



# HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)

Re-Accredited with A++ Grade by NAAC (3<sup>rd</sup> Cycle)

Uthamapalayam - 625 533.

## DEPARTMENT OF MICROBIOLOGY

BACHELOR OF SCIENCE – MICROBIOLOGY

SYLLABUS

Choice Based Credit System – CBCS

With

Outcome Based Education (OBE)

(Academic Year 2026 - 2027 onwards)

# **HAJEE KARUTHA ROWTHER HOWDIA COLLEGE**

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)

Re-Accredited with A++ Grade by NAAC (3<sup>rd</sup> Cycle)

**Uthamapalayam - 625 533.**

## **College Vision and Mission**

### **Vision**

Our vision is to provide the best type of higher education to all, especially to students hailing from minority Muslim community, rural agricultural families and other deprived, under privileged sections of the society, inculcating the sense of social responsibility in them. Our college is committed to produce talented, duty-bound citizens to take up the challenges of the changing times.

### **Mission**

Our mission is to impart and inculcate social values, spirit of service and religious tolerance as envisioned by our beloved Founder President Hajee Karutha Rowther.

The Vision beckons ..... the Mission continues forever.

# **HAJEE KARUTHA ROWTHER HOWDIA COLLEGE**

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)

Re-Accredited with A++ Grade by NAAC (3<sup>rd</sup> Cycle)

**Uthamapalayam - 625 533.**

## **Department Vision and Mission**

### **Vision**

The Department of Microbiology envisions inculcating in students right skills oriented towards self-development and as a center for academic, research and extension activities, who can realize the need for the value of dignity of labor and the attitude and proper community orientation and civic responsibilities in their outlook.

### **Mission**

- Create a centre of Academic Excellence in the field of education and research in Microbiology.
- Provide a sound academic background for overall development of personality for a successful career in Microbiology.
- Provide an environment that fosters continuous improvement and innovation in the subject.

### Programme Educational Objectives (PEO)

Our graduates will be progressive, efficient, value based academically excellent capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling.

<b>PEO1</b>	Capable of demonstrating (i) comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Microbiology
<b>PEO2</b>	Ability to transmit complex technical information relating to Microbiology in a clear and concise manner in writing and orally skills.
<b>PEO3</b>	Ability to employ critical thinking and efficient problem solving skills in the basic areas of Microbiology.
<b>PEO4</b>	Capability for asking relevant/appropriate questions relating to issues and problems in the field of Microbiology, and planning, executing and reporting the results of an experiment or investigation
<b>PEO5</b>	Capable of working effectively in diverse teams in both classroom, laboratory and in industry and field-based situations.

### Programme Outcomes(PO):

On completion (after three years) of B.Sc. Microbiology programme, the students can achieve

<b>PO1</b>	To promote the students to understand the impact of Microbiology in life.
<b>PO2</b>	To develop practical skills in Microbiology for their job oriented career.
<b>PO3</b>	To promote the students to be self-employed in the field of Microbiology Such as mushroom farming, Dairy etc.,
<b>PO4</b>	To enable the students to apply Microbiology to the various fields such as agriculture, industries, clinical, genetic engineering etc.,
<b>PO5</b>	To insist the golden opportunities for their career in research and job in The field of Microbiology.

### Programme Specific Outcomes(PSO):

The graduates are

<b>PSO1</b>	Apply knowledge of molecular mechanism and cellular process in microbes.
<b>PSO2</b>	Our graduate will able to analyze be the problem in basic and current area of industrial microbiology, fermentation technology, environmental and agricultural microbiology are included to train the students and also sensitize them to scope for research.
<b>PSO3</b>	Our graduate of the programme will serve as a successful microbiologist and apply the fundamentals concepts of Microbiology and laboratory technology in the agriculture, industry, healthcare, societal relate demerging application areas
<b>PSO4</b>	The graduate will be equipping themselves in higher studies, entrepreneur and applying new ideas and technologies in Microbiology
<b>PSO5</b>	Our graduate will able to practicing excellent to their experience Which addresses issues in a responsive ethical and innovative manner.

## Programme Scheme

### Eligibility

A Pass in +2 examination conducted by Board of Higher Secondary Education, Government of Tamilnadu or equivalent with Microbiology/ Biology / Botany and Zoology as one of the subjects.

