

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

Affiliated to Saurashtra University, Rajkot

**Department of Microbiology
Scheme of Instruction & Examinations
Integrated B.Sc. - M.Sc. Microbiology programme**

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.
5. To impart in-depth knowledge, inculcate scientific thinking and develop practical skills to Microbiology students to pursue career in industry, academia or research.
6. To develop Microbiologists with ability to design, plan and implement research projects, scientific report writing skills and apply them to solve problems related to areas of Microbiology.
7. To work safely, independently and effectively in Microbiology laboratories along with understanding of microbes at molecular level.
8. To enable students to understand the applications of microbiology in healthcare, agriculture, food technology & environmental protection.

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							
16ILCEN01	Functional English-I	3	3	40	60	100	3
Part – II							
16IMBCC01	Core 1: Fundamentals of Microbiology	4	3	30	70	100	4
16IMBCC02	Core 2: Cell Biology	4	3	30	70	100	4
16IMBCC03	Core 3: Basic Biochemistry	4	3	30	70	100	4
16IMBDA01	DSE allied-1: Basics of Zoology and Life Sustainable Systems in Human	4	3	30	70	100	4
16IMBCC04	Core Practical - 1- Fundamentals of Microbial Science	6	6*	40	60	100	2
16IMBDA02	DSE allied-1–Practical Basics of Zoology and Life Sustainable Systems in Human	2	3	20	30	50	1
TOTAL		27				650	22
Part –III							
	AECC-I: Environmental Sciences	1	--	-	-	-	-
	SEC-I: Value Education –I	1	--	REMARKS			1
		29					

*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
				CIA	SEE	Total	
Part –I							
16ILCEN02	Functional English-II	3	3	40	60	100	3
Part- II							
16IMBCC05	Core 4: Microbial Diversity	4	3	30	70	100	4
16IMBCC06	Core 5: Microbial Ecology	5	3	40/3 0	60/7 0	100	5
16IMBCC07	Core 6: Bacteriology	4	3	30	70	100	4
16IMBDA03	DSE allied-2: Medicinal Botany	4	3	30	70	100	4
16IMBCC08	Core Practical – 2 Microbial Biodiversity	6	6*	40	60	100	2
16IMBDA04	DSE allied-2: Practical - Medicinal Botany	2	3	20	30	50	1
TOTAL		28				650	23
Part – III							
	AECC-I: Environmental Sciences	1	-	REMARKS			2
	SEC-I: Value Education – II	1	-	REMARKS			1
		30					

*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
				CIA	SEE	Total	
Part –I							
16ILCEN03	Advanced English Language – I	3	3	40	60	100	3
Part –II							
16IMBCC09	Core 7: Aquatic Microbiology	4	3	30	70	100	4
16IMBCC10	Core 8: Agricultural Microbiology	4	3	30	70	100	4
16IMBCC11	Core 9: Food and Dairy Microbiology	4	3	30	70	100	4
16IMBDA05	DSE allied -3: Sustainable Management	4	3	40	60	100	4
16IMBCC12	Core Practical – 3 Applied Microbiology	6	6*	40	60	100	3
16IMBDA06	DSE Allied -3: Practical - Sustainable Management	2		-	-	-	-
TOTAL		27				600	22

*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
				CIA	SEE	Total	
Part - I							
16IENLC04	Advanced English Language – II	3	3	40	60	100	3
Part - II							
16IMBCC13	Core 10: Bacterial Metabolism	4	3	30	70	100	4
16IMBCC14	Core 11: Analytical Techniques	4	3	30	70	100	4
16IMBCC15	Core 12: Industrial Microbiology	4	3	30	70	100	4
16IMBDA07	DSE allied -4: Biostatistics and Bioinformatics	4	3	30	70	100	4
16IMBCC16	Core Practical – 4 Bacterial Physiology	6	6	40	60	100	3
16IMBDA08	DSE allied -4 Practical Biostatistics and Bioinformatics	2	--	20	30	50	1
TOTAL		27				650	23

