differential- Grams and Acid Fast Special-Capsule, Spore, Cell wall, Granule, Nucleus, Spirochetes
5. Localization of Barr Body
6. Study of Bacterial Motility
7. Study of Salivary Gland chromosome of Dipterian Larva-Drosophila or Chironomas Spp.
8. Micrometry: Measurement of given biological sample.
9. Study of the Microscope : Basic components of microscope and their working principle

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the structure of cell and classification of cell.	2 Understanding
CLO2	List the applications of Biotechnology in different area of research in science.	1 Remembering
CLO3	Acquire fundamentals and translate the knowledge that will enable them for cell-based research.	2 Understanding,
CLO4	Learn basic techniques to identify and interpret Protein synthesis and transporting in the cell.	2 Understanding 3 Applying
CLO5	Learn about membrane transport, evaluate diseases associated with them, identify, and compare the exocytosis and endocytosis in the cell.	3 Applying, 4 Analyze 5 Evaluate,
CLO6	Discuss the mechanisms involved in mitosis and meiosis.	6 Creating

Mapping of CLOs with Pos & PSOs

Course Learning Outcomes	Programme Outcomes (Pos)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1	1		1	1											1	1
CLO2	1	3	1		1	1									2		3	3
CLO3	1	3	1		2	2			2						1		3	3
CLO4	2	3	1		3	3			3								3	3
CLO5	2	3	3		3	3			3						3		3	3
CLO6	3	3	3		3	3			3								1	1

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Title:	Fundamentals of Botany
Course Code:	11-BIE202-1C
Pre-requisite Course:	Fundamentals of biology I

Course Objectives:

- Develop understanding on the concept of microbial nutrition.
- Classify viruses based on their characteristics and structures.
- Develop critical understanding of plant diseases and their remediation.
- Examine the general characteristics of bacteria and their cell reproduction/ recombination.
- Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance.
- Conduct experiments using skills appropriate to subdivisions.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Course Contents:

Unit	Topic	Total Hours	Weightage
1	Viruses and Bacteria Plant Viruses: Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), RNA virus (TMV). • General characteristics of Bacteria; Cell structure- Salient features; Types of Bacteria based on flagella, Nutritional types (Brief explanation with suitable example). • Reproduction: Vegetative, Asexual and Recombination (conjugation, transformation and transduction). • Economic importance of Bacteria with reference to their role in agriculture, fermentation and medicine.	11	25%
2	Algae General characteristics of algae, occurrence, and range of thallus organization (included types); Classification system of Fritsch (included types up to family). • Cell structure and components: cell wall, pigment system, reserve food. • Reproduction in algae: Vegetative and Asexual methods. • Role of algae in the environment, agriculture, biotechnology and industry.	11	25%
3	Cyanophyta and Chlorophyta General characters of Cyanophyta and Chlorophyta. • Cell structure and components of Chlamydomonas. • Life history of Nostoc with reference to: • Systematic position with reasons up to family	11	25%

	- Habit and Habitat, Vegetative structure and Reproduction - Life history of Oedogonium with reference to: - Systematic position with reasons up to family - Habit and Habitat, Vegetative structure and Reproduction		
4	Phaeophyta and Rhodophyta - General characteristics of Phaeophyta and Rhodophyta. - Life cycle types: Haplontic, Diplontic and Haplodiplontic. - Life history of Ectocarpus with reference to: - Systematic position with reasons up to family - Habit and Habitat, Vegetative structure and Reproduction - Life history of Batrachospermum with reference to: - Systematic position with reasons up to family - Habit and Habitat, Vegetative structure and Reproduction	12	25%

Reference Books:

- Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
- Wiley JM, Sherwood LM and Woolverton CJ. (2013). Prescott's Microbiology. 9th Edition. McGrawHill International.
- Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
- Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
- Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
- Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi

List of Experiments:

- To study viruses using electron micrographs/Models/charts: TMV.
- To study bacteria using electron micrographs/Models/charts: Types of Bacteria based on flagella.
- To study cell structure of Chlamydomonas through chart/permanent slide.
- To study the Life history of Nostoc through:
 - Mountings – Thallus and Reproductive structure
 - Permanent Slides of – Thallus and Reproductive structure (Heterocyst)
- To study the Life history of Oedogonium through:
 - Mountings – Thallus and Reproductive structure
 - Permanent Slides of – Thallus, Cap cell, sex organ – oogonium
- To study the Life history of Ectocarpus through:
 - Mountings – Thallus and Reproductive structure
 - Permanent Slides of – Thallus, Unilocular and plurilocular sporangia
- To study the Life history of Batrachospermum through:
 - Mountings – Thallus and Reproductive structure
 - Permanent Slides of – Thallus and cystocarp

