



C. U. SHAH UNIVERSITY

FACULTY OF SCIENCES

BACHELOR OF SCIENCE (MICROBIOLOGY)

DEPARTMENT OF ARTS & HUMANITIES

SEMESTER: I

CODE: 4SC01FEN1

NAME: Functional English I

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester								
						Theory				Practical				Total marks
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Internal		University		
						Marks	Hrs	Marks	Hrs	Pr	TW	Pr		
4SC01FEN1	Functional English I	2	2	0	4	30	1	70	3	---	20	30	150	

Objectives:

- To train students in/for basic fundamentals skills of Communication – LSRW in English
- To provide them the value education for better society
- To make them able to communicate well in the Professional world

Prerequisites:

- i) Students should have basic knowledge of English Language and grammar.
- ii) Students should have ability to speak and write correct sentences in their day to day language.
- iii) Students should be familiar with correct usage of language.

Course outline:

Sr. No.	Course Content (Title of the Unit) Part-A	Minimum Number of Hours
0	Prerequisites	02
1	Basic Concepts of Grammar – Parts of Speech	06
2	Determiners	04
3	Basic Sentence Pattern in English	01
4	Modal Auxiliaries	04
5	Tenses	06



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6	Reading Skill	04
7	Speaking Skill	08
8	Listening Skill	04
9	Leave Report Writing	03
	Part-B Literature	
10	Prose	18

Total Hours (Theory): 30 Total Hours (Lab) : 30 Total Hours : 60

Detail Course Content of different above mention topics:

Unit No.	Content In details including Its Sub Topics Part-A LSRW Skills
1	Basic Concepts of Grammar – Parts Of Speech
	<ul style="list-style-type: none"> • Noun • Pronoun • Verb • Adverb • Adjective • Preposition • Conjunction • Interjection
2	Determiners
	Articles : A, An, The Indefinite Pronouns
3	Basic Sentence Pattern in English Language
4	Modal Auxiliaries
	Simple Auxiliaries: Be, Do, Have, Modals: Shall, Will, Should, Would, Can, Could, May, Might, Must, Ought to, Need, Dare to, Used to
5	Tenses
	<ul style="list-style-type: none"> • Simple Present, Simple Past, Simple Future, Present Continuous, Past Continuous, Future Continuous, Present Perfect, Past Perfect, Future Perfect, Present Perfect Continuous
6	Listening Skill
	<ul style="list-style-type: none"> • Students will watch and listen selected videos and after that either they will discuss what about the watched video and can be asked question on the basis of videos • Video based teaching (Educational Movies will be shown to the students



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	during the semester)
7	Speaking Skill Students will speak on the following situations: Talking about Present, Past & Future, Meeting & Greeting People, Talking about Time, Describe the things around you
8	Reading Skill Selected text will be read and various aspects of the texts will be discussed on the basis of students' understanding.
9	Writing Skill Leave Report writing
	Part-B Literature
10	Selected Stories from "Wise and Otherwise" by Sudha Murthy 1) A Lesson in Life from a Beggar 2) Death without Grief 3) Idealists at Twenty Realists at Forty 4) Think Positive, Be Happy 5) Crisis of Confidence 6) Sorry, The line is Busy 7) Oh Teacher, I Salute Thee 8) Life is an Examination

Resources:

- Wise and Otherwise, Sudha Murthy, Penguin Books India Pvt. Ltd. Delhi
- An Intermediate English Grammar, Raymond Murphy, Cambridge University Press
- A High School English Grammar, Wren & Martin, S. Chand Publication

Reference Reading:

Note: To develop the LSRW skills of the students, it is suggested the following texts should be read as reference books.

- Tagore Rabindranath, Selected Short Stories of Tagore
- Short Stories of R. K. Narayana
- Small articles from daily newspaper: The Indian Express & The Times of India
- Readers Digest, an English Magazine



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FACULTY OF SCIENCES BACHELOR OF SCIENCE (MICROBIOLOGY)

SEMESTER: I

CODE: 4SC01EVS1

NAME: Environmental science (THEORY)

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester							
						Theory				Practical			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Internal		Univ	
						Marks	Hrs	Marks	Hrs	Pr	TW	Pr	
4SC01EVS1	Environmental Science	3	0	0	3	30	1	70	3	---	----	-----	100

Objectives: -

The primary objective of this course is to make people aware of the importance of environment on health of every individual and the society as a whole.

