AVS

COLLEGE OF ARTS & SCIENCE

(AUTONOMOUS)

Attur Main Road, Ramalingapuram, Salem - 106.

(Recognized under section 2(f) & 12(B) of UGC Act 1956 and

Accredited by NAAC with 'A' Grade)

(Co - Educational Institution | Affiliated to Periyar University, Salem

ISO 9001 : 2015 Certified Institution)

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Syllabus for

B. Sc MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM –

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

(CBCS – LOCF)

(Applicable to the Candidates admitted from 2023-24 onwards)

VISION

- To attain excellence in the field of education by creating competent scholars with a touch of human values.

MISSION

- To accomplish eminence in the academic domain.
- To provide updated infrastructure.
- To educate value based education.
- To impart skills through efficient training programs.
- To cultivate culture and tradition with discipline and determination.

REGULATIONS

1. Eligibility for Admission:

A candidate who has passed higher secondary examination in any one of the biological sciences (Botany, Zoology, Biology). (Academic/Vocational stream - Agri, Home Science, Poultry) under higher secondary board of examination, Tamil Nadu or as per norms set by the Government of Tamil Nadu or an examination accepted as Equivalent thereto by the Syndicate subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the B.Sc., Microbiology degree examination of this University after a course of study of three academic years.

2. Duration:

The course for the degree of Bachelor of Microbiology shall consist of three academic years divided into six semesters.

3. Eligibility for award of degree:

A candidate shall be eligible for the award of the degree only if he / she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than Three academic years, passed the examination of all the six semesters prescribed earning 141 credits and fulfilled such conditions as have been prescribed therefore.

4. Course of Study:

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

5. Scheme of Examination:

The theory examination shall be three hours duration to each paperat the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the sub sequent examinations. The practical examinations for UG course should be conducted in the semesters.

6. Passing Rules:

Theory- Internal Mark-25 External Mark-75 = 100 Marks

Practical- Internal Mark-40 External Mark- 60 = 100 Marks

i) Theory

Maximum Mark-75

Minimum Pass Mark-30

ii) Practical

Maximum Mark- 60

Minimum Pass Mark-24

Programme Outcomes (POs) On successful completion of the B. Sc Microbiology	
PO1	Students will also acquire knowledge in laboratory safety and in routine and specialized microbiological skills applicable to clinical research, including accurately reporting observations and analysis.
PO2	Students will help them to impart the knowledge of the basic principles of bacteriology, virology, mycology, immunology and parasitology including the nature of pathogenic microorganisms, pathogenesis, laboratory diagnosis, transmission, prevention and control of diseases common in the country.
PO3	Students will get Basic knowledge about microbiology, biophysical techniques, biochemistry, cell biology, molecular biology, cancer biology, metabolic disorders etc. To create awareness to become conscious citizens with a sense of responsibility towards their surrounding irrespective of any man made differences.
PO4	Students will gain knowledge of various bioinstrumentation and biotechnological applications of microorganisms and will learn the industrially important substances produced by microorganisms and familiar with the unique role of microbes in genetic modification technologies.
PO5	Students will appreciate the biological diversity of microbial forms and be able to describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations. They will learn of the role of microorganisms in plant, animal and human health and disease.

Program Specific Outcomes (PSOs)	
After the successful completion of B. Sc Microbiology programme the students are expected to	
PSO1	Themicrobiologicalequipmentespeciallymicroscope,Incubator,LaminarAirFlowchamber,Centrifuge etc.,
PSO2	The micro organism specially Bacteria, Fungi, Algae, Protozoa, Virus.
PSO3	The various fields in microbiology particularly Agricultural, Medical, Environmental, Industrial areas.
PSO4	Explain and describe importance of organic compounds and its chemistry found in living cells. Understand and explain various processes of metabolism of carbohydrates amino acids and vitamins. Explain DNA
PSO5	**PSO4:** Prepare and view specimens for examination using light microscopy. Use pure culture and selective techniques to isolate microorganisms. Identify microorganisms (media-based
PSO6	**PSO5:** Understand the concept of disease development

Programme Educational Objectives (PEOs)	
The B. Sc Microbiology programme describe accomplishments the graduates are expected to attain within five to seven years after graduation.	
PEO1	Analyze the basics concepts of microorganisms, its developments and its classification for microbial diversity and its applications.
PEO2	Apply the knowledge acquired on different microscopes, working principles for visualization and study of structural features of microorganisms.
PEO3	Compare eukaryotic and prokaryotic cell structures observe and interpret them through staining procedures
PEO4	Executing cultivation procedures to identify and differentiate morphological
PEO5	Employ sterilization techniques in health

CREDIT DISTRIBUTION FOR 3 YEARS B. Sc MICROBIOLOGY PROGRAMME

Part	Course Type	Credits per Course	No. of Papers	Total Credits
Part I	Language – I (Tamil/Hindi/French)	3	4	12
Part II	Language – II (English)	3	4	12
Part III	Core Courses- Theory	4	5	40
		5	4	
	Core Courses- Practical	5	4	28
		4	2	
	Major Elective Courses- Theory			
	Major Elective Courses- Practical			
	Generic Discipline Specific/ Allied Courses – Theory	3	8	24
	Generic Discipline Specific/ Allied Courses – Practical			
			Total	**92**
Part IV	Non Major Elective Courses	2	2	4
	Skill Enhancement Courses	2	4	9
	Professional Competency Skill Enhancement Course	2	1	2
	EVS (Environmental Studies)	2	1	2
	Value Education	2	1	2
	Internship	2	1	2
	Field Project	3	1	3
	Research Project (for PG only)			
	MOOC/ SWAYAM/ NPTEL Courses			
			Total	**24**
Part V	Extension Activity (NSS/NCC/Physical Education)	1	1	1
			Total Credits	**141**

CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT DISTRIBUTION FOR 3 YEARS B. Sc PHYSICS PROGRAMME

Parts	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI	Total Credits
Part I	**3**	**3**	**3**	**3**	**-**	**-**	**12**
Part II	**3**	**3**	**3**	**3**	**-**	**-**	**12**
Part III	**13**	**13**	**13**	**13**	**22**	**18**	**92**
Part IV	**4**	**4**	**3**	**6**	**4**	**3**	**24**
Part V	**-**	**-**	**-**	**-**	**-**	**1**	**1**
Total	**23**	**23**	**22**	**25**	**26**	**22**	**141**

*Part I, II and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programmes and the other components IV and V have to completed during the duration of the programmes as per the norms, to be eligible for obtaining the UG degree.

METHOD OF EVALUATION

Evaluation	Components		Marks
Internal Evaluation	Continuous Internal Assessment Test	15	25 Marks
	Assignments	3	
	Class Participation	2	
	Distribution of marks for Attendance (in percentage) 96 – 100: 5 Marks 91 – 95: 4 Marks 86 – 90: 3 Marks 81 – 85: 2 Marks	5	
External Evaluation	End Semester Examination		75 Marks
Total			**100 Marks**

Note: 1.UG Programmes- A candidate must score minimum 10 marks in Internal and 30 marks in External Evaluation.

