

**Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot
(Autonomous)**

Affiliated to Saurashtra University, Rajkot

Department of Microbiology

B. Sc. MICROBIOLOGY

OBJECTIVES OF THE PROGRAMME

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. Understand the basic anatomy, physiology, diversity, and genetics of microorganisms including viruses, bacteria, protozoa, algae and fungi, and exploit their interactions with environment and human beings.
2. Plan production of economically important products including antibiotics, organic acids, vitamins, growth factors, hormones, enzymes.
3. Isolate, identify and maintain microbial cultures for disease diagnosis, application in agriculture, environment, genetic engineering, industry and other related fields of applied Microbiology.
4. Skill to operate basic and advanced instruments used for analysis of various biomolecules.

**SCHEME OF INSTRUCTION AND EXAMINATIONS
For Students Admitted From A.Y. 2016-2017 & Onwards**

Semester –I							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durat ion hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part – I							
16ULCEN01	Functional English-I	3	3	40	60	100	3
Part – II							
16UMBCC01	Core 1: Fundamentals of Microbiology	4	3	30	70	100	4
16UMBCC02	Core 2: Cell Biology	4	3	30	70	100	4
16UMBDA01	DSE allied-1: Basics of Zoology and Life Sustainable Systems in Human	4	3	30	70	100	4
16UMBCC03	Core Practical - 1- Fundamental Microbiology and Cell Biology	6	6*	40	60	100	2
16UMBDA02	DSE allied-1–Practical Basics of Zoology and Life Sustainable Systems in Humans	2	3	20	30	50	1
	Microbiology Outreach Activity	2	-	-	-	-	-
TOTAL		25				550	18
Part –III							
	AECC-I: Environmental Sciences	1	--	-	-	-	-
	SEC-I: Value Education –I	1	--	REMARKS			1
		27					1

*3 hrs on day 1 and 3 hrs on second day

Semester –II							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part –I							
16ULCEN02	Functional English-II	3	3	40	60	100	3
Part- II							
16UMBCC04	Core 3: Microbial Diversity	4	3	40	60	100	4
16UMBCC05	Core 4: Basic Biochemistry	4	3	30	70	100	4
16UMBCC06	Core 5: Bacteriology	4	3	30	70	100	4
16UMBDA03	DSE allied-2: Medicinal Botany	4	3	30	70	100	4
16UMBCC07	Core Practical – 2 Bacteriology and Microbial Biochemistry	6	6*	40	60	100	2
16UMBDA04	DSE allied-2: Practical - Medicinal Botany	2	3	20	30	50	1
TOTAL		27				650	22
Part – III							
	AECC-I: Environmental Sciences	1	-	REMARKS			2
	SEC-I: Value Education – II	1	-	REMARKS			1
		29					

*3 hrs on day 1 and 3 hrs on second day

Semester – III							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part –I							
16ULCEN03	Advanced English Language - I	3	3	40	60	100	3
Part –II							
16UMBCC08	Core 6: Microbial Ecology	5	3	30	70	100	5
16UMBCC09	Core 7: Agricultural Microbiology	4	3	30	70	100	4
16UMBCC10	Core 8: Food and Dairy Microbiology	4	3	30	70	100	4
16UMBDA05	DSE allied -3: Sustainable Management	4	3	30	70	100	4
16UMBCC11	Core Practical – 3 Agriculture, Food and Dairy Microbiology	6	6*	40	60	100	3
16UMBDA06	DSE allied -3: Practical - Sustainable Management	2	-	-	-	-	-
	Microbiology Outreach Activity	2	-	-	-	-	-
TOTAL		30				600	23

*3 hrs on day 1 and 3 hrs on second day

Semester – IV							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part - I							
16UENLC04	Advanced English Language - II	3	3	40	60	100	3
Part - II							
16UMBCC12	Core 9: Bacterial Metabolism	4	3	30	70	100	4
16UMBCC13	Core 10: Analytical Techniques	4	3	30	70	100	4
16UMBCC14	Core 11: Industrial Microbiology	4	3	30	70	100	4
16UMBDA06	DSE allied -4: Biostatistics and Bioinformatics	4	3	30	70	100	4
16UMBCC15	Core Practical – 4 Metabolic Analysis and Fermentation	6	6	40	60	100	3
16UMBDA07	DSE Allied -4 Practical Biostatistics and Bioinformatics	2	2	20	30	50	1
TOTAL		27				650	23