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the structure and reproduction of bacteria virus	2 Understanding
CLO2	List general characteristics of virus , bacteria and Algae.	1 Remembering
CLO3	Acquire fundamentals and translate the knowledge that will enable them for cell-based research.	2 Understanding,
CLO4	To study the life history of various types of virus, bacteria and algae	3 Applying, 2 Understanding
CLO5	Identify and compare various algae on the basis of its characteristic and reproduction.	3Applying,, 4 Analyze 5. Evaluate,
CLO6	Discuss the mechanism involved in reproduction of various akaryotic, prokaryotic and eukaryotic.	6 Creating

Mapping of CLOs with Pos & PSOs

Course Learning Outcomes	Programme Outcomes (Pos)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1			1	1							1				1	3
CLO2	1	3			1	1							1				2	2
CLO3	1	3		2	3	3							3				2	1
CLO4	1	2			3								1				3	3
CLO5	3	3		1	2	2							2				2	2
CLO6	3	3		3	3	3							3				1	1

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Biodiversity
Course Code:	11-BIE204-1C
Pre-requisite Course:	Basics Biotechnology up to 12 th Science.

Course Objectives:

- Get a deep knowledge on biodiversity richness in global scale and biogeography of India.
- Assess the value of biodiversity wealth of our Nation.
- Analyze various threats to our biodiversity and able to suggest measures for conservation Strategies.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	Introduction- Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. Bio-geographic classification of India. Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation, current practice in conservation, conservation of genetic diversity, conservation of species diversity, conservation of ecosystem diversity, relevance of ecosystem diversity as well as services in conservation	15	30%
2	Value of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information. Biodiversity and ecosystem functioning. Biodiversity and stability of ecosystem functioning. Biodiversity at global, national and local levels India as a Mega Diversity Nation. Hotspots of Biodiversity: Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka.	18	40%
3	Threats to Biodiversity- Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Manwildlife conflicts. Endangered and endemic species of India, common plant species, common animal species.	12	30%

Text Books: An, S., & Verhoeven, J. T. (Eds.). (2019). Wetlands: Ecosystem Services, Restoration and Wise Use (Vol. 238). Springer

Reference Books:

- Carina Hoorn, Allison Perrigo, Alexandre Antonelli (2018). Mountains, Climate and Biodiversity John Wiley and Sons Ltd ,Oxford,UK.
- Copsey, J. A., Black, S. A., Groombridge, J. J., & Jones, C. G. (Eds.). (2018). Species Conservation: Lessons from Islands. Cambridge University Press.
- Krishnamoorthy, K.V (2004) An Advanced text book on Biodiversity- principles and Practice: Oxford and IBH publishing company Pvt. Ltd. New Delhi.

List of Open Source Software/learning website:

<https://nptel.ac.in/courses/129105008>

<https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07FvIArQ==>

List of Experiments:

1. Field Survey for studying plant species diversity
2. Ex-situ conservation of plant species using in vitro technique
3. Micropropagation of an endangered plant species
4. Green pod (embryo culture) culture of orchid

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the Genetic Diversity.	2 Understanding
CLO2	List the current practice in conservation.	1 Remembering
CLO3	Acquire fundamentals and translate the knowledge that will enable them for understanding of overexploitation.	2 Understanding,
CLO4	Learn Habitat loss to identify and interpret overexploitation as threats of biodiversity.	3 Applying, 2 Understanding
CLO5	Learn about Extinction, evaluate ecosystem degradation associated with them, identify and compare the increase and decrease of Human factors for it.	3 Applying,, 4 Analyze 5. Evaluate,
CLO6	Discuss the mechanisms involved in ecosystem diversity.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	2																
CLO2	2	1												1				
CLO3	2	3																
CLO4	1	3			3	2							3					
CLO5	3	3																
CLO6	3	3			2									3				

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Cyber Security-I
Course Code:	11-MDC223-1C
Pre-requisite Course:	Basics of computer

Course Objectives:

- Graduates will have solid basics in Mathematics, Programming, Computer Network, Network Security, Cyber Security fundamentals and advancements to solve technical problems.
- Graduates will have the capability to apply their knowledge and skills acquired to solve the issues in real world network and cyber security areas and to develop feasible and reliable systems to prevent and protect systems from security attack.
- Graduates will have exposure to emerging cutting-edge technologies and excellent training in the field of Computer network, Network security and cyber security related issues.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	Fundamentals of Cyber security Defining cyberspace and overview of computer and web-technology, architecture of cyberspace, communication and web technology, internet, world wide web, advent of internet, internet infrastructure for data transfer and governance, internet society, regulation of cyberspace, concept of cyber security, issues and challenges of cybersecurity.	15	33%
2	Cyber-crime and Cyber Laws Classification of cyber-crimes, common cyber-crimes- cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, cyber criminals modus-operandi, reporting of cyber-crimes, remedial and mitigation measures, legal perspective of cyber-crime, IT act 2000 and its amendments, cyber-crime and offences, organisations dealing with cyber-crime and cyber security in India, case studies	15	33%
3	Social Media Overview and Security Introduction to Social networks. Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of Social media, Case studies.	15	34%

Reference Books:

1. “Cyber Security (with CD): Understanding Cyber Crimes, Computer Forensics and Legal Perspectives” by Nina Godbole, SunitBelapure.
2. “Cyber Laws & Information Technology” by Dr.Jyoti Rattan
3. Cyber Crimes & laws by Taxman and Technology decoded by N.S.Nappani.
4. AviSilberschatz, Greg Gagne, and Peter Baer Galvin Operating System Concepts John Wiley & Sons, Inc.
5. Computer Forensics: Computer Crime Scene Investigation by John R. Vacca.
6. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

List of Open-Source Software/learning website:

1. <https://swayam.gov.in>
2. <https://nptel.ac.in>
3. https://en.wikipedia.org/wiki/Main_Page

• List of Experiments:

Sr. No	Experiments
1	Study of steps to protect your personal computer system by creating user accounts with passwords and types of user accounts for safety and security.
2	Study the steps to protect a Microsoft word document of different version with different operating system. Study “How to make strong passwords” and “passwords cracking techniques”
3	Study the steps to remove passwords from Microsoft word and various methods of protecting and securing databases.
4	Checklist for reporting cyber-crime at cyber-crime police station. Checklist for reporting cyber-crime online. Reporting phishing emails. Demonstration of email phishing attack and preventive measures.
5	Basic checklist, privacy and security settings for popular social media platforms. Reporting and redressal mechanism for violations and misuse of social media platforms.
5	Evidence collection from running computer, imaging of an evidence, and image analysis using different tools.
6	Windows registry analysis, analysis of windows artifacts, analysis of USB devices different password cracking and steganography techniques
7	Basic checklist, privacy and security settings for popular social media platforms. Reporting and redressal mechanism for violations and misuse of social media platforms.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the broad set of technical, social & political aspects of Cyber Security.	2 Understanding
CLO2	Appreciate the vulnerabilities and threats posed by criminals, terrorist and nation states on national infrastructure.	2 Understanding
CLO3	Understand the importance of ethical hacking tool.	2 Understanding
CLO4	Implementing ethical hacking tools in an organization.	3 Applying
CLO5	Apply security principles to system design.	3 Applying
CLO6	Apply methods for authentication, access control, intrusion detection and prevention and conduct research in Cyber Security	3 Applying 4 Analysing

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1	1		2				1	2						2		
CLO2		2				2					1	1			1			
CLO3			1						1	2						2		
CLO4		1	2			1		2	2				1		2			
CLO5	2	1			2	1	2	3							1			
CLO6	2				1	1	3	2	2						1			

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Title:	Reaction of Organic Chemistry-I
Course Code:	11-MDC224-1C
Pre-requisite Course:	Basic Chemistry up to 12 Sciences

Course Objectives:

- The capacity to job effectively and safely in a laboratory environment.
- Opportunities for student and faculty to interact with alumni and with professional chemists.
- To develop the fundamental analytical and industrial skills to work effectively in the different fields of chemistry.
- To develop idea for the new way of green synthesis.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Course Contents:

Unit	Topic	Total Hours	Weightage
1	INTRODUCTION OF GREEN CHEMISTRY What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ by products; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so.	15	33%
2	STRUCTURE AND PROPERTIES Factors affecting to the properties of organic molecule Intramolecular forces (dipole-dipole interaction, vanderwaals forces), Electromeric effect, Inductive effect, Resonance effect (draw resonating structures of Nitro benzene, Chlorobenzene, Phenoxide ion, Anillinium ion, Acetate ion), Hyperconjugation (o,p-directing effect of Alkylgroup, Stability of Carbonium ion and Free radicals).	15	34%
3	NAME REACTIONS AND MECHANISM Aldol Condensation, Baeyer-Villiger Oxidation, Benzoin Condensation, Birch Reduction, Claisen Condensation, Claisen Rearrangement, Cope Elimination, Curtius Rearrangement, Dakin Reaction, Favorskii Reaction, Hofmann Elimination, Pinacol Rearrangement.	15	33%

Text Books:

1. Textbook of Chemistry paper -101, Nirav Publication

Reference Books:

Organic Chemistry

1. Organic reaction and mechanism, P.S.Kalsi, New Age international Publishers.
2. Reaction mechanism in Organic Chemistry, S.M.Mukhergi, S.P.Singh. 3rd edn, Macmillan.

3. Reaction Mechanism and Reagents in Organic Chemistry, Gurdeep R. Chatwal 4th edn, Himalaya Publication House.

4. Text book of Organic Chemistry, Arun Bahal, S. Chand.

Green Chemistry

1 A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).

2 M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).

List of Open-Source Software/learning website:

1. <https://swayam.gov.in>
2. <https://nptel.ac.in>
3. <http://onlinelibrary.wiley.com>
4. https://en.wikipedia.org/wiki/Main_Page

List of Experiments:

Sr.No	Practical Exercise
1.	Demonstrations Preparation of standard stock solution by w/v method and their different dilutions. Preparation of standard stock solution of HCl by v/v method and their different dilutions. (Any 5 solution preparation)
2.	Melting point and Boiling point of an organic compound. Identify the types of organic compound. (Any 10 compounds)

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understanding the different effects in organic compounds	2 Understanding
CLO2	Understand the resonance effect in organic chemistry	2 Understanding
CLO3	Use and explain of reaction mechanism	3 Applying 2 Understanding
CLO4	Understand the name reaction and their application	2 Understanding 3 Applying
CLO5	Explain basics of the green chemistry.	2 Understanding
CLO6	To prepare standard solution.	3 Applying

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)																PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2
CLO1	1		2															
CLO2		2					2											
CLO3					1													
CLO4													1					
CLO5				1														
CLO6																		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Basic English-1
Course Code:	11-AEC201-1C
Pre-requisite Course:	Basics English Grammar and Composition up to 12 th Science.

Course Objectives:

- To create an interest in literature and to develop language skills.
- To acquaint students with communication skills.
- To inculcate human values among the students through poems and prose.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	--	--	2	25	25	--	--	50

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	VOCABULARY & GRAMMAR LINK Irregular Verbs' meanings with past and past participle forms, Words often Confused, Punctuation and Capitalization, Abbreviations, Affirmative, Apostrophe 'S', Negative Sentence, Idioms and Phrases.	9	30%
2	SPEAKING Public Speaking: (Teacher has to give Tips to the students about How to deliver speech in front of public) Speeches: Google: a new Guru to the World, Smart Phone/Internet: Use & Misuse, Global Warming, Today's Youth, Movies: good & bad impact on Society (or more than these topics)	6	20%
3	READING & WRITING Translate the Accident/Incident Paragraphs given by your teacher from the English News Papers (Teacher has to give small paragraphs at least 5 to 6 paragraphs or more than that for the entire semester based on especially from the pages no. 3 & 4 of The Times of India)	6	20%
4	TEXT Fantasy a collection of short stories edited by V Sasikumar (Orient Black Swan) Lesson 1 to 5	9	30%

Text Books:

1. Fantasy a collection of short stories edited by V Sasikumar (Orient Black Swan)
2. Easy to learn English grammar by Dr. Jayesh Patel

Reference Books:

1. Very Useful Verbs book (Enka Publication)
2. Contemporary English Grammar Structure & Composition
3. Murphy R. Intermediate English Grammar (New Delhi: Cambridge University)
4. The Art of Public Speaking by Vijay Kumar.
5. The Times of India/The Indian Express
6. Business Correspondence and Report Writing by R.C Sharma & Krishna Mohan.