2. PG Programmes- A candidate must score minimum 13 marks in Internal and 38 marks in External Evaluation.

CONTINUOUS INTERNAL ASSESSMENT

Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

level	Cognitive Domain	Description
K1	Remember	It is the ability to remember the previously learned concepts or ideas.
K2	Understand	The learner explains concepts or ideas.
K3	Apply	The learner uses existing knowledge in new contexts.
K4	Analyze	The learner is expected to draw relations among ideas and to compare and contrast.
K5	Evaluate	The learner makes judgements based on sound analysis.
K6	Create	The learner creates something unique or original.

Question Paper Blue Print for Continuous Internal Assessment- I & II

Duration: 2 Hours							Maximum: 50 marks
Section	K level						Marks
	K1	K2	K3	K4	K5	K6	
A (no choice)	10						10 X 1 =10
B (no choice)		1	1				2 X 5 =10
C (either or choice)				3			3 x 10 = 30
Total							50 marks

Note: K4 and K5 levels will be assessed in the Model Examination whereas K5 and K6 Levels will be assessed in the End Semester Examinations.

Question Paper Blue Print for Continuous Internal Assessment- I

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section – C
I	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
I or II	-	-	Q.N. 14 A, 14 B
II	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Continuous Internal Assessment - II

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section – C
III	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
III or IV	-	-	Q.N. 14 A, 14 B
IV	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Model Examination & End Semester Examination

Duration: 3 Hours								Maximum: 75 marks
Section		K level						Marks
		K1	K2	K3	K4	K5	K6	
A (no choice, three questions from each unit)		15						15 X 1 =15
B (choice, one question from each unit)			1	1				2 X 5 =10
C (either or choice& two questions from each unit)	Courses with K4 as the highest cognitive level				4	1		5 x 10 = 50
	Course with K5 as the highest cognitive level wherein three K4 questions and two K5 questions are compulsory.				3	2		
	Course with K6 as the highest cognitive level wherein two questions each on K4, K5 and one question on K6 are compulsory.				2	2	1	
Total								75 marks

Question Paper Blue Print for Model Examination & End Semester Examination

Time: 2 Hours Total Marks: 75 Marks Minimum Pass: 30 Marks

Unit	Section - A	Section - B	Section – C
I	Q.N. 1, 2, 3	Q.N. 16	Q.N. 21 A, 21 B
II	Q.N. 4, 5, 6	Q.N. 17	Q.N. 22 A, 22 B
III	Q.N. 7, 8, 9	Q.N. 18	Q.N. 23 A, 23 B
IV	Q.N. 10, 11, 12	Q.N. 19	Q.N. 24 A, 24 B
V	Q.N. 13, 14, 15	Q.N. 20	Q.N. 25 A, 25 B

SECTION – A (15 X 1 = 15 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ANY TWO QUESTIONS

SECTION – C (5 X 10 = 50 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Model Practical Examination & End Semester Examination (Practical)

Time: 3 Hours Total Marks: 60 Marks Minimum Pass: 24 Marks

Practical Marks	Maximum Mark	Minimum Mark
Internal	40	16
External	60	24
Total	100	40

Evaluation for End Semester Examinations (Practical)

Record	10 marks
Formula with expansion	05 marks
Observation with data	20 marks
Viva-voce	05 marks
Calculation	15 marks
Result with units	05 marks
TOTAL	**60 MARKS**

*Submission of record with due certification is a must for external practical examinations.

**A student should complete all requires experiments to get 10 marks for the record.

Scheme of Examination for B. Sc Microbiology

First Year – Semester - I

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA01	Podhu Tamil-I	3	3	25	75	100
II	23UFEN01	General English-I	3	3	25	75	100
III	23UMBCT01	Core Course I - Fundamentals of Microbiology and microbial diversity	5	5	25	75	100
III	23UMBCP01	Core Course II - Practical-I Fundamentals of Microbiology and Microbial diversity	5	5	40	60	100
III	23UMBDE01	Elective I - Basic and Clinical Biochemistry	5	3	25	75	100
IV	23UMBFC01	Foundation Course - Introduction to Microbial World	2	2	25	75	100
IV	23UTANE01	Non Major Elective Course - Pechukalai Thiran	2	2	25	75	100
Total			**25**	**23**			

First Year – Semester - II

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA02	Podhu Tamil - II	3	3	25	75	100
II	23UFEN02	General English - II	3	3	25	75	100
III	23UMBCT02	Core Course III - Microbial physiology And Metabolism	5	5	25	75	100
	23UMBCP02	Core Course IV - Practical II - Microbial Physiology and Metabolism	5	5	40	60	100
III	23UMBDE02	Elective II - Bio-Instrumentation	5	3	25	75	100
IV	23UMBSE03	Skill Enhancement Course III - Sericulture	2	2	25	75	100
	23UGENE02	Non Major Elective Course - Oceanography	2	2	25	75	100
Total			**25**	**23**			

Second Year – Semester - III

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA03	Podhu Tamil - III	3	3	25	75	100
II	23UFEN03	General English - III	3	3	25	75	100
III	23UMBCT03	Core Course V - Molecular Biology And microbial genetics	5	5	25	75	100
	23UMBCP03	Core Course VI - Practical III - Molecular Biology and microbial genetics	5	5	40	60	100
III	23UBMDE03	Elective III - Clinical Laboratory Technology	4	3	25	75	100
IV	23UMBSE04	Skill Enhancement Course IV - Organic Forming and Biofertilizer Technology	1	1	25	75	100
IV	23UMBSE05	Skill Enhancement Course V - Aquaculture	2	2	25	75	100
IV		Environmental Studies	2	-	25	75	100
Total			**25**	**22**			

Second Year – Semester - IV

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA04	Podhu Tamil - IV	3	3	25	75	100
II	23UFEN04	General English - IV	3	3	25	75	100
III	23UMBCT04	Core Course VII - Immunology and Immunology technology	5	5	25	75	100
III	23UMBCP04	Core Course VIII - Practical-IV Immunology and Immunology Technology	5	5	40	60	100
III	23UMBDE04	Elective IV - Food Processing Technology	3	3	25	75	100
IV	23UMBSE06	Skill Enhancement Course VI - Vaccine Technology	2	2	25	75	100
IV	23UMBSE07	Skill Enhancement Course VII - Apiculture	2	2	25	75	100
IV		Environmental Studies	2	2	25	75	100
Total			**25**	**25**			

Third Year – Semester – V

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
III	23UMBCT05	Core Course IX - Bacteriology and Mycology	4	4	25	75	100
III	23UMBCT06	Core Course X - Virology and Parasitology	4	4	25	75	100
III	23UMBCP05	Core Course XI - Practical-V	4	4	40	60	100
III	23UMPCGPR1	Core Course XII - Project Viva voce	4	4	40	60	100
III	23UMBDE05	Elective V - Recombinant DNA Technology	4	3	25	75	100
III	23UMBDE06	Elective VI - Bio-Safety and Bio-ethics	3	3	25	75	100
IV	23UMBVE01	ValueEducation	2	2	25	75	100
IV	23UMBSI04 Summer Internship	Internship / industrial visit / Field visit	Minimum 15 days during summer holidays	2	25	75	100
Total			**25**	**26**			