Prerequisites:- Basic understanding of concepts related to environment and awareness about the harmful effects of pollution are required to understand the concept better.

Course outline:

Sr. No.	Course contents	Teaching Hours
1	The Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness.	02
2	Environment Concept: Introduction, concept of biosphere – lithosphere, hydrosphere, atmosphere; Biogeochemical cycle.	10
3	Principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.	06
4	Natural Resources: Renewable and non-renewable resources • Natural resources and associated problems.	06
5	Environmental Pollution Causes, effects and control measures of:- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution & Nuclear hazards	12
6	Conservation of Environment: The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems – soil, water, air, wildlife, forests.	04
7	Biodiversity :	05



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What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.	
Total Hours	45

Learning Outcomes:-

The course provides knowledge regarding conservation of environment which is very crucial in the present day scenario.

Teaching & Learning Methodology:-

Use of multimedia, Field trip, student interaction, group discussion, seminar, quizzes, assignment, brain storming session, expert talks.

Books Recommended:

1. **Masters, G.M.**, “Introduction to Environmental Engineering and Science”, Prentice – Hall of India Pvt. Ltd., 1991
2. **Nebel, B.J.**, “Environmental Science”, Prentice –Hall Inc., 1987
3. **Odum, E.P.**, “Ecology: The Link between the natural and social sciences”, IBH Publishing Com., Delhi.

E-Resources:

1. en.wikipedia.org/wiki/Environmental_science
2. www.iisc.ernet.in/ug/enviromentscience.htm
3. www.sciencedaily.com/gallery/earth_climate/environmental_science/
4. environment.nationalgeographic.co.in/



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FACULTY OF SCIENCES

BACHELOR OF SCIENCE (MICROBIOLOGY)

DEPARTMENT OF CHEMISTRY

SEMESTER: I

CODE: 4SC01CSM1

NAME: Chemical Structure and Macromolecules (THEORY)

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester							
						Theory				Practical			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Internal		Univ	
						Marks	Hrs	Marks	Hrs	Pr	TW	Pr	
4SC01CSM1	Chemical structure & macromolecules	2	0	2	4	30	1	70	3	30	---	70	200

Objectives:

- To understand the properties of different types of chemical bonding and in addition to that what are the factors which affect nature of bonding.
- To study the importance of macromolecules.

Prerequisite: Students should have knowledge of basic chemistry.

Course Content:

Sr. No.	Course contents	Teaching Hours
1	Review of atomic structure & chemical bonding: Shapes of orbitals (s, p, d & f) Electronic configuration Quantitative analysis of elements Determination of molecular weight & molecular formula. Chemical bonding: Types of chemical bond: Ionic, Covalent bond (Polar & non polar), Co-ordinate bonds, weak chemical forces: Van der waals force, dipole dipole interaction & hydrogen bonding. Effect of chemical bonds on physical properties of molecules.	09
2	Macromolecules: Carbohydrates Classification of carbohydrates, stereo isomerism and optical isomerism of sugars, anomeric form and mutarotation. Occurrence, structure and biological importance of mono, di and polysaccharide (esp. starch, glycogen and	07



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	cellulose). Reaction of Carbohydrates due to the presence of hydroxyl, aldehyde and ketone groups. Macromolecules: Lipids Introduction, definition of fatty acids. Classification, nomenclatures, structures, properties of fatty acids (Essential Fatty Acids) Structure and function of prostaglandins, tri-acyl glycerol. Structure and functions of phospholipids (esp. lecithin, phosphotidyl inositol and phosphotidyl serine) spingomyelin, plasmologens. Structure and function of glycolipids, cholesterol.	
3	Proteins: Introduction, classification based on solubility, shape, composition and function. Structure of proteins-Primary, secondary, tertiary and quaternary. Chemical synthesis of poly peptide chain and solid phase polypeptide synthesis. Brief study of biologically important peptides-structure and functions (esp. insulin, glutathione, vasopressin).	07
4	Nucleic acids: Nature of genetic material, structure of purine and pyrimidine, nucleotide. Composition of DNA and RNA-Watson crick model of DNA. Types of nucleic acid (DNA and RNA). Properties of nucleic acid.	07
Total Hours		30

Learning outcomes:

The students are expected to

- Understand basic atomic and molecular structure and factors that determine stability of inorganic compounds.
- Study about the various macromolecules and their properties.