*** Internship/ Training / Project in the vacation after Semester – IV for 2 months. The Internship / training report is to be submitted in the V Semester and the Viva-voce will be conducted in the beginning of V Semester**

Semester – V							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks allotted			Credits
				CIA	SEE	Total	
Part –II							
16IMBCC17	Core 13: Immunology	4	3	30	70	100	4
16IMBCC18	Core 14: Medical Microbiology and Diagnostic Techniques	4	3	30	70	100	4
16IMBCC19	Core 15: Corporate Microbiology - Self Study	1	-	30	70	100	4
16IMBCC20	Core 16: Computer Based Test (for Core Courses of Semesters I to V)	-	2	50	-	100	1
16IMBDC01/ 16IMBDC02/ 16IMBDC03	DSE-Core elective 1 Pharmaceutical Microbiology/ Quality Assurance and Quality control/ Bioethics and IPR	4	3	30	70	100	4
16IMBCC21	Core Practical- 5 Medical and Diagnostic techniques	9*	6	60	90	100	3
16IMBDC04/ 16IMBDC05/ 16IMBDC06	DSE-Core elective 1 – Practical: Pharmaceutical Microbiology/ Quality Assurance and Quality control/ Bioethics and IPR	3	3	20	30	50	1
16IMBCC22	Research Project/ Training/Internship	In the vacation after semester – IV		50	50	100	6
	Microbiology Outreach Activity	2	-	-	-	-	-
	Generic Elective-1 From Common UG Pool	2	-	100	-	100	2
TOTAL		29				850	29
*3 hrs each Day for 3 days							

Semester – VI							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks allotted			Credits
				CIA	SEE	Total	
Part –II							
16IMBCC23	Core 17: Molecular Biology	4	3	30	70	100	4
16IMBCC24	Core 18: Genetic Engineering	4	3	30	70	100	4
16IMBDC07/ 16IMBDC08/ 16IMBDC09	DSE-Core elective 2 Mushroom Cultivation / Microbiology and Health Care / Fundamentals of Research Methodology	4	3	60	40	100	4
16IMBCC25	Core Practical- 6 Genetics and Molecular biology	9*	6	60	90	100	3
16IMBDC10/ 16IMBDC11/ 16IMBDC12	DSE-Core elective 2 Practical Mushroom Cultivation / Microbiology and Health Care / Fundamentals of Research Methodology	3	-	-	-	-	1
16IMBCC26	Microbiology Outreach Activity	2	-	-	-	-	2
	Generic Elective-2 From Common UG Pool	2	3	50	-	100	2
		28				500	19
				Total Marks: 3900			
				Total Credit: 132 + 6 + 8 = 146			

Semester – VII							
Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CIE	SEE	Total	
Part- I							
16IMBCC27	Core 19: Cell Biology	4	3	30	70	100	4
16IMBCC28	Core 20: Microbial Genetics	4	3	30	70	100	4
16IMBCC29	Core 21: Microbial Diversity and Evolution	4	3	30	70	100	4
16IMBDA09/ 16IMBDA10	DSE- Allied- 5 - Research Methodology and Experimental Design/ Good Laboratory Practice	5	3	40	60	100	5
16IMBCC30	Core Practical - 7 Cell Biology, Microbial Genetics and Microbial Diversity	12	9(3 days)	80	120	200	4
Part – II							
16IMBCE01	Poster/ Seminar Presentation	1	-	-	-	-	1
Total		30				650	22
16IMBCE02	Professional Certification course		-				2
Total		30				650	24