Third Year – Semester - VI

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
III	23UMBCT07	Core Course XIII - Environmental and Agriculture Microbiology	5	4	25	75	100
III	23UMBCT08	Core Course XIV - Food, dairy and Pro Biotic Microbiology	5	4	25	75	100
III	23UMBCP06	Core Course XV - Practical-VI	5	4	40	60	100
III	23UMBDE07	Elective VII - Pharmaceutical Microbiology	4	3	25	75	100
III	23UMBDE08	Elective VIII - Entrepreneurship and Bio-Business	4	3	25	75	100
IV	23UMBPCS	Professional competency skill Microbial Quality Control and Testing	2	2	25	75	100
IV	23UMBVE02	Extension Activity		2	25	75	100
Total			**25**	**22**			

****Ins. Hrs** – Instructional Hours**, CIA-** Continuous Internal Assessment**, ESE-** End Semester Examination

Semester: I	Course Code: 23UMBC T01	Hours/Week: 5	Credit: 5
COURSE TITLE: CORE COURSE I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			

Course Overview:

1. Basics of cell types, bacteria characteristics and classifications, Kingdom Protista, algae and fungi, microorganism growth and much more.
2. Microbial diversity can be defined as the range of different kinds of unicellular organisms, bacteria, archaea, protists, and fungi.
3. Various different microbes thrive throughout the biosphere, defining the limits of life and creating conditions conducive for the survival and evolution of other living beings.
4. Microbial diversity is the key to human survival and economic security as it provides a vast variety and reservoir of resources which can be utilized by humans for their benefits

Learning Objectives:

1. Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
2. Describe the structural organization, morphology and reproduction of microbes.
3. Explain the methods of cultivation of microbes and measurement of growth.
4. Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
5. Compare and contrast the different methods of sterilization.

Unit - I	History and Evolution of Microbiology	12 Hours

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity ecological niche Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity.

Unit - II	General characteristics of cellular microorganisms	12 Hours

General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions) Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles Structure of fungi (Mold and Yeast), Structure of microalgae

Unit - III	Bacterial culture techniques	12 Hours

Bacterial culture media and pure culture techniques Mode of cell division, Quantitative measurement of growth Anaerobic culture techniques

Unit - IV	Microscopy	12 Hours

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM Confocal microscopy, and Atomic Force Microscopy Stains and staining methods

Unit - V	Sterilization Methods	12 Hours

Sterilization – moist heat - autoclaving, dry heat – Hot air oven Radiation – UV, Ionization, filtration – membrane filter Disinfection, antiseptic; Antimicrobial agents

Text Book(s):

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition., McGraw – Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition. McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11th Edition. A La Carte Pearson.
4. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition. McGraw Hill Inc. New York.
5. Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby College Publishing, St Louis.

Reference Books:

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones &Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings
4. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition. McGraw Hill Publications.
5. Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

Web Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-tomicrobiology/a-brief-history-of-microbiology.
2. https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188
5. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbialnutrition/

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	K1
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	K2
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	K3
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	K4
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S						S		
CO2	S		M		S	S	S	S	S
CO3		S		M		M		M	M
CO4	S		S		S		M		S
CO5					M	S			

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UMBCP01	Hours/Week: 5	Credit: 5
COURSE TITLE: CORE COURSE II - PRACTICAL I-FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY			

Course Overview:

1. Microbial diversity can be defined as the range of different kinds of unicellular organisms, bacteria, archaea, protests, and fungi.
2. Various different microbes thrive throughout the biosphere, defining the limits of life and creating conditions conducive for the survival and evolution of other living beings.
3. Microbiology is the study of microscopic organisms (microbes), which are defined as any living organism that is either a single cell (unicellular), a cell cluster, or has no cells at all (acellular).
4. This includes eukaryotes, such as fungi and protists, and prokaryotes.

Learning Objectives:

1. Acquire knowledge on Cleaning of glassware's, GL Pan sterilization.
2. Gain knowledge on media preparation and cultural characteristics.
3. Learn the pure culture technique
4. Learn the microscopic techniques and staining methods.
5. Acquire knowledge on stain and staining methods

Unit - I	Microbiology	12 Hours

Cleaning of glassware's

Microbiological good laboratory practice and safety

Sterilization and assessment of sterility

Autoclave

Hot air oven

Membrane filtration

Unit - II	Media preparation	12 Hours

Media preparation: liquid media

Solid media

Semi solid media

Agar slants

Agar deeps

Agar plates

Unit - III	Preparation of basal	12 Hours

Preparation of basal

Differential media

Enriched media

Enrichment media

Transport media

Selective media

Preparation - quality control of media

Sterility check of media

Fungal media :

SDA

PDA

CMA

Pure culture techniques: streak plate

Pour plate

Slide culture techniques

Decimal dilution.

Unit - IV	Culture characteristics of microorganisms	12 Hours

Culture characteristics of microorganisms

Different media

Growth characteristics and description

Demonstration of pigment production

Microscopy: light microscopy

Microscopy: bright field microscopy

Unit - V	Staining techniques	12 Hours

Staining techniques: smear preparation

Simple staining

Gram's staining

Capsule staining

Endosperm staining

Lacto phenol cotton blue staining

Study on Microbial Diversity using Hay Infusion Broth

Wet mount to show different types of microbes

Hanging drop

Text Book(s):

1. James G Cappucino and N. Sherman MB (1996). Alabmanual Benjamin Cummins,
2. New York 1996.
3. Kannan.N (1996). Laboratory manual in General Microbiology. Palani Publications.
4. SundararajT (2005). Microbiology Lab Manual (1st edition) publications.
5. Gunasekaran,P.(1996).Laboratory manual in Microbiology. New Age International
6. Ld., Publishers, New Delhi.
7. R C Dubey and D K Maheswari (2002).Practical Microbiology .S. Chand Publishing.

Web Resources:

1. http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-
2. methods- and-principles-microbiology/24403.
3. https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
4. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
5. https://microbiologyinfo.com/top-and-best-microbiology-books/
6. https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-
7. microbiology/a-brief-history-of-microbiology

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to		
COs	**Statements**	**Bloom's Level**
CO1	Practice sterilization methods; learn to prepare media and their Quality control.	K1
CO2	Learn streak plate, pour plate and serial dilution and pigment Production of microbes.	K2
CO3	Understand Microscopy methods, different Staining Techniques and motility test.	K3
CO4	Observe culture characteristics of microorganisms.	K4
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet Mount	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	M	S							
CO2	M		M	S		M		M	
CO3				M			S		
CO4				M	S				
CO5			S						

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UMBDE01	Hours/Week: 4	Credit: 4
COURSE TITLE: ELECTIVE – I - BASIC ANDCLINICAL BIOCHEMISTRY			

Course Overview:

1. Study the path physiology of diseases of the major organ systems within the body and how laboratory analysis can help to elucidate the cause and advise on patient management.
2. Understand the regulation of endocrinology systems and investigation of disorders.
3. Study specialist topics including pediatric biochemistry, drug monitoring and nutritional analysis.
4. Learn to apply theoretical knowledge to case based discussions.

Learning Objectives:

1. Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.
2. Explain the biological activity of amino acids and proteins.
3. Identify the metabolic errors in enzymes of carbohydrates and lipids.
4. Describe the disorders in amino acid metabolism.
5. Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.