### For Programme Completion

A Candidate shall complete:

- Part I - Language Courses – Tamil/Arabic/Malayalam in semesters I, II, III and IV respectively
- Part II - Language Courses - English in semesters I, II, III, IV respectively
- Part III - Core Courses in semesters I, II, III, IV, V and VI respectively
- Part III - Generic Elective Courses in semesters I, II, III and IV respectively
- Part III - Discipline Elective Courses in semesters IV, V and VI respectively
- Part IV - Foundation Course (Skill Enhancement Course) in Semester I
- Part IV - Entrepreneurial Skills (Skill Enhancement Course) Course in Semester III
- Part IV - Professional Competency Skill (Skill Enhancement Course) Course in Semester V
- Part IV – Non Major Elective (Skill Enhancement Course) Courses in Semesters V and VI respectively
- Part IV - Environmental Studies Course in semester I
- Part IV - Value Education Course in semester III
- Part IV - Summer Internship/Industrial Training Course in semester V
- Part V - Extension activity in semester IV

### Scheme of Examinations under Choice Based Credit System

Term End Examinations (TEE)	- 75 Marks
Continuous Internal Assessment Examinations (CIAE)	- 25 Marks
Total	- 100 Marks

### Pattern of Continuous Internal Assessment Examinations (CIAE)

Average of Two Internal Tests (each 20 marks)	- 20 Marks
Assignment	- 05 Marks
Total	- 25 Marks

### Pattern of Term End Examinations (Max. Marks: 75 / Time: 3 Hours)

### External Examinations Question Paper Pattern for Part I & III and Part IV (Non- Major Elective & Skill based Subject)

#### Section - A (5 X 1 = 5 Marks)

Answer ALL questions.

- Questions 1 - 5
- One question from each unit
- Multiple choice questions and each question carries Four choices

#### Section - B (5 X 2 = 10 Marks)

Answer ALL questions.

- Questions 6 - 10
- One question from each unit
- Short Answer (Definition)

#### Section - C (5 X 6 = 30 Marks)

Answer any ALL questions (Choose either a or b).

- Questions 11 - 15
- One question from each unit
- Paragraph

**Section - D (3 X 10 = 30 Marks)**

Answer any THREE out of five questions.

- Questions 16 - 20
- One question from each unit
- Essay type

**External Examinations Question Paper Pattern for Part IV-  
Foundation Course**

- MCQ Pattern (1 X 75 = 75 Marks)

**External Examinations Question Paper Pattern for Part IV-  
Environmental Studies and Value Education**

**Section - A: (5 X 6 = 30 Marks)**

Answer ALL questions choosing either A or B.

- Questions 1 - 5
- Two questions from each unit (either .... or .... type)
- Paragraph

**Section - B (3 X 15 = 45 Marks)**

Answer any THREE out of five questions.

- Questions 6 - 10
- One question from each unit
- Essay type

**Part V (Extension Activities) - 13 Activities**

- Internal Evaluation

**Passing Marks**

Minimum 27 for External Exam

Eligibility for the degree - passing minimum is **40%**

**Practical Examination**

Internal - 40 marks

External - 60 marks (minimum 24 marks)

Total - 100 marks

Passing minimum is **40%**

**Weightage**

Weightage for Bloom's Taxonomy	Percentage	Marks	
		CIAE	TEE
Knowledge (Remembering) - K1	15	4	11
Understanding - K2	20	5	15
Applying - K3	25	6	19
Analyzing - K4	40	10	30
<b>Gross Total</b>	<b>100</b>	<b>25</b>	<b>75</b>

**Assessment**

**Distribution of questions and marks for Continuous Internal Assessment Examinations**

Bloom's Taxonomy	Section A	Section B	Section C	Section D	Total
Knowledge(K1)	2(2)	2(2)	-	-	<b>25 marks</b>
Understanding(K2)	<b>Assignment (5)</b>				
Apply(K3)	-	-	2(6)	-	
Analyzing (K4)	-	2(2)	-	1(8)	

**Distribution of questions and marks for Term End Examinations.**

Bloom's Taxonomy	Section A	Section B	Section C	Section D	Total
Knowledge(K1)	1(1)	2(4)	1(6)	-	<b>Total 75 Marks</b>
Understanding(K2)	1(1)	1(2)	2(12)	-	
Apply(K3)	3(3)	2(4)	2(12)	-	
Analyzing (K4)	-	-	-	3(30)	