Teaching & Learning Methodology:-

- Use of audiovisual aids.
- Use of charts.
- Student interaction, group discussion, seminar, quizzes, assignment, brain storming session

Books Recommended:

1. **P. Sykes.** A Guide to Organic Reaction Mechanism.
2. **J. D. Lee, E L. B. S.** A new Concise Inorganic Chemistry.
3. **Barrow, G. M.** Physical Chemistry Tata McGraw-Hill, India. 2007.
4. **Castellan, G. W,** Physical Chemistry 4th Ed. Narosa, India. 2004.



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5. **James E. Huheey, Ellen Keiter and Richard Keiter**, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
6. **I.L.Finar**, Organic Chemistry (vol.1&2).
7. **David L. Nelson, Michael M. Cox**, Lehninger Principles of Biochemistry- Macmillan Worth Publishers.
8. **Rober K. Murray, Daryl K. Grammer**, Harper's Biochemistry- McGraw Hill, Lange Medical Books. 25th edition.

E-Resources:

1. <http://library.thinkquest.org/10429/low/atomic/atomic.html>
2. <http://en.wikipedia.org/wiki/Atom>
3. <http://www.chemguide.co.uk/atoms/properties/gcse.html>
4. http://en.wikipedia.org/wiki/Chemical_bond
5. <http://www.sparknotes.com/chemistry/bonding/properties/section1.rhtml>
6. <http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/bond2.html>
7. <http://www.chem1.com/acad/webtext/chembond/cb01.html>
8. http://en.wikipedia.org/wiki/Nuclear_chemistry
9. http://www.chem.duke.edu/~jds/cruise_chem/nuclear/nuclear.html
10. <http://library.thinkquest.org/10429/low/nuclear/nuclear.htm>
11. http://www.visionlearning.com/library/module_viewer.php?mid=59
12. http://en.wikipedia.org/wiki/Chemical_thermodynamics
13. <http://www.shodor.org/unchem/advanced/thermo/>
14. <http://www.chem.arizona.edu/~salzmanr/480a/480ants/chemther.html>



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DEPARTMENT OF CHEMISTRY

SEMESTER: I

CODE: 4SC01CSM1

NAME: Chemical Structure and Macromolecules (PRACTICALS)

1. Limit tests for Cl, SO₄, As, Heavy metals and Lead along with a few modifications.
2. The background and systematic qualitative analysis of Inorganic compound (solid) of up to 2 radicals.
3. Volumetric Analysis of few important compounds.
4. Qualitative analysis of Carbohydrates (Monosaccharides, Disaccharides & Polysaccharides).
5. Qualitative analysis of Lipids.
6. Qualitative analysis of Carbohydrates.
7. Qualitative analysis of Amino acids & proteins.
8. Quantitative estimation of Glucose.
9. Quantitative estimation of Proteins.



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DEPARTMENT OF MICROBIOLOGY

SEMESTER: I

CODE: 4SC01PMA1

NAME: Plant Morphology & Anatomy (THEORY)

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester							
						Theory				Practical			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Internal		Univ	
						Marks	Hrs	Marks	Hrs	Pr	TW	Pr	
4SC01PMA1	Plant Morphology & Anatomy	2	0	2	4	30	1	70	3	30	---	70	200

Objectives: -

- The course aims to enlighten the students on the concept of phytodiversity.
- The course serves as a platform for further studies in Botany in succeeding semesters by providing basic concepts.

Prerequisites:-

- Ability to understand the concepts of biology.