Unit - I	Biomolecules	12 Hours

Carbohydrate – General properties, function, structure, classification– monosaccharide's (Glucose, Fructose, Galactose) Oligosaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL – biological significance

Unit - II	Biomolecules	12 Hours

Amino acids – General properties, functions, structure, classification and biological significance Proteins– General Structure, Properties, Functions Classification and Biological Significance of Protein

Unit - III	Disorders of Metabolism	12 Hours

Disorders of Carbohydrate Metabolism: Diabetes Mellitus, Ketoacidosis, Hypoglycemia Glycogen Storage Diseases, Galactosemia and Lactose intolerance Disorders of Lipid Metabolism: Hyperlipidemia, Hyperlipoproteinemia, Hyper cholesterolemia, Hyper triglyceridemia, Sphingolipidosis.

Unit - IV	Disorders of amino acid metabolism	12 Hours

Alkaptonuria, Phenylketonuria

Tyrosinemia, Aminoacidurias

Phenylalaninemia,Homocystineuria

Unit - V	Evaluation of organ function tests	12 Hours

Assessment and clinical manifestations of Renal, Hepatic, Pancreatic, Gastric and Intestinal Functions. Diagnostic Enzymes: Principles of Diagnostic Enzymology. Clinical significance of Aspartate Aminotransferase, Alanine Aminotransferase Creatine Kinase, Aldolase and LactateDehydrogenase

Text Book(s):

1. Satyanarayana, U. and Chakrapani, U (2014). Biochemistry, 4th Edition, Made Simple Publisher.
2. Vasudevan. D.M. Sreekumari.S, Kannan Vaidyanathan (2019). Textbook of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
3. Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, edition. WH Freeman publisher.
4. Ambika Shanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd.
5. Jain J L, Sunjay Jain and Nitin Jain (2016). Fundamentals of Biochemistry, 7th Edition, S Chand Company.

Reference Books:

1. Lupert Styrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9th Edition, W.H. Freeman & Co. New York.
2. Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.

3. David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry,7thEdition W.H. Freeman and Co., NY
4. Amit Kessel & Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2nd Edition, Chapman and Hall.

Web Resources:

1. https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-tomicrobiology/a-brief-history-of-microbiology.
2. https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4. https://bio.libretexts.org/@go/page/9188

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Explain the structure, classification , biochemical functions and significance of carbohydrates and lipids	K1
CO2	Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation.	K2
CO3	Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.	K3
CO4	Discuss and evaluate the pathology of amino acid metabolic disorders.	K4
CO5	Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S						S		
CO2	S		M		S	S	S	S	S
CO3		S		M		M		M	M
CO4	S		S		S		M		S
CO5					M	S			

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UMBFC01	Hours/Week: 2	Credit: 2
COURSE TITLE: FOUNDATION COURSE I - INTRODUCTION TO MICROBIAL WORLD			

Course Overview:

1. Introduced to basic microbiological principles, fundamental laboratory diagnostics and mechanisms by which microbes transmit and cause diseases.
2. How disease-causing microbes, called pathogens, are classified, identified and transmitted.
3. Microbiologists are needed to do the research required for the future battle against infectious diseases worldwide, understanding the environmental importance of microbes and to exploit them for food production, biotechnological and industrial applications.
4. Examine the ways in which microbial processes can be managed and manipulated for the benefit of society and the environment

Learning Objectives:

1. To emphasize economic importance of bacteria.
2. To gain knowledge on beneficial and harmful aspects of fungi.
3. To explore the role of algae in various sectors.
4. To acquire basic insight on significance of viruses
5. To impart importance of protozoa in day-to-day life

Unit - I	General features and economic importance of bacteria	09 Hours

General characteristics and morphology of bacteria, mycoplasma, and archaebacteria Economic importance of bacteria with examples in antibiotic production (Streptomyces), biofertilizer (Rhizobium), superbugs (Pseudomonas), fermentation (Lactobacillus) Harmful aspects such as food spoilage (Clostridium) and diseases (Xanthomonas, Salmonella, Vibrio).

Unit - II	General features and economic importance of fungi	09 Hours

General characteristics and morphology of fungi, Economic importance of fungi with examples in biopesticide (Beauveria), industry (Saccharomyces), medicine (Penicillium). Harmful aspects-food spoilage (mold), diseases in crops (Fusarium), humans (Aspergillus), allergic reactions (Mucor).

Unit - III	General features and economic importance of algal	09 Hours

General characteristics and morphology of algae. Beneficial aspects of algae with examples in single cell protein (Spirulina) soil fertility (Anabaena), environment (Phytoplanktons) Harmful aspects Eutrophication and phycotoxins

Unit - IV	General features and economic importance of virus	09 Hours

General characteristics of virus. Economic importance of virus vaccine production (Rabies virus), gene therapy (Adenovirus), biopesticides (Cauliflower mosaic virus). Harmful aspects - diseases (plant-TMV, human-Influenza virus).

Unit - V	General features and economic importance of profozoa	09 Hours

General characteristics of protozoa. Beneficial applications of protozoa Biocontrol (Haemogregarina), sanitation (Amoeba), oil exploration (Radiolaria) Harmful aspects –diseases (Entamoeba, Giardia)

Text Book(s):

1. Pelczar, M.J., Chan, E. C. S. and Kreig, N. R. (2006). Microbiology. 5th edition, Tata Mc Grow Hill Inc, New York.
2. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of Microbiology. S. Chand & Company Ltd, New Delhi.
3. Subba Rao, N.S. (1995). Soil microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

Reference Books:

1. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). Manual of Environmental Microbiology, 2nd Edition. A. SM Press, New Delhi.
2. Atlas, R.A. (1995). Principles of Microbiology. Mosby Publications, USA.
3. Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th Edition. Prentice Hall International Inc., USA

Web Resources:

1. http://sciencenetlinks.com/tools/microbeworld
2. https://www.microbes.info/
3. https://www.asmscience.org/VisualLibrary

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Describe microorganisms based on nutrition	K1
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth	K2
CO3	Explain the methods of nutrient uptake	K3
CO4	Describe anaerobic and aerobic energy production	K4
CO5	Elaborate on the process of bacterial photosynthesis and reproduction methods	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M				L		M		L
CO2		S							
CO3			L			M		L	
CO4	L	M							M
CO5				M		S		S	

S - Strong, M – Medium, L – Low

SEMESTER-II

Semester: II	Course Code: 23UMBCT02	Hours/Week: 4	Credit: 4
COURSE TITLE: CORE COURSE III - MICROBIAL PHYSIOLOGY AND METABOLISM			

Course Overview:

1. Understanding Microbes Physiology &their Metabolism provide insight knowledge on their sources of energy &its utilization as they are tiny factories for the production of high-value low-volume products to low-value high-volume products which are its primary & secondary metabolites.
2. Primary metabolites are typically formed during the growth phase as a result of energy metabolism and are deemed essential for proper growth. Many of the identified microbes' secondary metabolites have a role in ecological function.
3. Microbes have a diverse metabolic activity which not observed in any other group of organisms.
4. It is critical understand Microbe's physiology and metabolism, to manipulated them, in order to enhance their growth or to product desired products of commercial value

Learning Objectives:

1. Study the basic principles of microbial growth
2. Understand the basic concepts of aerobic and anaerobic metabolic pathways
3. Analyze the role of individual components in overall cell function
4. Provide information on sources of energy and its utilization by microorganisms
5. Gain the knowledge the different types of metabolic strategies

Unit - I	Physiology of microbial growth	09 Hours

Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count) Control of microbial growth. Factors affecting microbial growth

Unit - II	Nutrition requirements	09 Hours

Nutrition requirements - Photoautotrophs, Photoorganotrophs Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria) Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and active transport.