**Note: Figures in parenthesis are Marks**

**Credits Distribution**

S. No	Part	Category	No of Courses	No of Credits
1	Part - I	Language	4	12
2	Part - II	English	4	12
3	Part - III	Core (Theory / Practical / Project)	17	69
		Discipline Elective (Theory / Practical)	4	14
		Generic Elective (Theory / Practical *)	6	16
4	Part - IV (AEC)	Foundation Course	1	2
		EVS	1	2
		Value Education	1	2
		NME	2	4
5	Part - IV (SEC)	Entrepreneurial Skills	1	2
		Professional Competency	1	2
		Internship	1	2
6	Part - V	Extension Activity	1	1
<b>Total</b>			<b>44</b>	<b>140</b>

\* Generic Elective Practical Examinations should be Conducted only in Even Semester

**B.Sc., MICROBIOLOGY**

**Details of Course Category, Code, Credits & Title**

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max. Marks	Credits
<b>Semester - I</b>							
<b>Part - I</b>							
Language - I	26UTALL11	பொதுத்தமிழ் - I	6	25	75	100	3
	26UARLL11	Introduction to Arabic Language - I					
	26UMMLL11	History of Malayalam Literature					
<b>Part - II</b>							
English - I	26UENLL11	General English - I	6	25	75	100	3
<b>Part - III</b>							
Core - I	26UMBCC11	General Microbiology	5	25	75	100	5
Core - II (Lab)	26UMBCC1P	Basic Microbiology Practical	3	40	60	100	3
Generic Elective - I	26UCHGE11	Ancillary Chemistry - I	4	25	75	100	3
Generic Elective - II (Lab)	26UCHGE2P	Volumetric Analysis Ancillary Chemistry Lab	2	-	-	-	-
<b>Part - IV</b>							
Foundation Course (SEC)(MCQ)	26UMBFN11	Introduction to Microbial World	2	25	75	100	2
EVS	26UGEVS11	Environmental Studies	2	25	75	100	2
<b>TOTAL</b>			<b>30</b>				<b>21</b>

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max. Marks	Credits
<b>Semester - II</b>							
<b>Part - I</b>							
Language - II	26UTALL21	பொதுத்தமிழ் - II	6	25	75	100	3
	26UARLL21	Introduction to Arabic Language - II					
	26UMMLL21	Prose, Composition & Translation					
<b>Part - II</b>							
English - II	26UENLL21	General English - II	6	25	75	100	3
<b>Part - III</b>							
Core - III	26UMBCC21	Biochemistry	5	25	75	100	5
Core - IV (Lab)	26UMBCC2P	Biochemistry and Microbial Physiology Practical	3	40	60	100	3
Core - V	26UMBCC22	Microbial Physiology and Metabolism	4	25	75	100	4
Generic Elective - II	26UCHGE21	Ancillary Chemistry - II	4	25	75	100	3
Generic Elective - II (Lab)	26UCHGE2P	Volumetric Analysis Ancillary Chemistry Lab	2	40	60	100	2
<b>TOTAL</b>			<b>30</b>				<b>23</b>

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBCC11	GENERAL MICROBIOLOGY	Core - I	5	5	25	75	100

Course Objectives		
<ul style="list-style-type: none"> <li>To promote the basics of General microbiology.</li> <li>To understand the structure and features of microbes.</li> </ul>		
UNIT	Contents	No. of Hours
I	History and Scope of Microbiology, Contributions of Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister.- Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Differences between prokaryotic and eukaryotic microorganisms	15
II	Bacteria-size, shape and arrangements of bacterial cells. Ultra structure of bacterial cell wall, cell membrane, capsule, flagella, Ribosomes, chlorosomes, and phycobilisomes. General characteristics and nature of Archaeobacteria, Actinomycetes, and Eubacteria. Viruses- Viroids, and Prions.	15
III	Cultivation of microbes- Culture media- Types, Aerobic culture technique- Pure culture techniques- pour plate, spread plate and streak plate method. Anaerobic culture techniques - Wright's tube, McIntosh fildes jar method	15
IV	Microscopy –Bright field, Dark field, phase contrast, electron microscope – SEM & TEM, Confocal microscopy, and Atomic Force Microscopy. Staining methods- Gram stain, Acid fast, Endospore, and Negative stain.	15
V	Sterilization–Physical method- Moist heat –autoclaving. Dry heat –Hot air oven. Radiation – UV, Ionization, Filtration – membrane filter and HEPA filters Chemical agent – Disinfectants - High level, Intermediate level and Low level disinfectants.	15
<b>Total</b>		<b>75</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Study basics of history, scope and classification of Microbiology	K1, K2,K3
2	Gain Knowledge about characteristics of Bacteria and Virus	K1, ,K3
3	Understand cultivation of Microbes and types of media	K1, K2,K3
4	Study on principle and applications of Microscope	K1, K2,
5	Understand sterilization techniques	K1, K2,K3,K4
Textbooks		
1.	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). <i>Microbiology. 7<sup>th</sup> Edition.</i> , McGraw	