Semester – VIII

Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CIE	SEE	Total	
Part –I							
16IMBCC31	Core 22: Bioprocess Technology	4	3	30	70	100	4
16IMBCC32	Core 23: Microbial Physiology and Energetic	4	3	30	70	100	4
16IMBCC33	Core 24: Mycology and Virology – Self Study	1	3	30	70	100	4
16IMBCC34	Core 25: Computer Based Test	-	-	100	-	100	1
16IMBDC13	DSE- Core—3: Pharmaceutical Microbiology	4	3	30	70	100	4
16IMBDA11/ 16IMBDA12/ 16IMBDA13	DSE- Allied-- 6- Soil and Agriculture Microbiology / Food and Dairy Microbiology / Cell Culture Technology	4	3	30	70	100	4
16IMBCC35	Core Practical - 8 Bioprocess Technology, Physiology and Energetic, Mycology and Virology	6	6	80	120	200	3
16IMBDC14	DSE- Core—3 – Practical Pharmaceutical Microbiology	2	3	20	30	50	1
16IMBDA14/ 16IMBDA15/ 16IMBDA16	DSE- Allied-- 6 – Practical Soil and Agriculture Microbiology / Food and Dairy Technology	2	3	50	-	50	1
	Generic elective – 3	2	-	100	-	100	2
Part-II							
16IMBCE03	Research Proposal Writing	1	-	-	-	-	1
Total		30				1000	29

Semester-IX							
Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CIE	SEE	Total	
Part-I							
16IMBCC36	Core 26: Molecular Biology and Genetic Manipulation Techniques	4	3	30	70	100	4
16IMBCC37	Core 27: Basic Instrumentation and Biophysics and	4	3	30	70	100	4
16IMBCC38	Core Practical – 9 Molecular Biology and Genetic Manipulation Techniques and Basic Instrumentation and Biophysics	6	9	60	90	150	3
	Project / Training / internship	16	-	-	-	-	-
		30				350	11

Semester – X							
Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CIE	SEE	Total	
Part – I							
16IMBCC39	Core 28: Environmental Microbiology	4	3	30	70	100	4
16IMBCC40	Core – 29: Forensic Microbiology	4	3	30	70	100	4
16IMBCC41	Core – 30: Medical Microbiology and Immunology	4	3	30	70	100	4
16IMBDC15	DSE- Core-- 4: Bio-entrepreneurship, Bioethics & IPR and Bioinformatics	4	3	40	60	100	4
16IMBCC42	Core Practical – 10 Environmental Microbiology, Forensic Science and Medical Microbiology and Immunology	9	6	60	140	200	3
16IMBCC43	Project / Internship/Training and Viva Voce	5	-	80	120	200	12
		30				800	31
TOTAL						2800	95

FOR SEMESTER: I - VI

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 V AND VI will be assessed in VI semester.

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

Project/Survey/Review writing / Internship: Between 4th and 5th semester (Vacation period)

Total Credit to earn Degree = 146credits

Part I and II = 138credits 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	126
3.	PART III: AECC- I & II SEC – I,II &III	Remarks	08
TOTAL		3900	146

- PART – I : LANGUAGE COURSE**

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

S.No	Semester	Course code	Course
1	I	16ILCEN01	Functional English –I
2	II	16ILCEN02	Functional English –II
3	III	16ILCEN03	Advanced English Language – I
4	IV	16ILCEN04	Advanced English Language – I

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

CORE COURSES [Theory]

S. No	Semester	Course code	Course
1	I	16IMBCC01	Core 1: Fundamentals of Microbiology
2		16IMBCC02	Core 2: Cell Biology
		16IMBCC03	Core 3: Basic Biochemistry
3	II	16IMBCC05	Core 4: Microbial Diversity
4		16IMBCC06	Core 5: Microbial Ecology
5		16IMBCC07	Core 6: Bacteriology
6	III	16IMBCC09	Core 7: Aquatic Microbiology
7		16IMBCC10	Core 8: Agricultural Microbiology
8		16IMBCC11	Core 9: Food and Dairy Microbiology
9	IV	16IMBCC13	Core 10: Bacterial Metabolism
10		16IMBCC14	Core 11: Analytical Techniques
11		16IMBCC15	Core 12: Industrial Microbiology
12	V	16IMBCC17	Core 13 Immunology
13		16IMBCC18	Core 14: Medical Microbiology & Diagnostic Techniques
14		16IMBCC19	Core 15: Corporate Microbiology-Self Study
15		16IMBCC20	Core 16: Computer Based Test
16	VI	16IMBCC23	Core 17: Molecular Biology
17		16IMBCC24	Core 18: Genetic Engineering