Unit - III	An overview of Metabolism	09 Hours

An overview of Metabolism - Embden Meyerhof Pathway, Enter Doudoroff Pathway Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation ATP synthesis. Fermentation - Homolactic and Heterolactic, Mixed Acid Fermentation

Unit - IV	Photosynthesis	09 Hours

Photosynthesis - An Overview of chloroplast structure Photosynthetic Pigments, Light Reaction - Cyclic and Non-cyclic Photo phosphorylation Dark Reaction - Calvin Cycle.

Unit - V	Bacterial reproduction	09 Hours

Bacterial reproduction - Binary fission, Budding, endospore formation Fungi asexual and sexual reproduction, Microalgae reproduction Asexual and sexual reproduction of protozoa.

Text Book(s):

1. Schlegal, H.G. (1993). General Microbiology., 7th Edition, Press syndicate of the University of Cambridge.
2. RajapandianK. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co. Meena Kumari. (2010). S. Microbial Physiology, Chennai 1st Edition MJP Publishers.
4. S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

Reference Books:

1. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, Volume 49, New York.
2. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
3. Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm. C. Brown Communications, Inc. USA.
4. Bhanu Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
5. Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.

Web Resources:

1. http://sciencenetlinks.com/tools/microbeworld
2. https://www.microbes.info/
3. https://www.asmscience.org/VisualLibrary
4. https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to		
COs	**Statements**	**Bloom's Level**
CO1	Describe microorganisms based on nutrition	K1
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth	K2
CO3	Explain the methods of nutrient uptake	K3
CO4	Describe anaerobic and aerobic energy production	K4
CO5	Elaborate on the process of bacterial photosynthesis and reproduction methods	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	S								S
CO2	S		S		M	S	S	S	
CO3	S	S		M	S		M	S	S
CO4		M	M		S	M	M	S	
CO5	S	M	S		S			S	

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UMBCP02	Hours/Week: 5	Credit: 5
COURSE TITLE: CORE COURSE IV - PRACTICAL II - MICROBIAL PHYSIOLOGY AND METABOLISM			

Course Overview:

1. Methods of Microbial diagnosis
2. Methods of the bacterial cultivation
3. Identification of bacteria
4. Bacterial metabolism ,Media for bacterial growth

Learning Objectives:

1. Understand the principles of motility test.
2. Understand the basic concepts of staining methods.
3. Learn the bacterial count using different methods and anaerobic culture
4. Learn the microscopic techniques and staining methods.
5. Study the biochemical identification of the bacteria.

Unit – I	Motility demonstration	12 Hours

Motility demonstration: hanging drop, wet mount preparation

semi-solid agar

Craigie's tube method

Smear preparation, permanent specimen preparation

Capsular staining

Acid-fast staining

Unit – II	Direct counts	12 Hours

Direct counts – Direct cell count (Petroff - Hausser counting chamber),

Turbidometry

Viable count

pour plate

spread plate

Bacterial growth curve

Unit – III	Quality control with standard strains	12 Hours

Anaerobic culture methods

Antibiotic sensitivity testing

Disc diffusion test- quality control with standard strains

Unit – IV	Morphological Variations	12 Hours

Morphological Variations In Algae,

Fungi

Protozoa.

Micrometry: Demonstration Of The Size Of Yeast

Fungal FilamentsAnd Protozoa.

Unit – V	Maintenance Of test	12 Hours

Imvic Test,

H2s, TSI,Oxidase,

Catalase, Urease Test

Carbohydrate Fermentation Test.

Maintenance Of Pure Culture,

Paraffin Method

Stab Culture

Maintenance Of Mold Culture

Text Book(s):

1. James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins,
2. New York 1996.
3. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
4. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
5. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International
6. Ld., Publishers, New Delhi.
7. Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference Publisher.

Web Resources:

1. https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3. https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4. https://www.studocu.com/microbial-physiology-practicals
5. https://www.agr.hokudai.ac.jp/microbial-physiology

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	K1
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	K2
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	K3
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa	K4
CO5	Elaborate on the bacterial identification - morphological, physiological, and biochemical methods.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S								S
CO2	S		S		M	S	S	S	
CO3	S	S		L			M	S	S
CO4		L	M			M	M		
CO5	S	M			S			S	

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UMBDE02	Hours/Week: 4	Credit: 3
COURSE TITLE: ELECTIVE II - BIO-INSTRUMENTATION			

Course Overview:

1. Bioinstrumentation is an interdisciplinary field requiring a knowledge of the basic principles in several areas including digital electronic systems, control systems, detection systems, and material biocompatibility.
2. Bioinstrumentation is the development of technologies for the measurement and manipulation of parameters within biological systems, focusing on the application of engineering tools for scientific discovery and for the diagnosis and treatment of disease.
3. Biomedical Instrumentation course is a perfect blend of two polar opposite streams of science: Engineering and Medicine.
4. Biomedical instrumentation helps physicians diagnose the problem and provide treatment.

Learning Objectives:

1. Understand the analytical instruments and study the basic principles in the field of sciences.
2. To gain knowledge about principles of spectroscopy
3. Understand the analytical techniques of Chromatography and electrophoresis
4. To understand the principle of different types of scans used in medical diagnosis
5. To gain information about the principles of radioactivity and its measurements

Unit - I	Basic instruments	12 Hours

pH meter, Buffer of biological importance, Centrifuge - Preparative,
Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.
Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate,
Acetate, TE, TAE. Calculation of Normality, PPM - Ammonium sulphate precipitation.

Unit - II	Spectroscopic Techniques	12 Hours

Colorimeter.
Ultraviolet and visible, Infra red.
Mass Spectroscopy.

Unit - III	Chromatographic and Electrophoresis Techniques	12 Hours

Paper, Thin Layer chromatography

Column, HPLC and GC

Starch Gel, AGE, PAGE.

Unit - IV	Imaging techniques	12 Hours

Principle, Instrumentation and application of ECG, EEG

Principle, Instrumentation and application of EMG, MRI, CT

PET scan radioisotopes.

Unit - V	Fluorescence and radiation based techniques	12 Hours

Spectro fluorimeter

Flame photometer

Scintillation counter

Geiger Muller counter

Autoradiography

Text Book(s):

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi.
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1st Edition. MJP publishers.
3. Veerakumari, L (2009).Bioinstrumentation- 5 th Edition -.MJP publishers
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.

Reference Books:

1. Rodney.F. Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2. SkoogA.,West M (2014). Principles of Instrumental Analysis – 14th Edition W. B. Saunders Co., Philadephia.
3. N. Gurumani. (2006). Research Methodology for biological sciences- 1 st Edition – MJP Publishers.