	-Hill, New York.
2.	Willey J., Sherwood L., and Woolverton C. J., (2017). <i>Prescott's Microbiology</i> . 10 <sup>th</sup> Edition., McGraw-Hill International edition.
Reference Books	
1.	Jeffrey C. Pommerville., <i>Alcamo's Fundamentals of Microbiology</i> (9 <sup>th</sup> Edition). Jones & Bartlett learning 2010.
2.	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). <i>General Microbiology</i> , 5 <sup>th</sup> Edition., MacMillan Press Ltd
3.	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). <i>Microbiology-An Introduction</i> , 11 <sup>th</sup> Edition., Benjamin Cummings.
4.	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). <i>Microbiology-A Human Perspective</i> , 5 <sup>th</sup> Edition., McGraw Hill Publications.
5.	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - <i>Biology of Microorganisms</i> , 13 <sup>th</sup> Edition Benjamin-Cummings Pub Co.
e-Resources	
1.	<a href="https://bio.libretexts.org/@go/page/9188">https://bio.libretexts.org/@go/page/9188</a>
2.	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#</a>

### Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
C01	2	2	2	2	2
C02	2	1	2	3	2
C03	1	2	1	3	2
C04	2	3	3	3	3
C05	2	2	3	3	1

Strong-3      Medium-2      Low-1

### Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	3	3	1	2	3
C02	1	2	2	2	2
C03	3	3	1	3	3
C04	2	2	2	2	2
C05	2	2	3	2	2

Strong-3      Medium-2      Low-1

### COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
<b>UNIT - I</b>		
1.1	History and Scope of Microbiology, Contributions of Leeuwenhoek, Edward Jenner	4

1.2	Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister	4
1.3	Classification – Three kingdom, five kingdom, six kingdom and eight kingdom.	4
1.4	Differences between prokaryotic and eukaryotic microorganisms	3
<b>UNIT - II</b>		
2.1	Bacteria-size, shape and arrangements of bacterial cells.	3
2.2	Ultra structure of bacterial cell wall, cell membrane, capsule, flagella, Ribosomes, chlorosomes, and phycobilisomes.	4
2.3	General characteristics and nature of Archaeobacteria, Actinomycetes, and Eubacteria	4
2.4	Viruses- Viroids, and Prions.	4
<b>UNIT - III</b>		
3.1	Cultivation of microbes- Culture media- Types, Aerobic culture technique	4
3.2	Pure culture techniques- pour plate, spread plate and streak plate method	3
3.3	Anaerobic culture techniques - Wright's tube,	4
3.4	Anaerobic culture techniques -McIntosh fildes jar method	4
<b>UNIT - IV</b>		
4.1	Microscopy –Bright field, Dark field, phase contrast,	4
4.2	Electron microscope-SEM & TEM	3
4.3	Confocal microscopy, and Atomic Force Microscopy	4
4.4	Staining methods- Gram stain, Acid fast stain and Endospore stain	4
<b>UNIT - V</b>		
5.1	Sterilization–Physical method- Moist heat autoclaving	3
5.2	Dry heat –Hot air oven	2
5.3	Radiation – UV, Ionization,	2
5.4	Filtration-membrane filter and HEPA filters .	4
5.5	Disinfectants - High level, Intermediate level and Low level disinfectants.	4
<b>Total</b>		<b>75</b>

**Course Designer**

**Name: Dr. P. Sivamanikandan**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBCC1P	BASIC MICROBIOLOGY PRACTICAL	Core - II	3	3	40	60	100