Semester – V							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part –II							
16UMBCC16	Core 12: Immunology	4	3	30	70	100	4
16UMBCC17	Core 13: Medical Microbiology and Diagnostic Techniques	4	3	30	70	100	4
16UMBCC18	Core 14: Corporate Microbiology - Self Study	1	3	30	70	100	4
16UMBCC19	Core 15: Computer Based Test	-	-	100	-	100	1
16UMBDC01/ 16UMBDC02/ 16UMBDC03	DSE-Core elective 1 Pharmaceutical Microbiology/ Quality Assurance and Quality control/ Bioethics and IPR	4	3	30	70	100	4
16UMBCC20	Core Practical- 5 Clinical Microbiology	9*	6	60	90	150	4
16UMBDC04/ 16UMBDC05/ 16UMBDC06	DSE-Core elective 1 – Practical Pharmaceutical Microbiology/ Quality Assurance and Quality control/ Bioethics and IPR	2	3	20	30	50	1
	Research Project/ Training/Internship	4	-	-	-	-	-
	Generic Elective-I- From Common UG Pool	2	-	100	-	100	2
TOTAL		30				800	24

***3 hrs each Day for 3 days**

Semester – VI							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks Allotted			Credits
				CIE	SEE	Total	
Part –II							
16UMBCC21	Core 16: Molecular Biology	4	3	30	70	100	4
16UMBCC22	Core 17: Genetic Engineering	4	3	30	70	100	4
16UMBDC07/ 16UMBDC08/ 16UMBDC09	DSE-Core elective 2 Mushroom Cultivation / Microbiology and Health Care / Research Methodology	4	3	60	40	100	4
16UMBCC23	Core Practical- 6 Genetics and Molecular biology	9*	6	60	90	100	3
6UMBDC10/ 16UMBDC11/ 16UMBDC12	DSE-Core elective 2 Practical Mushroom Cultivation / Microbiology and Health Care / Research Methodology	2	2	20	30	50	1
16UMBCC24	Research Project/ Training/Internship	4	3	50	50	100	2
	Generic Elective-II From Common UG Pool	2	3	50	-	100	2
16UMBCC25	Microbiology Outreach Activity	1	-	Remarks			2
		30				650	22
Total Marks : 3900							

***3 hrs each Day for 3 days**

Part III						
Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
<i>Ability Enhancement Compulsory Course (AECC)</i>						
As per common list	I & II	AECC-I Environment Science	1	1	2	2
	IV & V	AECC-II Communication Skill/Soft Skills	2	2	1	2
					Sub Total	4
<i>Skill Enhancement Course (SEC)</i>						
As per common list	I	SEC-I Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	SEC-II *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	SEC-III **Value Added Courses	40 hours in total	1	1	1
					Sub Total	4
					Grand Total	8

* **Co- Curricular Courses** – Option to student to choose one from a list of courses offered by the college, such as Add-on courses, Gandhian Studies Certificate Course, Women Studies Course, etc.

** **Value Added Courses** - Option to student to choose at least one from a list of courses offered by UG Departments

Microbiology Outreach Course offered in Semester I, III,VI will be assessed in VI semester.

3/6 hrs on first day and 3 hrs on second day

Project/Survey/Review Writing / Internship: 4 hrs in 5th Semester and 6 hrs in Semester VI

Total Credit to earn Degree = 140 credits

Part I and II = 132credits AND Part III = 8 credits

- **TOTAL MARKS & CREDIT DISTRIBUTION**

S.NO	PART	Total Marks	Total Credits
1.	PART I: Language Course	400	12
2.	PART II : Core, DSE Allied, DSE Core, GE	3500	120
3.	PART III: AECC- I & II SEC – I,II &III	Remarks	08
TOTAL		3900	140

- **PART – I : LANGUAGE COURSE**

The following are compulsory courses offered in first to fourth semesters.