4. Wilson K and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th Edition. Cambridge University Press.
5. Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

Web Resources:

1. http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroductiontypes-uses-and-other-details-with-diagram/12489
2. https://www.watelectrical.com/biosensors-types-its-working-andapplications/ 34
3. http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75
4. https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Gain knowledge about the basics of instrumentation.	K1
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	K2
CO3	Evaluate by separating and purifying the components.	K3
CO4	Understand the need and applications of imaging techniques.	K4
CO5	Categorize the working principle and applications of fluorescence and radiation.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	S								S
CO2	S		S		M	S	S	S	
CO3	S	S		L			M	S	S
CO4		L	M			M	M		
CO5	S	M			S			S	

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UMBSE03	Hours/Week: 5	Credit: 2
COURSE TITLE: SKILL ENHANCEMENT COURSE III - SERICULTURE			

Course Overview:

1. Sericulture courses are educational programs that focus on the cultivation of silkworms and the production of silk.
2. Sericulture courses are designed to provide students with the knowledge and skills required to engage in sericulture-related activities.
3. Sericulture is the Science and practice of silk farming, and it involves various stages such as silkworm rearing, mulberry cultivation, cocoon harvesting, silk extraction, and silk processing.
4. Students with the knowledge and skills required to engage in sericulture-related activities.

Learning Objectives:

1. Acquire knowledge on Sericulture and scientific approach of mulberry plant.
2. Describe the morphology and physiology of silkworm
3. Discuss effective management of silkworm diseases.
4. Demonstrate field skills in mulberry cultivation and silkworm rearing technology
5. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Unit - I	General introduction to Sericulture	5 Hours

Its distribution in India. Botanical distribution and taxonomical characters of mulberry

Mulberry varieties and species. Biology of Mulberry plant

Biology of Mulberry plant and Mulberry crop cultivation and protection..

Unit - II	Silkworm- -morphology	5 Hours

Morphology of silkworm

Life cycle of silkworm- egg, larva, pupa, and moth.

Unit - III	Silkworm pathology	5 Hours

Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm

Diseases: Introduction, types, Pebrine, Grasserie, Mustarding, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control - Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Pests and Predators of Silkworms, Nature of damage and control measures

Unit - IV	Rearing of silkworm	5 Hours

Cocoon assessment and processing technologies

Value added products of mulberry and silkworms

Unit - V	Entrepreneurship and rural development in sericulture	5 Hours

Planning for EDP, Project formulation, Marketing,

Insectary facilities and equipments: Location, building specification

air conditioning and environmental control, furnishings and equipment,

Sanitation and equipment, subsidiary facilities.

Text Book(s):

1. Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2. Dr. R. K. Rajan &Dr. M. T. Himantharaj (2005). Silkworm Rearing Technology, Central Silk Board, Bangalore
3. Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore
4. M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty (2010). Advances in Mulberry Sericulture,, CVG Publications, Bangalore

Reference Books:

1. S. Morohoshi (2001). Development Physiology of Silkworms 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
2. Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. New Delhi.
3. M. Johnson, M. Kesary (2019). Sericulture, 5th. Edition. Saras Publications.

Web Resources:

1. https://www.abebooks.com › plp
2. https://www.academic.oup.com
3. http://www.sericulture.karnataka.gov.in

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to		
COs	**Statements**	**Bloom's Level**
CO1	Discuss the Sericulture biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	K1
CO2	Familiarize with the lifecycle of silk worm	K2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices	K3
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques	K4
CO5	Plan the facilities required for establishment of in sectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	S				S		S		
CO2	M				S				
CO3	S				S				
CO4							S	S	
CO5					S		S	S	

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UGENE02	Hours/Week: 4	Credit: 2
COURSE TITLE: NON MAJOR ELECTIVE COURSE - OCEANOGRAPHY			

Course Overview:

1. Advanced earth science course will explore numerous aspects pertaining to the field of Oceanography
2. Topics covered include the chemistry of ocean water, the physics of wave patterns and tides, seafloor geology and topography, and marine biology.
3. Research techniques, both modern and historical, will also be studied.
4. Impact that climate change is having on our oceans around the world.

Learning Objectives:

1. Understand the basics of Ocean
2. Understand the importance of Major Ocean affecting factor
3. Know different group of factor using tides
4. Understand the descriptive types of ocean
5. Understand the importance of Resource of ocean

Unit - I	Oceanography	12 Hours

Oceanography: Scope, Content, Significance, Distribution of Land and Sea

Hypsometric Curve, Surface Configuration of the Ocean Floor

Continental Shelf, Continental Slope, Deep Sea Plain, Oceanic Deeps and Submarine Canyons

Unit - II	Relief Features of the Major Oceans	12 Hours

Relief Features of the Major Oceans: Atlantic, Pacific and Indian Ocean

Horizontal and Vertical Distribution of Seawater Temperature. Salinity

Factors Affecting Salinity and Distribution

Unit - III	Ocean Water Circulation	12 Hours

Ocean Water Circulation: Factors Influencing Ocean Circulation

General Circulation of Ocean Currents, 12 CO3 90 Currents of the Atlantic, Pacific and Indian Ocean, Waves and Tides: Definition and Types, Tsunamis: Origin and Effects

Unit - IV	Marine Deposits	12Hours

Marine Deposits

Classification and Distribution

Coral Reefs types - Conditions for the Growth

Unit - V	Marine Resources	12 Hours

Marine Resources

Types - Distribution and Uses - Tidal Energy

Role of National Institute of Oceanography in India

Text Book(s):

1. Anikouchine, W. A. and Sternberg, R. W., (1973): The World Oceans - An Introduction to Oceanography, Englewood Cliffs.
2. Garrison, T., (1998): Oceanography, Wadsworth Co.USA
3. Gerald, S. (1980): General Oceanography: An Introduction, John Wiley & Sons, New York
4. King, C. A. M., (1972): Beaches and Coasts, E. Arnold, London: King, C. A. M.,(1975): Oceanography for Geographers, E. Arnold, London

Reference Books:

1. Sharma, R. C. and Vatel, M., (1970): Oceanography for Geographers, Cheytanya Publishing House, Allahabad

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	This will elucidate what the student will acquaint once he completes that particular unit	K1
CO2	There will be equal number of Course objectives and Course outcomes.	K2
CO3	The blooms taxonomy verbs will be given as a separate annexure for your reference	K3
CO4	Each course objective will have a course outcome.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	S			L	M		M	L	
CO2		M	L						S
CO3			M		L		L		L
CO4		S		S				S	
CO5						M			

S - Strong, M – Medium, L – Low

SEMESTER-III

Semester: III	**Course Code: 23UMBCT03**	**Hours/Week: 4**	**Credit: 4**
COURSE TITLE: CORE COURSE – V - MOLECULAR BIOLOGY AND MICROBIAL GENETICS			

Course Overview:

1. Genetics of bacteria and phage, focusing on replication, repair, transcription, translation, gene regulation, genetic networks, plasmids, conjugation, transformation, microbial and phage interactions, and different types of phage and their lifestyles.
2. Microbial genetics is a subject area within microbiology and genetic engineering.
3. Microbial genetics studies microorganisms for different purposes. The microorganisms that are observed are bacteria, and archaea.
4. Microbial genetics provides powerful tools for deciphering the regulation, as well as the functional and pathway organization, of cellular processes.

Learning Objectives:

1. Provide knowledge on structure and replication of DNA.
2. Illustrate the significance and functions of RNA in protein synthesis.
3. Explain the cause and types of DNA mutation and DNA repair mechanisms.
4. Outline the role of plasmids and phages in genetics.
5. Examine mechanisms of gene transfer and recombination.

Unit - I	Structure of DNA in Prokaryotes & eukaryotes	15 Hours

DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Super coiling, linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. DNA replication modes - rolling circle, D-loop modes.

Unit - II	Transcription in Prokaryotes	15 Hours

Transcription in Prokaryotes. Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - lac, trp and a raoperons as examples. Regulation of gene expression by DNA methylation.