Course Objectives		
<ul style="list-style-type: none"> <li>To familiarize the basic culture techniques in Microbiology.</li> <li>To understand the staining of microbes.</li> </ul>		
UNIT	Contents	No. of Hours
I	<b>Microbiological good laboratory practice and safety.</b> Cleaning of glass wares, sterilization and assessment of sterility- Autoclave, hot air oven, and membrane filtration.	9
II	<b>Media preparation:</b> Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation. agar slants, and agar deeps.	9
III	<b>Culture characteristics of microorganisms:</b> growth on different media, growth characteristics, and description. Microscopy: bright field microscopy.	9
IV	<b>Pure culture techniques:</b> streak plate, pour plate, spread plate and serial dilution method. Anaerobic culture methods.	9
V	<b>Staining techniques:</b> smear preparation, simple staining, Gram's staining, endospore and Capsular Staining. Demonstration of Acid Fast staining, Fungal staining - LCB Mount, KOH Method. Motility demonstration- Hanging drop.. Semi-solid agar.	9
<b>Total</b>		<b>45</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Practice sterilization methods; learn to prepare media and their quality control.	K1, K2, K3
2	Understand Microscopy methods, different Staining techniques	K1, K2, K3, K4
3	Observe culture characteristics of microorganisms.	K1, K3
4	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	K1, K2, K3, K4
5	Study on Staining techniques: and motility test.	K1, K2
Textbooks		
1.	James G Cappucino and N. Sherman MB(1996). <i>A lab manual Benjamin Cummins</i> , New York 1996.	
2.	Kannan. N (1996). <i>Laboratory manual in General Microbiology</i> . Palani Publications.	
Reference Books		
1.	Atlas.R (1997). <i>Principles of Microbiology</i> , 2 <sup>nd</sup> Edition, Wm.C.Brown publishers.	

2.	Amita J, Jyotsna A and Vimala V (2018). <i>Microbiology Practical Manual</i> . (1 <sup>st</sup> Edition). Elsevier India
3.	Talib VH (2019). <i>Handbook Medical Laboratory Technology</i> . (2 <sup>nd</sup> Edition). CBS
4.	Wheelis M, (2010). <i>Principles of Modern Microbiology</i> , 1st Edition. Jones and Bartlett Publication.
5.	Lim D. (1998). <i>Microbiology</i> , 2 <sup>nd</sup> Edition, WCB McGraw Hill Publications.

**Mapping with Programme Outcomes:**

CO /PO	P01	P02	P03	P04	P05
C01	2	2	1	2	3
C02	2	2	2	3	3
C03	3	3	2	2	2
C04	2	2	3	3	2
C05	2	2	2	3	2

**Strong-3      Medium-2      Low-1**

**Level of Correlation between PSO's and CO's**

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	2	2	2	2	1
C02	2	3	2	3	2
C03	1	2	2	2	3
C04	3	2	1	2	3
C05	1	2	3	2	3

**Strong-3      Medium-2      Low-1**

**COURSE CONTENTS AND LAB SCHEDULE**

Module No.	Topic	No. of Hours
<b>UNIT - I</b>		
1.1	Microbiological good laboratory practice and safety	1
1.2	Cleaning of glass wares	1
1.3	Sterilization and assessment of sterility	3
1.4	Autoclave, hot air oven, and membrane filtration	4
<b>UNIT - II</b>		
2.1	Media preparation: Preparation of basal, differential media	2
2.2	Enriched, enrichment, transport media preparation	2
2.3	Selective media preparation	2
2.4	Agar slants, and agar deeps preparation	3
<b>UNIT - III</b>		
3.1	Culture characteristics of microorganisms: growth on different media	3
3.2	Growth characteristics, and description	3

3.3	Microscopy: bright field microscopy	3
<b>UNIT - IV</b>		
4.1	Pure culture techniques: streak plate, pour plate	3
4.2	Spread plate and serial dilution method	3
4.3	Anaerobic culture methods	3
<b>UNIT - V</b>		
5.1	Staining techniques: smear preparation, simple staining	1
5.2	Gram's staining, endospore and Capsular Staining	2
5.3	Demonstration of Acid Fast staining	2
5.4	Fungal staining - LCB Mount, KOH Method	2
5.5	Motility demonstration- Hanging drop.. Semi-solid agar	2
<b>Total</b>		<b>45</b>

**Course Designer**

**Name: Dr. P. Sivamanikandan**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE11	ALLIED CHEMISTRY - I	Generic Elective-I	4	3	25	75	100