CORE COURSE [Practical]

S. No	Semester	Course code	Course
1	I	16IMBCC04	Core Practical - 1- Fundamental of Microbial Science
2	II	16IMBCC08	Core Practical – 2- Microbial biodiversity
3	III	16IMBCC12	Core Practical – 3- Applied Microbiology
4	IV	16IMBCC16	Core Practical – 4 - Bacterial Physiology
5	V	16IMBCC21	Core Practical – 5 - Medical and diagnostic techniques
6	VI	16IMBCC25	Core Practical - 6 - Genetics and Molecular biology

OTHER CORE COURSES

S. No.	Semester	Course Code	Course
1	IV & V	16IMBCC22	Research Project/ Training/Internship
2	V – VI	16IMBCC26	Microbiology Outreach Programme

DSE ALLIED COURSE

S.No	Semester	Course code	Course
1	I	16IMBDA01	Basics of Zoology and Life Sustainable Systems in Human
2	II	16IMBDA03	Medicinal Botany
3	III	16IMBDA05	Sustainable Management
4	IV	16IMBDA07	Biostatistics and Bioinformatics

DSE ALLIED COURSE [Practical]

S.No	Semester	Course code	Course
1	I	16IMBDA02	Basics of Zoology and Life Sustainable Systems in HumanLife Sustainable Systems in Humans
2	II	16IMBDA04	Medicinal Botany
3	III	16IMBDA06	Sustainable Development and Management
4	IV	16IMBDA08	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	16IMBDC01/	Pharmaceutical Microbiology	16IMBDC04/	Pharmaceutical Microbiology
		16IMBDC02 /	Quality Assurance and Quality Control	16IMBDC05/	Quality Assurance and Quality Control
		16IMBDC03	Bioethics and IPR	16IMBDC06	Bioethics and IPR
2.	VI	16IMBDC07/	Mushroom Cultivation	16IMBDC10/	Mushroom Cultivation
		16IMBDC08/	Microbiology and health	16IMBDC11/	Microbiology and health
		16IMBDC09	Research Methodology	16IMBDC12	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

GENERIC ELECTIVE COURSE

S. No.	Semester	Course Code	Course	Name of Program
1	V	16IMBGE01	Microbes in Human welfare	For all other UG Programs
2	VI	16IMBGE02	IPR and Patenting	For all other UG Programs

FOR SEMESTER VII - X

• **TOTAL MARKS & CREDIT DISTRIBUTION**

S.NO	PART	Total Marks	Total Credits
1.	PART I: Core, DSE Allied, (Theory & Practical)	2800	91
2.	PART II : SEC, CC	Remarks	02
4	Professional Certification course	-	02
TOTAL		3000	95

• **PART – I : CORE, DSE**

CORE COURSES [Theory]

S. No	Semester	Course code	Course
1	VII	16IMBCC27	Core 19: Cell Biology
2		16IMBCC28	Core 20: Microbial Genetics
3		16IMBCC29	Core 21: Microbial Diversity and Evolution
4	VIII	16IMBCC31	Core 22: Bioprocess Technology
5		16IMBCC32	Core 23: Microbial Physiology and Energetic
6		16IMBCC33	Core 24: Mycology and Virology – Self Study
7		16IMBCC34	Core 25: Computer Based Test
8	IX	16IMBCC36	Core 26: Molecular Biology and Genetic Manipulation Techniques
9		16IMBCC37	Core 27: Basic Instrumentation and Biophysics
10	X	16IMBCC39	Core 28: Environmental Microbiology
11		16IMBCC40	Core 29: Forensic Science
12		16IMBCC41	Core 30: Medical Microbiology and Immunology