Unit - III	DNA Mutation	15 Hours

Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photore activation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.

Unit - IV	DNA Replication	15 Hours

Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Tiplasmid, linear plasmids, yeast 2µ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phageStructure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.

Unit - V	Gene Transfer Mechanisms	15 Hours

Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative

transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons.

Text Book(s):

1. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
2. Gardner E. J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3. Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.
4. Brown T. A. (2016). Gene Cloning and DNA Analysis - An Introduction. (7th Edition). John Wiley and Sons, Ltd.
5. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.

Reference Books:

1. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
2. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3. Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4 th Edition, ASM Press Washington-D.C. ASM Press.
5. Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing

Web Resources:

1. [PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download – StudyMaterialz.in.
2. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/
3. https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/
4. Molecular Biology Notes - Microbe Notes
5. Molecular Biology Lecture Notes & Study Materials | Easy Biology Class

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Analyze the significance of DNA and elucidate the replication mechanism.	K1
CO2	Illustrate the types of RNA and protein synthesis machinery.	K2
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.	K3
CO4	Evaluate the importance of plasmids and phages in genetics.	K4
CO5	Analyze gene transfer and recombination methods.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	M	M		M	S		L
CO2	S	M	M		S		S	M	M
CO3	S	S	S		L	S		S	
CO4	M	M		M	S	S		M	S
CO5	M	S	L	S	S		M	M	

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23UMBCP03	Hours/Week: 4	Credit: 4
COURSE TITLE: CORE COURSE – VI - PRACTICAL – III MOLECULAR BIOLOGY AND MICROBIAL GENETICS			

Course Overview:

1. Development of microbial genetics and need for culture collections
2. Reprogramming microbe genetically in terms of agronomy and clinical products
3. Setting the Foundation for a Research Strategy
4. Antibiotic resistance markers

Learning Objectives:

1. Provide knowledge on structure and replication of DNA.
2. Elucidate the methods of Genomic and Plasmid DNA isolation.
3. Explain methods of protein separation.
4. Explain artificial transformation method.
5. Outline the role of phages in genetics.

Unit – I	Different types of DNA and RNA using micrographs	15 Hours

Study of different types of DNA and RNA using micrographs andmodel / schematic representations

Study of semi-conservative replication of DNA

micrographs / schematic representations

Unit – II	Isolation of Genomic and Plasmid DNA from E	15 Hours

Isolation of Genomic and Plasmid DNA from E. coli and Analysisby Agarose gel electrophoresis

Estimation of DNA using colorimeter (diphenylamine reagent)

UV spectrophotometer (A260 measurement).

Unit – III	Resolution and visualization	15 Hours

Resolution and visualization of proteins by polyacrylamide gelelectrophoresis (SDS-PAGE) – Demonstration.

UV induced auxotrophic mutant production

isolation of mutants by replica plating technique – Demonstration.

Unit – IV	Perform artificial Transformation	15 Hours

Perform artificial Transformation in E. coli.

Isolation of antibiotic resistant mutants

gradient plate method.- Demonstration

Unit - V	Screening and isolation of phages from sewage	15 Hours

Screening and isolation of phages from sewage.

Perform RNA isolation.

Estimate RNA.

Text Book(s):

1. Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi.
2. Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
3. Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and
4. Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
5. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.

Reference Books:

1. Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applicationsof Recombinant DNA. 5th Edition. ASM Press. 2018.
2. Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3. Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition,
4. W.H. Freeman.
5. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th edition, ASM Press Washington-D.C. ASM Press.

Web Resources:

1. https://www.molbiotools.com/usefullinks.html
2. (PDF) Molecular Biology Laboratory manual (researchgate.net)
3. https://www.molbiotools.com/usefullinks.html
4. https://geneticgenie.org3.

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to		
COs	**Statements**	**Bloom's Level**
CO1	Illustrate different types of DNA and RNA.	K1
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.	K2
CO3	Analyze importance of experimental microbial genetics.	K3
CO4	Apply the knowledge of molecular techniques in various fields.	K4
CO5	Investigate the significance of Phages.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	L	M				S			
CO2				L					S
CO3		S					M		
CO4	M		S		M			L	
CO5									

S - Strong, M – Medium, L - Low

Semester: III	Course Code: 23UBMDE03	Hours/Week: 4	Credit: 4
COURSE TITLE: ELECTIVE – III - CLINICAL LABORATORY TECHNOLOGY			

Course Overview:

1. Understand the role of the laboratory and its contribution to the nation's health service; .
2. Appreciate the need to involve all members in the provision of health service;
3. Follow professional ethics and code of conduct
4. Experience job satisfaction and have professional loyalty

Learning Objectives:

1. Demonstrate ethical and professional conduct with patients, laboratory personnel, health-careprofessionals, and the public.
2. Explain how accurate and reliable information might be obtained about proper procurement,storage, and handling of laboratory specimens.
3. Develop a sound scientific knowledge foundation that prepares them to interpret, analyze andevaluate scientific knowledge in clinical practice.
4. Perform a full range of laboratory tests with accuracy and precision.
5. Establish quality assurance principles and practices to ensure the accuracy and reliability oflaboratory information.

Unit - I	Introduction to Clinical Laboratory Science	12 Hours

Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel Organization of clinical laboratory and role of medical laboratory technician Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices

Unit - II	Specimen collection and processing	12 Hours

Specimen collection and processing - Blood, urine, stool, sputum CSF, amniotic fluid and bile Separation of serum and plasma, Handling of specimens for testing, Preservation of specimens, transport of specimens and factors affecting the clinical results.

Unit - III	Introduction to histopathology-	12 Hours

Introduction to histopathology - Methods of examination of tissues and cells, Fixation of tissues Classification and properties of fixatives.Tissue processing - Collection of specimens, Labeling and

fixation Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections

Unit - IV	Introduction to Haematology	12 Hours

Introduction to Haematology - Laboratory methods used in the investigation of coagulation disorders coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time, partial thromboplastin time activated partial thromboplastintime, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors

Unit - V	Quality Standards in Health Laboratories	12 Hours

Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards NABL, ISO, CAP, COLA, Performing quality assessment pre-analytical, analytical, and post-analytical phases of testing.

Text Book(s):

1. Mukharji, K.L. (2000). Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. TataMcGraw Hill, Delhi.
2. Ochei, A., Kolhatkar. A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education.
3. Ramnik Sood (2015).Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2nd Edition, Jaypee Brothers Medical Publishers, New Delhi.
4. Ramakrishnan, KN Sulochana (2012). Manual of Medical LaboratoryTechniques, Jaypee Brothers Medical Publishers Pvt. Ltd

Reference Books:

1. Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
2. Baker, F.J., Silverton, R.E., and Pallister, J. (1998). An Introduction to Medical
3. Laboratory Technology, 7th Edition, CBS Publishers and Distributors Pvt. Ltd.
4. Godkar (2021).Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House.
5. M.N. Chatterjee and Rana Shinde. (2008). Textbook of Medical Biochemistry, 7th Edition, Jaypee Brothers Medical Publishers Pvt. Limited.