Course Objectives		
To understand the properties of hydrogen, oxides, water, colloids and concept of carbohydrates, chemical bonding, amino acids, proteins and dyes.		
UNIT	Contents	No. of Hours
I	<b>Hydrogen:</b> Isotopes of hydrogen – preparation, properties and uses of heavy hydrogen. <b>Hydrides</b> – definition – classification – examples. <b>Oxides</b> – Definition – classification – examples. <b>Water:</b> Hardness of water – types of hardness – removal of hardness – industrial implications of hardness in water – Units of hardness of water.	12
II	<b>Colloids:</b> Colloidal states of matter – various types – classification - Sols – dialysis - electrodialysis – electro osmosis – electrophoresis – stability of colloids – protective action – Hardy Schulze law – gold number - Emulsion: Types of emulsions – emulsifier with examples - Gels: Classification, preparation - Applications of colloids.	12
III	<b>Carbohydrates:</b> Definition – classification – monosaccharides – properties and uses of glucose and fructose – Haworth structure (glucose only) – conversion of glucose to fructose and vice versa, mutarotation - Disaccharides: Sucrose (Structure only) – distinction between sucrose, glucose and fructose - Polysaccharides: Starch and cellulose (Structure only).	12
IV	<b>Chemical Bonding:</b> Orbitals – shapes of s and p orbitals – principle of hybridization – sp, sp <sup>2</sup> and sp <sup>3</sup> hybridisation – methane, ethylene and acetylene – VSEPR theory - BeCl <sub>2</sub> , BF <sub>3</sub> , CH <sub>4</sub> , PCl <sub>5</sub> , SF <sub>6</sub> , IF <sub>7</sub> , H <sub>2</sub> O and NH <sub>3</sub> - M.O. theory: Formation of M.O's – bonding and antibonding and non – bonding. M.O.'s – M.O. diagram for H <sub>2</sub> , He and F <sub>2</sub> .	12
V	<b>Amino acids and proteins:</b> Classification – synthesis - Gabriel phthalimide – Strecker – Hell-Volhard-Zelinsky synthesis – properties of amino acids – action of heat, dipolar ion, iso-electric point, and Ruhemann's purple - polypeptides – proteins – classification and biological functions. <b>Dyes:</b> Definition – theory of colour and constitution – classification based on structure and applications – preparation of methyl orange – Bismark brown, malachite green – vat dye – indigo.	12
<b>Total</b>		<b>60</b>
<b>Course Outcomes</b>		<b>Knowledge Level</b>
<b>CO</b>	<b>On completion of this course, students will</b>	

1	Describe the preparation and properties of hydrides, oxides, hardness of water and its implications.	K1, K2
2	Classify the colloidal states of matter and its applications.	K1, K2, K3, K4
3	Demonstrate the reactions of glucose, fructose and sucrose and relate their uses.	K1, K2
4	Identify the concept of orbitals, hybridization, VSEPR and MO theories.	K1, K2, K3
5	Illustrate the properties, classification and functions of proteins and dyes.	K1, K2, K3, K4
<b>K1-Knowledge</b>		<b>K2-Understand</b>
<b>K3-Apply</b>		<b>K4-Analyze</b>
<b>Text books</b>		
1.	S.Vaithyanathan, <i>Text book of Ancillary Chemistry</i> ; Priya Publications, Karur, 2006.	
2.	V.Veeraiyan, <i>Text book of Ancillary Chemistry</i> ; High mount publishing house, Chennai, first edition, 2009.	
<b>Reference Books</b>		
1.	B. S. Bahl & Arun Bahl, <i>Advanced Organic Chemistry</i> , S. Chand & Company, New Delhi, 22 <sup>nd</sup> edition, 2022.	
2.	B.R. Puri and L.R. Sharma and Madan S. Pathania, <i>Principles of Physical Chemistry</i> , Vishal Publishing Co., Jalandhar, 50 <sup>th</sup> edition, 2025.	
3.	R.D. Madan, <i>Modern Inorganic Chemistry</i> , S. Chand, 2013.	
<b>e-Resources</b>		
1.	<a href="https://onlinecourses.nptel.ac.in/">https://onlinecourses.nptel.ac.in/</a>	
2.	<a href="https://swayam.gov.in/course/">https://swayam.gov.in/course/</a>	

**Mapping with Programme Outcomes:**

CO /PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	3	2	2	3
CO3	3	2	3	3	2
CO4	3	2	2	3	3
CO5	3	3	3	2	3

**Strong-3**

**Medium-2**

**Low-1**

**Level of Correlation between PSO's and CO's**

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO2	3	3	3	2	3
CO3	3	3	2	3	3
CO4	3	2	3	3	2
CO5	3	3	3	2	3