Course outline:

Sr. No.	Course contents	Teaching Hours
1	Cell and tissue Tissues – Meristems, Definition, Classification based on origin, position, growth patterns, functions. Permanent tissues – Definition, classification - simple, complex and secretory. Tissue systems – Epidermal tissue systems-stomata, structure and functions, Ground tissue systems & vascular tissue systems. Different types of vascular arrangements	08
2	Morphology Root and stem (exclude modification) Leaf: Parts of leaf, Phyllotaxis, Types of leaves, Stipules, Leaf shapes, margins, base, apex, venation. Inflorescence: Types with examples. Flowers: Definition and study of function and types of Calyx, Corolla, Perianth, Androecium, Gynoecium. Aestivation, placentation etc.	16



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	Floral formula & Floral diagram of the following: Apocynaceae, Leguminosae and Umbelliferae	
3	Anatomy of monocot and dicot (root, stem, leaf)	06
	Total Hours	30

Learning Outcomes:-

The course provides basic aspects of botany which may serve to be useful when more descriptive aspects are covered.

Teaching & Learning Methodology:-

- Use of multimedia, charts and models.
- Student interaction, group discussion, seminar, quizzes, assignment, brain storming session, expert talks.

Books Recommended:

1. **V. Singh, P.C. Pande & D.K. Jain**, A Text Book of Botany.
2. **A C Dutta**, Botany.
3. **N. S. Parihar**, Bryophytes.
4. **Ganguli and Kar**, College Botany Vol. I and II.
5. **G. M. Smith**, Cryptogamic Botany.
6. **D. Enger, F.C. Ross, D.B. Bailey**. Concepts in biology (McGraw-Hill). 2008.
7. **N. S. Parihar**, Pteridophytes.

E-Resources:

1. biology.uco.edu/bidlack/botany/notes.htm
2. www.liqwidmindz.com/LifeSciences/Botany.htm
3. www.bsnotes.gurukpo.com/
4. quizlet.com/subject/botany-notes/



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DEPARTMENT OF MICROBIOLOGY

SEMESTER: I

CODE: 4SC01PMA1

NAME: Plant Morphology & Anatomy (PRACTICALS)

S.No	Experiment
1	Study of microscope.
2	Anatomical study of Monocot root.
3	Anatomical study of Dicot root.
4	Anatomical study of Monocot stem.
5	Anatomical study of Dicot stem.
6	Anatomical study of Monocot leaf.
7	Anatomical study of Dicot leaf.
8	Morphological study of Leaf
9	Morphological study of Inflorescence.
10	Morphological study of Flowers (Calyx, Corolla and Perianth).
11	Morphological study of Flowers (Androecium).
12	Morphological Study of Flowers (Gynoecium)
13	Morphological study of Root.
14	Floral formula & diagram for Umbelliferae
15	Floral formula & diagram for Apocyanaceae.
16	Floral formula & diagram for Leguminosae.



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DEPARTMENT OF MICROBIOLOGY

SEMESTER: I

CODE: 4SC01WOM1

NAME: World of Microbes (THEORY)

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester							
						Theory				Practical			
		Th	Tu	Pr	Total	Sessional Exam		University Exam		Internal		Univ	
		Marks	Hrs	Marks	Hrs	Pr	TW	Pr					
4SC01WOM1	World of microbes	6	0	6	12	30	1	70	3	30	--	70	200

Objectives: -

- The course will help the student to have a good understanding of the history and basic concepts and contribution of various scientists in the field Microbiology.
- To study morphology, microscopy, staining technique and control of microorganism by different methods.

Prerequisites:- Students should have knowledge of fundamental concepts in biology.

Course content:

Sr. No.	Course contents	Teaching Hours
1	History of Microbiology Discovery of microorganisms, Controversy over spontaneous generation, Fermentation ,Germ theory of disease, Immunology and Immunization, Pure Culture Concept. Scope of Microbiology	10