Web Resources:

1. https://www.jaypeedigital.com › book

2. https://www.pdfdrive.com › wintrobes-clinical-hematology
3. https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5
4. https://vlab.amrita.edu/index.php?sub=3&brch=272

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team. Practice safety or infection control procedures in the clinical laboratory, properly use safety equipment and maintain a clean, safe Work environment.	K1
CO2	Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and transmission-based precautions, Engage in the scientific process byunderstanding the principles and practices of clinical study design, implementation, and dissemination of results.	K2
CO3	Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures. Relate and recognize the histological appearance of affected tissues to the underlying pathology.	K3
CO4	Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies.	K4
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M			S				M	
CO2		S			M				S
CO3							L		
CO4	L		M			S		L	
CO5				L					

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23UMBSE05	Hours/Week: 4	Credit: 4
COURSE TITLE: SKILL ENHANCEMENT COURSE IV- AQUACULTURE			

Course Overview:

1. Aquaculture is breeding, raising and harvesting fish, shellfish and aquatic plants.
2. environmentally responsible source of food and commercial products
3. used to rebuild stocks of threatened or endangered species
4. Marine aquaculture occurs in the open ocean, intercostals areas, and marine lagoons

Learning Objectives:

1. Provide a deeper knowledge in aquaculture systems and methods.
2. Explain the significance and functions of design, types and construction of aquaculture ponds
3. Demonstrate the biological characteristics of various aquaculture species.
4. Discuss the methods involved in post stocking management.
5. Illustrate major cultivatable species for aquaculture.

Unit - I	Aquaculture Systems and Methods	06 Hours

Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture Cage culture, pen culture, raft culture, race way culture.

Unit - II	Aquaculture Engineering	06 Hours

Aquaculture Engineering - Design and construction of pond, lay- out and design of aquaculture farm construction, water intake system, drainage system Aeration and aerators. Ponds - Types of ponds.

Unit - III	Selection of Species	06 Hours

Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio

Unit - IV	Post Stocking Management	06 Hours

Post Stocking Management - Water and soil quality parameters required for optimum production Control of aquatic weeds and aquatic insects, algal blooms and microorganisms Food conversion ratio (FCR). Growth - Measurement of growth, length - Weight relationship.

Unit - V	Major cultivable species for aquaculture	06 Hours

Major cultivable species for aquaculture –Culture of Indian Major Carps. Culture of Giant fresh water prawn, Macrobrachiumrosenbergii Seed collection formation sources. Hatchery management. Culture of tiger shrimp, Penaeusmonodon and LitopenaeusVannamei. Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.

Text Book(s):

1. Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019).Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi.
2. Stickney, R.R. (2016). Aquaculture: An Introductory Text. 3rd Edition. Centre for Agriculture and Bioscience International Publishing.
3. Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principlesof Aquaculture. CRC Press.
4. Mushlisin Z. A. (2012). Aquaculture. In Tech.

Reference Books:

1. Arumugam N. (2014). Aquaculture. Saras Publication.
2. Pillay T. V. R. and Kutty M.N. (2005). Aquaculture: Principles and Practices. 2ndEdition. Wiley India Pvt. Ltd.
3. Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra
4. Publishing House.
5. Rath R.K.(2011). Fresh Water Aquaculture. 3rdEdition. Scientific Publishers.

Web Resources:

1. Aquaculture: Types, Benefits and Importance (Fish Farming) - Conserve Energy Future (conserve-energy-future.com)
2. Fisheries Department - Tamil Nadu (tn.gov.in)
3. Aquaculture - Google Books
4. aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:
Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Analyze the significance and importance of aquaculture	K1
CO2	Illustrate the types and construction of aquaculture ponds	K2
CO3	Analyze the biological characteristics of species and choose thebest species for aquaculture.	K3
CO4	Follow methods involved for optimal growth of aquaculturespecies	K4
CO5	Summarize major species suitable for aquaculture in a particular Environment	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M				L		L	L	M
CO2			L				S		
CO3		M		M		S			M
CO4	L							M	
CO5			S	M			M		

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23UMBSE04	Hours/Week: 2	Credit: 1
COURSE TITLE: SKILL ENHANCEMENT COURSE IV - ORGANIC FARMING & BIOFERTILISER TECHNOLOGY			

Course Overview:

1. Increase genetic diversity.
2. Promote more usage of natural pesticides.
3. Make sure the right soil cultivation at the right time
4. Keep and build good soil structure and fertility.

Learning Objectives:

1. Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.
2. To encourage organic farming in urban areas.
3. Comprehensive knowledge about bacterial biofertilizers , its advantages and future perspective.
4. Structure and characteristic features of Cyano bacterial and fungal biofertilizer
5. Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assessthes helf life and bioefficacy of biofertilizers.

Unit - I	Organic And Chemical Farming	06 Hours

Principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability Reduces non-renewable energy by decreasing agrochemical need Biodiversity - crop rotation, inter - cropping. Ecological services – biological control, soil formation and nutrient cycling.

Unit - II	Certification And Schemes	06 Hours

Organic farming for urban space; Create a Sustainable Organic Garden (Backyard –Square Foot Gardening, Small Space Gardening, Mini Farming) Composting,Vermicomposting.

Unit - III	Biofertilizers	06 Hours

Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic feature sofbacterial biofertilizers, Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobiumand Frankia

Unit - IV	Cyanobacterial biofertilizers	06 Hours

Structure and characteristic features of Cyanobacterial biofertilizers Anabaena, Nostoc; Structure and characteristic features fungal biofertilizers - AMmycorrhiza.

Unit - V	Production Technology	06 Hours

Production of Rhizobium, Azotobacter Anabena ; Biofertilizers - Storage, shelflife, quality control and marketing.

Text Book(s):

1. A.K. Sharma (2006). Handbook of Organic Farming
2. A.C. Gaur (2017). Handbook of Organic Farming and Biofertilizers
3. N.S. Subbarao (2017). Bio – fertilizers in Agriculture and Forestry(4th Edition) Medtech publisher
4. Subba Rao, N.S.(2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books:

1. Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One Straw Revolution: An Introduction to Natural Farming, 1stedition, YRB Classics.
2. Sujit Chakrabarty (2018). Organic Home Gardening MadeEasy,1st Edition,
3. Bansal M (2019). Basics of Organic Farming CBS Publisher.
4. Hurst ,C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach
5. L.D.(2007).ManualofEnvironmentalMicrobiology.(3rd Edition).AmericanSocietyfor Microbiology.

Web Resources:

1. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2. https://www.fao.org/organicag/oa-faq/oa-faq6/en/
3. https://www.india.gov.in/topics/agriculture/organic-farming
4. https://agriculture.nagaland.gov.in/bio-fertilizer/

Teaching Methodology: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes: Upon successful completion of this course, the student will be able to		
COs	**Statements**	**Bloom's Level**
CO1	Become an Entrepreneur with wide knowledge about farming and sustainable resources.	K1
CO2	Implement organic farming inurbanareas with knowledge on compost.	K2
CO3	Gain knowledge about the bacterialbio fertilizers and its advantages	K3
CO4	Understand the significance about Cyano bacterial and fungal biofertilizers	K4
CO5	Understand and implement the use of biofertilizers.	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	M	-	-	-	L	-	L	L	M
CO2	-	-	L	-	-	-	S	-	-
CO3	-	M	-	M	-	S	-	-	M
CO4	L	-	-	-	-	-	-	M	-
CO5	-	-	S	M	-	-	M	-	-

S - Strong, M – Medium, L - Low