**Strong-3**

**Medium-2**

**Low-1**

**COURSE CONTENTS AND LECTURE SCHEDULE**

Module No.	Topic	No. of Lectures
------------	-------	-----------------

UNIT - I		
1.1	Isotopes of hydrogen – preparation, properties and uses of heavy hydrogen	2
1.2	Hydrides – definition – classification – examples	2
1.3	Oxides – Definition – classification – examples	2
1.4	Hardness of water – types of hardness - Removal of hardness - industrial implications of hardness in water - Units of hardness of water.	6
UNIT - II		
2.1	Colloidal states of matter – various types – classification	2
2.2	Sols – dialysis – electro osmosis – electrophoresis	2
2.3	Stability of colloids – protective action – Hardy Schulze law – gold number	2
2.4	Types of emulsions – emulsifier with examples	3
2.5	Classification, preparation - Applications of colloids	3
UNIT - III		
3.1	Carbohydrates: Definition – classification – monosaccharides – properties and uses of glucose and fructose	4
3.2	Haworth structure of glucose-mutarotation- Conversion of glucose to fructose and vice versa.	4
3.3	Sucrose – structure – distinction between sucrose, glucose and fructose	2
3.4	Polysaccharides: Starch and cellulose (Structure only).	2
UNIT - IV		
4.1	Chemical Bonding: Orbitals – shapes of s and p orbitals – principle of hybridization.	3
4.2	sp, sp <sup>2</sup> and sp <sup>3</sup> hybridisation – methane, ethylene and acetylene.	3
4.3	VSEPR theory - BeCl <sub>2</sub> , BF <sub>3</sub> , CH <sub>4</sub> , PCl <sub>5</sub> , SF <sub>6</sub> , IF <sub>7</sub> , H <sub>2</sub> O and NH <sub>3</sub> .	3
4.4	M.O. theory: Formation of M.O.'s – bonding and antibonding and non – bonding. M.O.'s – M.O. diagram for H <sub>2</sub> , He and F <sub>2</sub> .	3
UNIT - V		
5.1	Amino acids and proteins: Classification – synthesis - Gabriel phthalimide – Strecker – Hell-Volhard-Zelinsky synthesis.	2
5.2	Properties of amino acids – action of heat, dipolar ion, iso-electric point, and Ruhemann's purple.	3
5.3	Polypeptides – proteins – classification and biological functions.	2
5.4	Dyes: Definition – theory of colour and constitution – classification based on structure and applications.	2
5.5	Preparation of methyl orange – Bismark brown, malachite green – vat dye – indigo.	3
<b>Total</b>		<b>60</b>

**Course Designer**

**Name: Dr. M. Jannathul Firdhouse**

Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBFN11	INTRODUCTION TO MICROBIAL WORLD	Foundation Course (SEC)(MCQ)	2	2	25	75	100

Course Objectives		
<ul style="list-style-type: none"> <li>To understand the general features of microbes.</li> <li>To familiarize the economic importance of microbes.</li> </ul>		
UNIT	Contents	No. of Hours
I	General features and economic importance of bacteria- General characteristics and morphology of bacteria, mycoplasma, and archaeobacteria. Economic importance of bacteria with examples in antibiotic production ( <i>Streptomyces</i> ).	6
II	General features and economic importance of fungi-General characteristics and morphology of fungi, Economic importance of fungi with examples in biopesticide ( <i>Beauveria</i> ), industry ( <i>Saccharomyces</i> ), medicine ( <i>Penicillium</i> ).	6
III	General features and economic importance of algae- General characteristics and morphology of algae. Beneficial aspects of algae with examples in single cell protein ( <i>Spirulina</i> ), soil fertility ( <i>Anabaena</i> ), environment (Phytoplanktons).	6
IV	General features and economic importance of virus- General characteristics of virus. Economic importance of virus with examples in vaccine production (Rubella virus), gene therapy (Adenovirus), biopesticides (Cauliflower mosaic virus).	6
V	General features and economic importance of protozoa- General characteristics of protozoa. Beneficial applications of protozoa with examples – Biocontrol ( <i>Haemogregarina</i> ). Harmful aspects –diseases ( <i>Giardia</i> ).	6
<b>Total</b>		<b>30</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Study the general features and economic importance of bacteria	K1, K3
2	Gain Knowledge of general features and economic importance of fungi	K1, K2, K3
3	Understand the general features and economic importance of algae	K1, K2, K3
4	Study the general features and economic importance of virus	K1, K2, K3, K4
5	Understand the general features and economic importance of protozoa	K1, K2, K3, K4