S.No	Semester	Course code	Course
1	I	16ULCEN01	Functional English –I
2	II	16ULCEN02	Functional English –II
3	III	16ULCEN03	Advanced English Language - I
4	IV	16ULCEN04	Advanced English Language - I

- **PART – II : CORE, DSE ALLIED, DSE CORE, GE**

CORE COURSES [Theory]

S. No	Semester	Course code	Course
1	I	16UMBCC01	Core 1: Fundamentals of Microbiology
2		16UMBCC02	Core 2: Cell Biology
3	II	16UMBCC04	Core 3: Microbial Diversity
4		16UMBCC05	Core 4: Basic Biochemistry
5		16UMBCC06	Core 5: Bacteriology
6	III	16UMBCC08	Core 6: Microbial Ecology
7		16UMBCC09	Core 7: Agricultural Microbiology
8		16UMBCC10	Core 8: Food and Dairy Microbiology
9	IV	16UMBCC12	Core 9: Bacterial Metabolism
10		16UMBCC13	Core 10: Analytical Techniques
11		16UMBCC14	Core 11: Industrial Microbiology
12	V	16UMBCC16	Core 12 Immunology
13		16UMBCC17	Core 13: Medical Microbiology & Diagnostic Techniques
14		16UMBCC18	Core 14: Corporate Microbiology-Self Study
15		16UMBCC19	Core 15: Computer Based Test
16	VI	16UMBCC21	Core 16: Molecular Biology
17		16UMBCC22	Core 17: Genetic Engineering

CORE COURSE [Practical]

S. No	Semester	Course code	Course
1	I	16UMBCC03	Core Practical - 1- Fundamental Microbiology and Cell Biology
2	II	16UMBCC07	Core Practical – 2- Bacteriology and Microbial Biochemistry
3	III	16UMBCC11	Core Practical – 3- Agriculture, Food and Dairy Microbiology
4	IV	16UMBCC15	Core Practical – 4 - Metabolic Analysis and Fermentation
5	V	16UMBCC20	Core Practical- 5 - Clinical Microbiology
6	VI	16UMBCC23	Core Practical- 6 - Genetics and Molecular biology

OTHER CORE COURSES

S. No.	Semester	Course Code	Course
1	V & VI	16UMBCC24	Research Project/ Training/Internship
2	VI	16UMBCC25	Microbiology Outreach Programme

DSE ALLIED COURSE

S.No	Semester	Course code	Course
1	I	16UMBDA01	Basics of Zoology and Life Sustainable Systems in Human
2	II	16UMBDA03	Medicinal Botany
3	III	16UMBDA05	Sustainable Management
4	IV	16UMBDA06	Biostatistics and Bioinformatics

DSE ALLIED COURSE [Practical]

S.No	Semester	Course code	Course
1	I	16UMBDA02	Basics of Zoology and Life Sustainable Systems in Human
2	II	16UMBDA04	Medicinal Botany
3	III	16UMBDA05	Sustainable Development and Management
4	IV	16UMBDA07	Biostatistics and Bioinformatics

DSE CORE COURSES [Theory & Practical]

Students are required to opt for any one of the courses offered in 5th & 6th semesters respectively.

S. No	Semester	Theory		Practical	
		Course code	Course	Course code	Course
1.	V	16UMBDC01/	Pharmaceutical Microbiology	16UMBDC04/	Pharmaceutical Microbiology
		16UMBDC02 /	Quality Assurance and Quality Control	16UMBDC05/	Quality Assurance and Quality Control
		16UMBDC03	Bioethics and IPR	16UMBDC06	Bioethics and IPR
2.	VI	16UMBDC07/	Mushroom Cultivation	16UMBDC10/	Mushroom Cultivation
		16UMBDC08/	Microbiology and health	16UMBDC11/	Microbiology and health
		16UMBDC09	Research Methodology	16UMBDC12	Research Methodology