List of Open Source Software/learning website:

1. englishpage.com
2. epaper.timesofindia.com
3. epaperindianexpress.com
4. <https://www.youtube.com/watch?v=QdAgyD4xhY>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe the factors that influence use of grammar and vocabulary in speech and writing	1 Remembering
CLO2	Use punctuation, capitalization and spelling rules appropriately.	3 Applying
CLO3	Find the meanings of words using context clues.	1 Remembering
CLO4	Use correct verb forms in all tenses effectively.	3 Applying
CLO5	Explain sentences using collocation words.	2 Understanding
CLO6	Use appropriate note-taking styles for reading and listening texts.	3 Applying

Mapping of CLOs with Pos& PSOs

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2					3					2					3		
CLO2		1			2		1			3		1			2			
CLO3			3					2					2			2		
CLO4		2					2					2						
CLO5					2					2					2			
CLO6	1					1					1					2		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Yoga and Meditation
Course Code:	11-IKS101-1C
Pre-requisite Course:	

Course Objectives:

- To understand the basic concept of Sectional Breathing.
- To understand the concept of Pranava Manta.
- To be able to understand the Mental, Emotional, Physical, Social and Spiritual Health .

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
--	-	4	2	--	--	25	25	50

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	Breathing Practices and Pranayama • Sectional Breathing(Abdominal, Thoracic and Clavicular) • Yogic Deep Breathing • Concept of Puraka, Rechaka, and Kumbhaka • Concept of Bandha and Mudra • Anulmoa Viloma/Nadi Shodhana • Shitali, Bhramari Key Words: Sectional Breathing, Deep Breathing, Bandha & Mudra, Shitali, Bhramari.	30	50%
2	Practices Leading to Meditation • Recitation of Pranava Manta • Recitation of Hymns, In Vocations and Prayers • Anter Maun • Breath Meditation • Om Dhyana Key Words: Pranav Mantra, Antermaun, Breath meditation, Om Dhyana.	30	50%

Reference Books:

- 1) Singh S.P & Yogi Mukesh: Foundation of Yoga, Standard Publication, New Delhi, 2010
- 2) Sarswati, Swami Satyanand : Asana, Pranayama, Mudra, Bandha (APMB), Yoga Publication Trust, Munger, 2013
- 3) Ishwar Bhardwaj: Saral Yogasana, satyam Publishing House, New Delhi, 2018.

List of Open Source Software/learning website:

1. <https://sahayji.com/hathayoga-course>
2. <https://theyogagainstitute.org/>
3. www.rishikeshnathyogshala.com

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Tally Accounting
Course Code:	11-SEC201-1C
Pre-requisite Course:	

Course Objectives:

- To understand the basic concept of Radius of curvature.
- To understand the concept of Function.
- To be able to understand the linear differential equations and its application.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	-	-	50

Subject Contents:

Unit	Topic	Total Hours	Weightage
1	Introduction to GST • What is GST? • Dual GST • GST Council • Advantages of GST • Types of GST • GST Rate Computerized Accounting System • Advantages of computerized accounting system. • Tallysan Accounting Software • Features of TallySoftware • Starting Tally software, Gateway of Tally ,Button Toolbar • Creating a Company • Ledger and Groups • Opening an existing company • Shutting an Opened company • Exiting Tally software	15	50%
2	Voucher Entry • Concept of Voucher • Activate Voucher Entry screen • Types of Vouchers- Purchase, Sales, Payment ,Receipt, Contra, Journal, DebitNoteand Credit Note • Editingand Deletinglettingvoucher entry Reports • Ledger,TrialBalance,Profitand Lossstatement,BalanceSheet • RatioAnalysis,Cashand FundFlowstatement • DayBook,BankBook • Purchase-SalesandjournalRegister	15	50%

Reference Books:

- Tally.ERP 9withGST inSimpleStepsbyDT EditorialServices
- LearnTallyPrimeWith GSTBook byGaurav Agrawal

List of Open Source Software/learning website:

- <https://www.youtube.com/watch?v=HOLVBWEAxmE>
- <https://www.youtube.com/watch?v=wU4q99qG9NE>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Describe GST.	1 Remembering
CLO2	Discuss types of GST.	2 Understanding
CLO3	Use Tally as Accounting Software.	3 Applying
CLO4	Explain Editing and Deleting voucher entry.	4 Analysing
CLO5	Prioritize Advantages of GST.	5 Evaluating
CLO6	Create Profit and Loss statement.	3 Applying

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1		1			1		1								1			
CLO2	1	1			1		1											
CLO3		1			1				1	1			2					
CLO4	1			1			1											
CLO5		1			1		1								1			
CLO6	1		1	1			2	1			1		1					