CORE COURSES [Practical]

S. No	Semester	Course code	Course
1	I	16IMBCC30	Core Practical – 7 - Cell Biology, Microbial Genetics and Microbial Diversity
2	II	16IMBCC35	Core Practical – 8- Bioprocess Technology, Physiology and Energetic and Mycology and Virology
3	III	16IMBCC38	Core Practical – 9 – Molecular Biology and Genetic Manipulation Techniques and Basic Instrumentation and Biophysics
4	IV	16IMBCC42	Core Practical – 10 Environmental Microbiology, Forensic Science and Immunology

OTHER CORE COURSES

S. No.	Semester	Course Code	Course
1	IX - X	16IMBCC43	Internship / Training / Project and Viva Voce

DSE CORE COURSES - [Theory & Practical]

S. No	Semester	Theory		Practical	
		Course code	Course	Course code	Course
1.	VIII	16IMBDC13	Pharmaceutical Microbiology	16IMBDC14	Pharmaceutical Microbiology
2.	X	16IMBDC15/	Bioentrepreneurship, Bioethics, IPR and Bioinformatics	-	-

DSE ALLIED COURSES - [Theory & Practical]

S. No	Semester	Theory		Practical	
		Course code	Course	Course code	Course
1.	VII	16IMBDA09/ 16IMBDA10	Research Methodology and Biostatistics / Good Laboratory Practice	-	-
2.	VIII	16IMBDA11/ 16IMBDA12/ 16IMBDA13	Soil and Agriculture Microbiology / Food and Dairy Technology / Cell Culture Technology	16IMBDA14/ 16IMBDA15/ 16IMBDA16	Soil and Agriculture Microbiology / Food and Dairy Technology / Cell Culture Technology

GENERIC ELECTIVE:

Offered by Microbiology Department to the students of other Integrated B.Sc - M.Sc Programmes

S. No	Semester	Course
1.	VIII	Bioinformatics and Biostatistics

- **PART – II : COMPETENCY ENHANCEMENT COURSES**

S. No	Semester	Course code	Course
1	VII	16IMBCE01	Poster/ Seminar Presentation
2	VII	16IMBCE02	Professional Certification course
2	VIII	16IMBCE03	Research Proposal writing

- **PART – III : SKILL ENHANCEMENT COURSES**

S. No.	Semester	Course Code	Course
1	I	-	Value Added Courses offered by the Department / Institution

**Integrated B.Sc. - M.Sc. MICROBIOLOGY
SEMESTER - I**

.16IMBCC01	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. and N.R. Kreig (1993). Microbiology, 5th Edition, Tata Mc Graw Hill Publishing co. Ltd., New Delhi.
- Prescott, M. J., Harley, J.P. and D.A. Klein (2002). “Microbiology”, 5th Edition, WCB Mc GrawHill, New York

Reference Books:

- Alcamo’s Fundamentals of Microbiology, Ninth edition, Jeffrey C .Pommerville .Jones and Barlett learning LLC.
- Black, J. G. (2005). “Microbiology : Principles and Explorations”. John Wiley, U.S.A
- Tortora, G.J., Funke, B. R. and C. L. Case (2004). “ Microbiology : An Introduction”, Pearson Education, Singapore.
- Singh, R.P. (2007). “General Microbiology”. Kalyani Publishers, New Delhi.