GENERIC ELECTIVE

S. No	Semester	Course
1.	V	Any one course from list of courses offered across UG Departments
2.	VI	

- PART –III : AECC , SEC**

Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
<i>Ability Enhancement Compulsory Course (AECC)</i>						
As per common list	I & II	AECC-I Environment Science	1	1	2	2
	IV & V	AECC-II Communication Skill/Soft Skills	2	2	1	2
					Sub Total	4
<i>Skill Enhancement Course (SEC)</i>						
As per common list	I	SEC-I Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	SEC-II *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	SEC-III **Value Added Courses	40 hours in total	1	1	1
Sub Total						4
Grand Total						8

- Courses offered by the Department to UG students of other Departments**

B.Sc MICROBIOLOGY
SEMESTER - I

16UMBCC01	Core I: Fundamentals Of Microbiology	4hrs/wk	4 Credits
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Course Objectives:

After successfully completing this course the student should be able to:

1. Identify major contributions of the early scientists and the historical milestones that laid the groundwork for modern microbiology
2. Understand the characteristics of major groups of microorganisms
3. Explain the fundamentals of microscopy and staining technique
4. Understand the characteristics of prokaryotic cells and eukaryotic cells
5. Identify, discuss and illustrate morphological features of bacterial cell and its organelles.

Unit . 1: Scope and History of Microbiology (10hrs)

- Microbiology as a field of Biology
- History and Development of Microbiology
- The Place of Microorganisms in the living world; Distribution of Microorganisms in Nature
- Spontaneous generation versus Biogenesis; Germ Theory of disease
- Applied areas of Microbiology

Unit . 2: Microscopy (09hrs)

- Microscopy: Introduction and Types
- Principle, Construction and working of:
 - Bright field Microscopy
 - Dark field Microscopy
 - Fluorescent Microscopy
 - Phase Contrast Microscopy
- Introduction to Advanced Microscopic techniques
- Electron Microscopy – Types, working and Limitations
- Preparation of sample for Electron Microscopy

Unit . 3: Staining (09hrs)

- Stains and staining solutions
- Types of Stains: Natural, Acidic & Basic Stains
- Chromophore & Auxochrome groups, Leuco compounds
- Theories and types of Staining
- Non biological applications of Stains

Unit . 4: Major Groups of Microorganisms (10hrs)

- Difference between Eukaryotes, Prokaryotes and Archaea
- Major groups of Microorganisms
- Bacteria: General characteristics
- Eukaryotic Microorganisms: Fungi, Algae, Protozoa
- Viruses: Plant, Animal Viruses, Bacteriophages

Unit . 5: Morphology of Microorganisms

(10hrs)

- Size, Shape and Arrangement of Bacteria
- The cell wall of Bacteria – Structure and chemical composition of Gram negative and Gram positive Bacteria
- Bacterial Structures – Internal to Cell Wall – Cell Membrane, Protoplast, Spheroplast, Membranous intrusions and intracellular membrane system, Cytoplasm, Cytoplasmic inclusions and Vacuoles, Nuclear Material
- Bacterial Structures – External to Cell Wall – Capsule, Flagella, Pilli, Prostheca, Sheath & Stalk
- Bacterial Spores & Cyst – Types of Spore, Structure and formation of Endospores (Sporogenesis) , Occurrence & Functions of Akinetes & Heterocyst

Text Books:

- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing Company Ltd.
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition, New York: WCB Mc GrawHill publication.

Reference Books:

- Pommerville, J.C. (2013). Alcamo's Fundamentals of Microbiology, 10th Edition: Jones and Barlett learning LLC.
- Black, J.G. (2005). Microbiology: Principles and Explorations. New York: Wiley publication
- Tortora, G.J., Funke, B.R., Case, C.L. (2004). Microbiology: An Introduction. Singapore: Pearson Education.
- Singh, R.P. (2007). General Microbiology. New Delhi: Kalyani Publishers.