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2	<p>Microbial Nutrition Basic Nutritional requirements. Uptake of nutrient in to the cell. Transport of nutrients by active and passive ways. Types of Media: liquid, solid, semi-solid, synthetic, non-synthetic media, composition and functions of beef, malt, yeast extract, peptone, agar, gelatin. Specific Media: Enriched, Selective, differential, assay, maintenance, and enumeration and characterization media. Determination of nutritional requirements: Auxonography, Replica plating technique. Nutritional Classification: (i) On the basis of carbon source (ii) On the basis of energy source. (f) Concept of autotrophy.</p>	15
3	<p>Microscopy: (a) General principles, resolving power, numerical aperture, angular aperture, magnification, working distance, Aberrations. (b) Compound Microscope (Bright field microscopy)- Parts, their functions, use of oil immersion objective, ray diagram, magnification, applications and detailed comparative study of : Dark field, Phase contrast, Ultraviolet, Fluorescence, Electron-Transmission & Scanning.</p>	15
4	<p>Morphology of Bacteria Size shape and arrangement of bacteria. Cell wall structure of bacteria: structure and chemical composition of Gram positive and Gram negative bacteria. Bacterial structure: External & Internal to cell wall.</p>	15
5	<p>Staining: Dyes and stains - Definitions, auxochromes, chromophore, mordent, chromogen, leucostain. Classification of dyes and stains: Outline, Theories of staining: Physical and Chemical. Principle and method of following techniques: Simple, Differential: Gram, Acid fast, Negative: Capsule, Microchemical: storage granules, Flagella staining, Cytological: Endospore.</p>	15
6	<p>Control of Microorganisms Fundamental principles of microbial control. Physical agents of microbial control. Chemical agents of microbial control. Biological agents of microbial control. Antimicrobial agents: Classification, Characteristics, selection and evaluation of ideal antimicrobial agent.</p>	20
Total Hours		90

Learning Outcomes:-



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- The student would have got fundamental knowledge of the types of microbes.
- Knowledge pertaining to identification and observation of microbes would have been gained from this course.

Teaching & Learning Methodology:-

- Use of audiovisual aids.
- Use of charts.
- Student interaction, group discussion, seminar, quizzes, assignment, brain storming session

Books Recommended:

- **Dubey RC & Maheshwari AA**, Text Book of Microbiology, S. Chand Publications, New Delhi.
- **Harmeet Kaur**, Encyclopedia of Microbiology, Anmol Publication, New Delhi.
- **Mani A, Selvaraj AM, Narayanan LM and Armugam N**, Microbiology, Saras Publication, New Delhi.
- **Pelczar MJ, Chan ECS, Krieg NR**, Microbiology, 5th Edition, Tata McGraw Hill Publication Co. Ltd., New Delhi.
- **Purohit SS**, Microbiology – Fundamentals and Applications, 6th Edition, Agrobios Publications, New Delhi.
- **S.K. Sawhney, Randir Singh** Eds, Introductory practical biochemistry, Narosa publishing house New Delhi.
- **Sale, A.J**, "Fundamentals Principles of Bacteriology", 7th Edition. McGraw Hill Publishing Co. Ltd., New York. 1992.
- **Stanier RY, Lingraham JL, Wheelis ML, Painter RK**, General Microbiology, 5th Edition, McMillan Press Ltd., London.
- **Tortora, Funke & Case**, Microbiology – An Introduction, 8th Edition, Pearson Education, New Delhi.
- **Wiley, J., & Sherwood, L.** Prescott, Harley, and Klein's Microbiology, 7Ed., McGraw-Hill. 2007.

E-Resources:

1. http://www.cliffsnotes.com/study_guide/A-Brief-History-of-Microbiology.topicArticleId-8524,articleId-8406.html
2. <http://www.slic2.wsu.edu:82/hurlbert/micro101/pages/Chap1.html>
3. <http://www.austincc.edu/rohde/noteref.html>
4. http://faculty.ivytech.edu/~twmurphy/txt_202/disinfect.html
5. <http://www.liqwidmindz.com/LifeSciences/Microbiology.htm>
6. <http://www.rapidlearningcenter.com/biology/microbiology/08-Classification-of-Microorganisms.html>



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7. <http://www.slideshare.net/MMASSY/intro-to-medical-microbiology-lecture-notes>
8. <http://www.bristol.ac.uk/vetscience/pathology/labprot/histstaintechs/>
9. <http://sunitasharma091.hubpages.com/hub/-Basics-of-Microbiology>



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BACHELOR OF SCIENCE (MICROBIOLOGY)

DEPARTMENT OF MICROBIOLOGY

SEMESTER: I

CODE: 4SC01WOM1

NAME: World of Microbes (PRACTICALS)