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, andCytoskeletal 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 and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
- Verma P S, (2004). Cell biology, Genetics, Evolution and Ecology, 14th Edition, S Chand Publishers.
- C.B.Powar, Cell Biology, Himalaya Publications

Reference Books:

- Lansing M. Prescott, John P. Harley, Donald A. Klein. (2001). Microbiology, 5th Edition. McGraw – Hill Higher Education.
- Stanier, Y. Ingraham J.L. Wheolis H.H and Painter P.R. (1986). The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.
- Tortora, Funke and Case. (2008). Microbiology, 8th edition. Mc Graw Hill Company.

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., Microbiology, 2 nd Edition. Wm. C. Brown Publishers (Page. 1159 to 1177: Appendix-II)
- Satyanarayana. U., Biochemistry, Books and allied Pvt. Ltd. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
- Powar and Daginawala, General Microbiology Vol-I. Himalaya Publishing House, Mumbai.

Reference Book:

- Conn E.E. and Stumpt P.K , Outlines of biochemistry 5th Ed.,John Wiley & Sons, 2009
- Stanier R.Y, General Microbiology 5th Ed, MacMillan, 2009
- David Lee Nelson, Michael M. Cox,Lehninger Principles of Biochemistry, 5th Edition, W.H.Freeman, 2013

16IMBCC04	Core Practical – 1- Fundamentals of Microbial Science	6hrs/wk	2 Credits
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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.
- 18) Qualitative and quantitative analysis of Biomolecules
- 19) Determination of enzymatic activity
- 20) Techniques of Microbial Isolation
- 21) Enumeration of microbial cells
- 22) Effect of Chemicals on microbial growth
- 23) Estimation of Protein by Foiln-Lowry's Method.
- 24) Estimation of Reducing Sugar by DNSA Method.
- 25) Estimation of Reducing Sugar by Cole's Method.
- 26) Estimation of Non Reducing Sugar by Cole's Method.
- 27) Estimation of DNA by DPA Method.
- 28) Estimation of RNA by Orcinol Method.
- 29) Qualitative Analysis of Carbohydrates.
- 30) Qualitative Analysis of Proteins & Amino acids.
- 31) Determination of alpha amylase activity by iodometric method.

Reference Books:

- Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
- Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
- Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi
- Konika Sharma, Manual of Microbiology – Tools and Techniques , Ane books, Delhi
- Benson, Microbiological Applications – Laboratory Manual in General Microbiology – 8th edition, MacGrow Hill Companies, 2001

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, Healey and Klein., Microbiology-5th International Edition, Tata-McGraw Hill publications, Delhi
- Atlas. R.M., Principles of Microbiology- 2nd Edition ,
- Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). “Microbiology” 5th Edition, Tata Mc Graw Hill Publishing co. Ltd., New Delhi.

Reference Books:

- Modi, H.A. Elementary Microbiology - Vol -I, Akta Prakashan, Nadiyad.
- Modi, H.A. Elementary Microbiology – Vol-II, Akta Prakashan, Nadiyad.
- Dubey, R.C.and Maheshwari, D.K., A Text Book of Microbiology, S. Chand Publications , New Delhi.
- Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
- Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.

Course objectives:

- To introduce the field of microbial ecology and environmental microbiology
- To explore the functional ubiquity and diversity of microorganisms

Unit 1: Introduction to Microbial ecology

- History, Significance, Developments in the field of Microbial Ecology
- Major Contributions
- Microorganisms and their Habitat:
 - Terrestrial Environment: Soil characteristics, Soil profile, Soil formation, Soil as a natural habitat of microbes, Soil microflora
 - Aquatic Environment: Stratification & Microflora of Freshwater & Marine habitats
 - Atmosphere: Stratification of the Atmosphere, Aeromicroflora, Dispersal of Microbes
 - Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.
 - Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit 2: Successions and Interactions

- Succession of microbial communities in the decomposition of plant organic matter
- Biological Interactions
 - Microbe–Microbe Interactions
 - Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Biocontrol agents
 - Microbe–Plant Interactions
 - Roots, Aerial Plant surfaces, Biological Nitrogen fixation- (symbiotic / nonsymbiotic - biofertilizers)
 - Microbe–Animal Interactions (2 periods)
 - Role of Microbes in Ruminants, Nematophagus fungi, Luminescent bacteria as symbiont