16UMBCC02	Core 2: Cell Biology	4hrs/wk	4 Credits
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Course Objectives:

By the end of the semester, a student should be able to:

1. Appreciate and understand the dynamic nature of the cell, including how it receives and responds to information from its environment.
2. Explain and compare different mechanisms for receptor activation and regulation.
3. Understand and explain how membrane chemistry and regulation are essential in cell communication.
4. Understand intracellular signalling cascades and their impact on cellular activities, including cytoskeleton rearrangements, motility and changes in gene expression.
5. Understand mechanisms of cell cycle regulation.
6. Appreciate the cellular organization of intracellular and extracellular organelles

Unit . 1: Cell concept and Cytology (09hrs)

- Cell concept, principal levels of cellular organization
- Historical aspects of Cytology
- Basic differences in structural organization in Prokaryotes and Eukaryotes
- Structure of Animal and Plant cell
- Endosymbiosis Theory

Unit . 2: Membrane organization, function and Cell cycle (10hrs)

- Models of cell membrane
- Structural organization of plasma membrane – Fluid Mosaic Model
- Transport of Small Molecules across cell membrane-Active and Passive Transport
- Transport of Macromolecules across cell membrane -Phenomenon of exocytosis and endocytosis
- Cell Cycle and Cell Division – Mitosis and Meiosis

Unit . 3: Cell wall and intracellular transport (09hrs)

- Intracellular junction, tight junction, intermediate junction, spot desmosome, gap junctions, plasmodesmata
- Plant cell wall: its ultra structure and function
- Endoplasmic reticulum: structure, chemical nature and function
- Golgi apparatus: structure, chemical nature and function
- GERL system and its role in intra-cellular secretion

Unit . 4: Cellular Organelles (10hrs)

- Chloroplast: ultrastructure and function
- Mitochondria: structure, morphogenesis, chemical nature and functions
- Lysosomes: structure, chemical nature, concept of suicide bag
- Peroxisomes and Glyoxisomes:: structure & functions
- Centrosomes, Centrioles, and Cytoskeletal elements
- Motility: Cilia, Flagella

Unit . 5: Nucleus**(10hrs)**

- Light and electron microscopic structure of chromosome and types
- Polytene chromosome, lampbrush chromosomes and their importance
- Nucleus and nucleolus : Ultra structure, chemical nature, nucleolar Chromosome
- Nuclear envelop: ultra structure, transport of material

Text Books:

- De Robertis, EDP, De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Philadelphia: Lipincott Williams and Wilkins.
- Verma, P.S., Agrawal, V.K. (2005). Ecology, Cell Biology, Molecular Biology, Genetics. New Delhi: S. Chand and Company Limited.
- Powar, C.B., Daginawala, J.F. (1982). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.

Reference Books:

- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Mc GrawHill publication.
- Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.
- Tortora, G.J., Funke, B.R., Case, C.L. (2008). Microbiology, 8th Edition: McGraw Hill Company.

16UMBCC03	Core Practical – 1- Fundamental Microbiology & Cell Biology	6hrs/wk	2 Credits
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Course Objectives:

The course will impart

1. Operational skills for basic instruments used in Microbiology Laboratory
 2. Understanding about the staining process and reagent preparation
 3. Knowledge about the morphological properties of Microbial cell structure.
 4. To develop skills, through lab experiments, in some of the specific methodologies used in the study of modern cell biology
- 1) Good microbiological Laboratory Practice
 - 2) Principles of Laboratory Sanitation
 - 3) Principles, working and uses of the following laboratory instruments :
 - a) Microscope
 - b) Incubator
 - c) pH meter
 - d) Refrigerator
 - e) Colorimeter
 - f) Colony counter
 - 4) Principles, working and uses of the following sterilizers:
 - a) Autoclave
 - b) Hot air oven
 - c) Steam sterilizer
 - d) Inspissator
 - e) Bacteriological filters.
 - 5) Preparation of glassware for sterilization and disposal of laboratory media & cultures.
 - 6) Preparation of Stains and Staining Reagents.
 - 7) Study of Permanent Slides: Bacteria, Fungi, Algae, Protozoa, Flagella, Chromosome and its Abberations
 - 8) Study of bacterial motility by hanging drop method.
 - 9) Monochrome Staining:
 - a) Negative Staining
 - b) Positive Staining
 - 10) Gram's Staining
 - 11) Special staining of bacteria:
 - a) Capsule staining – Hiss's method
 - b) Cell wall staining – Webb's method
 - c) Spore staining – Schaeffer's method
 - d) Metachromatic granule staining – Albert's method
 - e) Spirochete staining – Harrie's method
 - 12) Measurement of size of microorganisms by Micrometry (Demonstration)
 - 13) Calibrations of microscopic measurements (Ocular & stage micrometers)
 - 14) Demonstration and study of various phases of mitosis and meiosis
 - 15) Microscopic observation of plant cells from onion

16) Microscopic observation of Barr bodies and Drum stick

17) Mitochondrial staining.