S.No	Experiment
1	Introduction to laboratory setup.
2	Cleaning of glass ware.
3	Sterilization principle and methods-moist heat, dry heat and filtration methods.
4	Media preparation: Liquid media, solid media, Agar deep, Agar slants, Agar plates, Basal, enriched, selective media preparation - quality control of media, growth supporting properties and sterility check of media.
5	Identification of bacteria using selective media.
6	Identification of bacteria using differential media.
7	Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution].
8	Sampling and quantification of microorganisms in air, soil and water.
9	Staining techniques: Smear preparation. Simple Staining Negative staining Differential staining. Capsule staining. Cell wall staining. Spore staining. Metachromatic granule staining. Spirochete staining.
10	Micrometry: Determination of size of Bacteria, yeast. Fungal filaments.
11	Determination of antibiotic resistance of bacteria. (Filter paper disc method).
12	Determination of antibiotic resistance of bacteria. (Cup and well method).
13	Sterility testing.



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BACHELOR OF SCIENCE (MICROBIOLOGY)

DEPARTMENT OF MICROBIOLOGY

SEMESTER: I

CODE: 4SC01MDT1

NAME: Microbial diversity & Taxonomy

Teaching & Evaluation Scheme:-

Subject Code	Subject Name	Teaching Hours/week				Evaluation scheme/Semester							
		Th	Tu	Pr	Total	Theory				Practical			Total marks
						Sessional Exam		University Exam		Internal		Univ	
						Marks	Hrs	Marks	Hrs	Pr	TW	Pr	
4SC01MDT1	Microbial Diversity & Taxonomy	3	0	0	03	30	1	70	3	---	----	-----	100

Objectives: -

- To study microbial taxonomy & diversity

Prerequisites:-

- Basic concept of microbiology is needed.

Course content:

Sr. No.	Course contents	Teaching Hours
1	Introduction to microbial diversity: Introduction to biodiversity & microbial evolution. Overview of microbial taxonomy. Classification systems.	09
2	Molecular approaches to taxonomy: Concept of Phylogenetic analysis, Brief study of Bergey's manual of bacteriology.	09
3	Prokaryotic diversity: Archaea & Eubacteria. Gram negative bacteria: General features of aerobic, microaerophilic motile, helical vibroid. Non motile curved bacteria, aerobic rods & cocci Facultative anaerobes-rods, curved & helical bacteria. Phototrophic bacteria Gram positive bacteria:	09



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	General features of: Endospore forming rods & Cocci. Asporogenous rods Mycobacteria & Actinomycetes	
4	Eukaryotic Diversity: Fungi: General characteristics, Structure, reproduction and classification of major division of Fungi. Importance of fungi. Algae: General characteristics, Structure, reproduction and economic importance of algae. Protozoa: General characteristics, Structure, reproduction and economic importance of protozoa.	09
5	Akaryotic diversity: Virus: Definition, structure & classification. Cultivation of virus Study of plant viruses: Tobacco mosaic virus. Study of animal viruses Bacteriophage: Classification, lytic cycle & lysogenic cycle	09
Total Hours		45

Learning Outcomes:-

The course provides detailed insight into the taxonomical aspect of microbes.

Teaching & Learning Methodology:-

- Use of audiovisual aids.
- Use of charts.

Books Recommended:

1. **Ananthanarayan and Paniker's** Textbook of Microbiology R. Ananthanarayan, C.K. Jayaram Panikar.
2. **Greenwood, D., & Black, R. C.** Medical Microbiology, 7Ed., Churchill Livingstone. 2007.
3. **Tortora, G. J., & Funke, B. R.** Microbiology: An Introduction, 9Ed., Benjamin Cummings. 2006.



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4. **Wiley, J., & Sherwood, L.** Prescott, Harley, and Klein's Microbiology, 7Ed., McGraw-Hill. 2007.

E-Resources:

1. https://en.wikipedia.org/wiki/Molecular_phylogenetics
2. <https://www.boundless.com/.../microbial...and.../phylogenetic-analysis>
3. www.wiziq.com/tutorial/181305-MOLECULAR-TAXONOMY