Unit 3: Biogeochemical cycles

- Carbon cycle: Microbial degradation of polysaccharide (cellulose, hemicellulose, lignin, chitin)
- Nitrogen cycle: Ammonification, nitrification, denitrification & nitrate reduction. Nitrate pollution.
- Phosphorous cycle: Phosphate immobilization and phosphate solubilization
- Sulphur Cycle: Microbes involved in sulphur cycle

Unit 4: Solid Waste Management

- Sources and types of solid waste,
- Methods of disposal of solid waste (incineration, composting, sanitary landfill)
- Liquid Waste Management:
Composition of sewage; strength of sewage (BOD and COD); Primary, secondary (aerobic – oxidation pond, trickling filter, rotating biological contractor/biodisc system, activated sludge process and anaerobic – septic tank, imhoff tank, anaerobic digester) and tertiary sewage treatment

Unit 5: Applications of Microbial processes

- Bioleaching
- Biodeterioration
- Microbial deterioration of metals (corrosion), textile and paper

Text Books:

- Atlas and Bertha, Microbial Ecology, 4th Edition
- Madigan et al. (2011) Brock Biology of Microorganisms, 13th ed. (Pearson),
- Barton LL & Northup DE (2011) Microbial Ecology (Wiley-Blackwell).

Reference Book:

- Begon M, Townsend CR & Harper JL (2006) Ecology – From Individuals to Ecosystems, 4th ed. (Blackwell).
- Kirchner DL (2008) Microbial Ecology of the Oceans (Wiley).
- Madsen EL (2008) Environmental microbiology - from genomes to biogeochemistry (Blackwell).
- Rochelle PA (2001) Environmental molecular microbiology: protocols and applications.

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., Microbiology, 2 nd Edition. Wm. C. Brown Publishers (Page. 1159 to 1177: Appendix-II)
- Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd. New Delhi.
- Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.

Reference Book:

- Stanier R.Y ,General microbiology ,5th Ed

Objective:

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
- 6) Estimation of Protein by Foiln-Lowry's Method.
- 7) Estimation of Reducing Sugar by DNSA Method.
- 8) Estimation of Reducing Sugar by Cole's Method.
- 9) Estimation of Non Reducing Sugar by Cole's Method.
- 10) Estimation of DNA by DPA Method.
- 11) Estimation of RNA by Orcinol Method.
- 12) Qualitative Analysis of Carbohydrates.
- 13) Qualitative Analysis of Proteins & Amino acids.
- 14) Determination of alpha amylase activity by iodometric method.
- 15) Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant.
- 16) Study of Turbidometric growth curve of *E.coli* and derivation of Growth rate & Generation time.
- 17) Enumeration of bacteria by viable count technique.
- 18) Enumeration of bacteria by Total Count Technique.
- 19) Effect of Disinfectants by Paper disc Method.
- 20) Demonstration to Lyophilizer.
- 21) Effect of various chemicals on microbial growth
- 22) Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action
- 23) Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C)
- 24) Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
- 25) Detection (qualitative) of the presence of enzymes (dehydrogenase, amylase, urease) in soil.
- 26) Isolation of Rhizobium from root nodules of legumes
- 27) Isolation of Azotobacter/Azospirillum from soil
- 28) Isolation of phosphate solubilizers from soil

Reference Books:

- J.Jayaraman., Laboratory Manual in Biochemistry
- S.K.Sawhney and Randhir Singh., Introductory Practical Biochemistry
- James Cappuccino. Microbiology- A Laboratory Manual
- Andreas Baxevanis, Bioinformatics – A Practical guide to analysis of genes and Proteins.
- Stephan Misener, Bioinformatics – Methods and Protocols