Reference Books:

- Patel. R.J., Patel. K.R. (2009). Experimental Microbiology, Vol-I, Ahmedabad: Aditya Publications.
- Patel. R.J., Patel. K.R. (2009). Experimental Microbiology, Vol-II, Ahmedabad: Aditya Publications.
- Dubey, R.C., Maheshwari, D.K. (2005). Practical Microbiology. New Delhi: S. Chand & Company Limited.
- Sharma, K. (2005). Manual of Microbiology – Tools and Techniques. New Delhi: Ane books.
- Benson, H.J. (2002). Microbiological Applications – Laboratory Manual in General Microbiology – 8th edition: MacGraw Hill Company.

SEMESTER – II

16UMBCC04	Core 3: Microbial Diversity	4hrs/wk	4 Credits
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Course Objectives:

After completing the course, the student will become competent enough to:

1. Understand the need and the types of microbial classification
2. Identify diverse varieties of microorganisms from their natural surroundings
3. Acknowledge the economical role of microorganisms

Unit . 1: Introduction to Microbial Diversity (09hrs)

- Introduction to Biodiversity- Microbial evolution and diversity, Types of diversity
- Microbial Taxonomy: Introduction and overview
- Taxonomic ranks of microorganisms , Classification systems
- Major characteristics used in taxonomy
- Assessing Microbial Phylogeny
- The Major Divisions of Life

Unit . 2: Prokaryotic Diversity (10hrs)

- Introduction to Archaea and Eubacteria
- Gram negative bacteria – General features of:
 - Aerobic/Microaerophilic motile, helical vibroid
 - Non-motile curved bacteria
 - Aerobic/Microaerophilic rods and cocci
 - Facultative anaerobes – rods, curved and helical bacteria
 - Dissimilatory Sulfate reducers
 - Anaerobic cocci
 - Phototrophic bacteria
- Gram positive bacteria – General features of:
 - 2.3.1 Endospore forming rods and cocci
 - 2.3.2 Asporogenous rods
 - 2.3.3Mycobacteria and Actinomycetes

Unit . 3: Diversity of some unusual Prokaryotes (09hrs)

- General Features of Bacteria with unusual morphology:
 - Rickettsia and Chlamydia
 - Budding and appendaged bacteria
 - Sheathed Bacteria
 - Bacteria with gliding motility
 - Mycoplasma
- General Features of Bacteria of extreme environments:
 - Thermophiles
 - Halophiles

- Acidophiles
- Barophiles
- Methanogens
- Psychrophiles

Unit . 4: Eukaryotic Diversity (10hrs)

A: FUNGI:

- General characteristics – Definition, occurrence, Structure , Reproduction
- Classification and introduction to major divisions of Fungi
- Economic importance of fungi
- Salient features of fungi

B: ALGAE:

- General Characteristics – Definition, Occurrence, Ultra- Structure, Reproduction
- Economic importance of Algae

C: PROTOZOA:

- General Characteristics – Definition, Occurrence, Ultra- Structure, Reproduction
- Economic importance of Protozoa

Unit . 5: Akaryotic Diversity - Viruses (10hrs)

- Introduction and General Characteristics: Definition, Structure, Classification
- Cultivation and Enumeration of Viruses
- Bacterial Viruses: Classification, Lytic life cycle (T4 phage), lysogenic life cycle (Lambda and Mu phage), RNA Phage (MS13)
- Overview of plant and animal viruses

Text Books:

- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Mc GrawHill publication.
- Atlas, R.M., Bertha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing co. Ltd.

Reference Books:

- Dubey, R.C., Maheshwari, D.K. (2005). Practical Microbiology. New Delhi: S. Chand & Company Limited.
- Tortora, G.J., Funke, B.R., Case, C.L. (2008). Microbiology, 8th Edition: McGraw Hill Company.
- Powar, C.B., Dagainawala, J.F. (1982). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.