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Personality Development
Course Code:	11-SEC202-1C
Pre-requisite Course:	

Course Objective:

- To increase Self-Awareness, Personal Development, and Life Skills.
- To inculcate Leadership qualities and Communication skills.
- To nurture Social Justice and Responsibility in the students.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	--	--	2	25	25	--	--	50

Subject Contents:

Unit	Content	Total Hours	Weightage
1	Introduction to Personality Development: The concept of personality - Dimensions of personality – Theories of Freud & Erickson-Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analysis Attitude & Motivation Attitude: Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages –Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation.	15	50%
2	Self-esteem: Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low self esteem - Positive and negative self esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviors - Lateral thinking. Other Aspects of Personality Development: Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette.	15	50%

Reference Books:

- Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
- Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behaviour 16th Edition: Prentice Hall.
- Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi.Tata McGraw-Hill 1988.
- Heller, Robert. Effective leadership. Essential Manager series. Dk Publishing, 2002.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn various theories of personality development	1 Remember
CLO2	Basically, understand the factors responsible for decision making and practice efficient decision making ability	2 Understand 3 Apply
CLO3	Apply the major personality domains and theories to better understand one's own behaviour and the behaviour of others, which helps in development of motivation and leadership ability	3 Apply
CLO4	Analyze the determinants of personality characteristics to better understand their effects on cognitions, emotions, and behavior.	4 Analyze
CLO5	Think critically about and apply theoretical and research-based explanations for human behavior in order to successfully negotiate the challenges of daily living.	5 Evaluate
CLO6	The Student would understand diversity to be one of the greatest assets to any community. Fueling the collective creativity and ingenuity, of diverse society which will create an energy of possibility as to negotiate and make positive change.	2 Understand 6 Create

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1			1	1	1													
CLO2		1		1			1			1								
CLO3		2		1			1		1									
CLO4		1		1														
CLO5	1	1	1		1	1		1		1								
CLO6		1		1			1											

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Title:	Application of Microbiology
Course Code:	11-SEC205-1C
Pre-requisite Course:	Basic Science

Course Objective:

- To identify and classify Microbes.
- Understanding various classification scheme with details of five kingdom concept
- Knowing application and scope of microbiology in various fields

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	--	--	2	25	25	--	--	50

Subject Content

Unit	Content	Total Hours	Weightage
1	Introduction to Microbiology • Taxonomic approach of Microbiology • Major group of Microbiology • Classification of microbes (three kingdom and five kingdom concept) Application of microbiology in various field • Applications of Microbiology in the field of drinking water • Applications of Microbiology in the field of wastewater and waste management • Applications of Microbiology in the field of agriculture.	15	50%
2	Application of microbiology in various field (cont.) • Applications of Microbiology in the field of medicines • Applications of Microbiology in the field of Dairy & Food Industries • Role of microbiology in public health. • Role of microbes in Immunology and medical microbiology. • Role of microbes in Bioleaching, Aeromicrobiology & Exomicrobiology • Role of microbes in Fermentation Industries (Production of Antibiotics, Organic Acids, Enzymes & Other Specialty Biochemicals)	15	50%

Text Books: Elementary Microbiology Vol.-1 by H.A.Modi

Reference book:

1. Microbiology by M.J.Pelczar, ECS Chan & NR Krieg
2. Principles of Microbiology by R.M. Atlas
3. Microbiology by Prescott, Harley & Klein
4. Textbook of Microbiology by R.C.Dubey & D.K.Maheshwari

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Enlist microbes used in different areas of microbiology	1 Remember
CLO2	Taxonomically classify various microbes according to their characteristic	1 Remembering 2 Understanding 3 Applying
CLO3	Study the application of microbes in medical and pharmaceutical Microbiology	1 Remembering 2 Understanding 3 Applying
CLO4	Describe the methods used using microbes in the field of agriculture microbiology and food industries.	1 Remembering 2 Understanding 3 Applying
CLO5	The ways and types of microbes used in environmental Microbiology	1 Remembering 2 Understanding 3 Applying
CLO6	To study the use of microbes in space research and exomicrobiology	1 Remembering 2 Understanding 3 Applying

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	1			1	1											1	1
CLO2	1	1			1	2											2	
CLO3	2	1			1	3												3
CLO4	3	2	2		1	3											2	3
CLO5	3	3			2	3								3			2	3
CLO6	3	3	1		3	3								3				3

3: High, 2: Medium, 1: Low