16UMBCC05	Core 4: Basic Biochemistry	4hrs/wk	4 Credits
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Course Objectives:

Upon completion of the course, the student should achieve an understanding of the following:

- Basic cellular structure and the special properties of water
- The structures of amino acids, their chemical properties and their organization into polypeptides and proteins.
- structure of fundamental monosaccharides and polysaccharides
- structure and basic function of nucleotides
- structure of different classes of lipids and their roles in biological systems

Unit . 1: Basic Biochemistry (09hrs)

- Introduction to Atoms, Elements & Molecules
- Major Chemical bonds found in biological system: Ionic Bonds, Covalent Bonds, Hydrogen Bonds, Vaan der Vaals interactions, Hydrophobic interactions
- Introduction to pH
- Major Chemical reactions: Acid Base, Redox, Condensation-Hydrolysis Reactions
- Water and its important properties
- Major elements of life and their significance

Unit . 2: Basics of Bioenergetics (09hrs)

- Laws of Thermodynamics
- Definitions of Gibb's Free Energy, Entropy and Enthalpy
- Standard free energy change and equilibrium constant
- Energy rich compounds: Phosphoenolpyruvate, Thioesters, ATP
- Role of Stereoisomers in biology

Unit . 3: Carbohydrates and Lipids (10hrs)

- Definition, Functions and Classification of Carbohydrates
- Structure of Monosaccharides
- Properties of Monosaccharides
- Overview of Disaccharides & Polysaccharides: Sucrose, Lactose, Starch, Cellulose, Glycogen, Hyaluronic acid, Chondroitin Sulfate, Heparin
- Definition, Functions and Classification of Lipids
- Fatty acids: Structure and types
- Introduction to phospholipids: Examples and Significance
- Introduction and Significance of Steroids

Unit . 4: Proteins and Nucleic acids (10hrs)

- Definition, Functions and Classification of Proteins
- Amino acids: Classification, Physical & Chemical Properties
- Structure of Proteins: Primary, Secondary, Tertiary & Quaternary Levels
- Introduction to Nitrogen Base, Nucleosides & Nucleotides
- Structure of Deoxyribonucleic acid: A-DNA, B-DNA, Z-DNA
- Unusual Structures of DNA
- Introduction to RNA & its types

Unit . 5: Enzymes**(10hrs)**

- Definition and Classification of Enzymes
- Definition of Apoenzyme, Core Enzyme, Holo enzyme, Coenzyme, Cofactors, Prosthetic Groups
- Mechanism of enzyme action – Active Sites, Activation Energy, Lock & Key Model, Induced Fit model
- Factors affecting enzyme activity
- Definition of terms: Enzyme unit, Specific Activity and turn over number
- Phenotypic and genotypic regulation of Enzymes

Text Book:

- Atlas, R.M., Bertha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Satyanarayan, U. (2008). Biotechnology. Kolkata, West Bengal: Books and allied (P) Ltd
- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing co. Ltd.
- Powar, C.B., Daginawala, J.F. (1982). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.

Reference Book:

- Conn E.E., Stumpt P.K. (1989). Outlines of Biochemistry. Wiley publication.
- Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.
- Nelson, D.L., Cox, M.M. (2013). Lehninger Principles of Biochemistry. W.H. Freeman publication.

16UMBCC06	Core 5: Bacteriology	4hrs/wk	4 Credits
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Course Objectives:

At the end of the course, the student shall be able to

1. Understand the nutritional requirements of microbes
2. Understand the principal and the techniques of microbial cultivation
3. Know the techniques of pure culture
4. Understand the methods of microbial control

Unit . 1: Bacterial Systematics (10hrs)

- Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain
- Conventional, Molecular and Recent approaches to polyphasic bacterial taxonomy,
- Evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences.
- Differences between eubacteria and Archaeobacteria

Unit . 2: Microbial Growth and Nutrition (09hrs)

- Introduction and Definition of Growth, Modes of Cell division in procaryotes
- Septum Formation
- Bacterial Growth Curve
- Synchronous culture & Continuous Growth of Bacteria
- Measurement of Bacterial Growth

Unit . 3: Cultivation of Bacteria and Pure Culture Techniques (09hrs)

- Nutritional requirements of Bacteria
- Nutritional types of Bacteria
- Chemical requirement of Growth – Bacteriological Media & their Types
- Physical Conditions required for growth – Air, pH & Temperature
- Cultivation of Anaerobes
- Natural Microbial Population (Mixed Cultures)
- Selective Methods to obtain Pure Cultures
- Isolation and Preservation of pure cultures
- Cultural Characteristics

Unit . 4: Control of Microbes by Physical methods (10hrs)

- Definitions: Sterilization, Disinfection, Sanitization, Antisepsis, Microbiocidal & Microbiostasis, Thermal Death Time, Thermal Death Point, D-Value, z-Value & F-value
- Control by High Temperature
- Moist Heat – Autoclave, Fractional Sterilization, Boiling, Use of Inspissator, Pasteurization
- Dry Heat – Hot Air Oven, Incineration
- Control by Low Temperature
- Control by Desiccation
- Control by Radiation – UV radiation, x-rays, Gamma rays and Cathode rays
- Control by Surface tension & Interfacial tension
- Control by Filtration

Unit . 5: Control of Microbes by Chemical methods**(10hrs)**

- Characteristics of an Ideal Antimicrobial agent
- Phenol & Phenolic compounds
- Alcohols
- Halogens – Iodine & Chlorine
- Heavy Metals & Dyes
- Detergents & Quaternary Ammonium Compounds
- Aldehydes & Gaseous agents
- Phenol coefficient method
- Antibiotics as Antimicrobial Agent- Types, mode of action, applications

Text Books:

- Atlas, R.M., Bertha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing co. Ltd.
- Powar, C.B., Daginawala, J.F. (1982). General Microbiology Vol-I. Mumbai: Himalaya Publishing House.

Reference Book:

- Stanier, R.Y. (1987). General Microbiology, 5th Edition: Macmillan publication.

16UMBCC07	Core Practical – 2 – Bacteriology and Microbial Biochemistry	6hrs/wk	3 Credits
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Course Objectives:

The course is designed to impart practical skills and the fundamental understanding about;

1. Qualitative and quantitative analysis of Biomolecules
2. Determination of enzymatic activity
3. Techniques of Microbial Isolation
4. Enumeration of microbial cells
5. Effect of Chemicals on microbial growth

- 1) Estimation of Protein by Foiln-Lowry's Method.
- 2) Estimation of Reducing Sugar by DNSA Method.
- 3) Estimation of Reducing Sugar by Cole's Method.
- 4) Estimation of Non Reducing Sugar by Cole's Method.
- 5) Estimation of DNA by DPA Method.
- 6) Estimation of RNA by Orcinol Method.
- 7) Qualitative Analysis of Carbohydrates.
- 8) Qualitative Analysis of Proteins & Amino acids.
- 9) Determination of alpha amylase activity by iodometric method.
- 10) Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant.
- 11) Isolation of Pure culture by Streak plate method.
- 12) Isolation of Pure culture by Spread plate method.
- 13) Isolation of Pure culture by Pour plate method.
- 14) Study of Turbidometric growth curve of *E.coli* and derivation of Growth rate & Generation time.
- 15) Enumeration of bacteria by viable count technique.
- 16) Enumeration of bacteria by Total Count Technique.
- 17) Effect of Disinfectants by Paper disc Method.
- 18) Demonstration to Lyophilizer.
- 19) Effect of various chemicals on microbial growth

Reference Books:

- Jayaraman, J. (1981). Laboratory Manual in Biochemistry: Wiley publication.
- Sawhney S.K., Singh, R. (2005). Introductory Practical Biochemistry: Alpha Science International.
- Chappuccino, J.G., Sherman, N. (2004). International student edition: Microbiology- A laboratory Manual 4th edition: Benjamin Cummings publications

- Andreas, D. B., Ouellette, B.F.F. (2004). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*, 3rd Edition: Wiley publication.
- Misener, S. (2000). *Bioinformatics – Methods and Protocols*: Humana Press.