<b>Textbooks</b>	
1.	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). <b>Microbiology</b> . 7 <sup>th</sup> Edition., McGraw-Hill, New York.
2.	Dubey, R.C. and Maheswari, D.K. (2005). <b>A Text book of Microbiology</b> . S.Chand & Company Ltd, New Delhi.
<b>Reference Books</b>	
1.	Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). <b>Manual of Environmental Microbiology</b> , 2nd Edition. A. SM Press, New Delhi.
2.	Atlas, R.A. (1995). <b>Principles of Microbiology</b> . Mosby Publications, USA.
3.	Madigan, M.T. and Martinko, J.M. (2014). <b>Brock Biology of Microorganisms</b> . 14th Edition. Prentice Hall International Inc., USA

### Mapping with Programme Outcomes:

CO /PO	P01	P02	P03	P04	P05
C01	1	2	3	2	1
C02	3	2	3	2	2
C03	2	3	3	3	3
C04	2	2	2	3	2
C05	1	2	2	2	3

**Strong-3      Medium-2      Low-1**

### Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	1	3	1	2	3
C02	3	2	2	3	2
C03	2	3	3	2	3
C04	2	2	2	3	3
C05	3	2	1	2	2

**Strong-3      Medium-2      Low-1**

### COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
<b>UNIT - I</b>		
1.1	General features and economic importance of bacteria	2
1.2	General characteristics and morphology of bacteria	2
1.3	Mycoplasma, and archaebacteria	1
1.4	Economic importance of bacteria with examples in antibiotic production ( <i>Streptomyces</i> )	1
<b>UNIT - II</b>		
2.1	General features and economic importance of fungi	2
2.2	General characteristics and morphology of fungi	1

2.3	Economic importance of fungi with examples in biopesticide ( <i>Beauveria</i> )	1
2.4	Industry ( <i>Saccharomyces</i> ), medicine ( <i>Penicillium</i> )	2
<b>UNIT - III</b>		
3.1	General features and economic importance of algae- General characteristics and morphology of algae	2
3.2	Beneficial aspects of algae with examples in single cell protein ( <i>Spirulina</i> )	2
3.3	Soil fertility ( <i>Anabaena</i> ), environment (Phytoplanktons)	2
<b>UNIT - IV</b>		
4.1	General features and economic importance of virus	1
4.2	General characteristics of virus	1
4.3	Economic importance of virus with examples in vaccine production (Rubella virus)	2
4.4	Gene therapy (Adenovirus) and Biopesticides (Cauliflower mosaic virus)	2
<b>UNIT - V</b>		
5.1	General features and economic importance of protozoa, General characteristics of protozoa	2
5.2	Beneficial applications of protozoa with examples	2
5.3	Biocontrol ( <i>Haemogregarina</i> ) and Harmful aspects –diseases ( <i>Giardia</i> )	2
<b>Total</b>		<b>30</b>

### Course Designer

**Name: R. Priya**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBCC21	BIOCHEMISTRY	Core - III	5	5	25	75	100

Course Objectives		
<ul style="list-style-type: none"> <li>• To promote the importance of Biomolecules.</li> <li>• To understand about the significance of Vitamins.</li> </ul>		
UNIT	Contents	No. of Hours
I	Introduction–Water, pH and Buffers. Carbohydrates-Classification Monosaccharides (glucose, fructose), Disaccharides (lactose, sucrose) Polysaccharides (starch, cellulose). Metabolism - Embden-Meyerhof-Parnas, Entner- Doudor off, Pentose Phosphate pathways –TCA cycle.	15
II	Lipids: Physical and Chemical properties of fatty acids- Nomenclature of fattyacids-Phospholipids-Sphingolipids Lipoproteins, Oxidation off attyacids ( $\beta$ -Oxidation)	15
III	Proteins: Structure, classification, properties of proteins. Configurations of Protein- Primary, secondary, tertiary and quaternary.	15
IV	Nucleic acids – Definition, Double helical structure, types of DNA. Structure and Types of RNA (mRNA, tRNA, rRNA).	15
V	Vitamins – Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A,D, E and K) and Water soluble vitamins (B1, B2, B3,B9 and C)	15
<b>Total</b>		<b>75</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Study of carbohydrates and its path way.	K1, K3
2	Understand about the Lipids	K1, K3
3	Analysis of Structure and classification of Protein	K1, K2,K3
4	Gain knowledge of the nucleic acids and its types.	K1, K2
5	Study about the vitamins and its deficiency	K1, K2,K3,K4
Textbooks		
1.	Deb AC, <i>Fundamentals of Biochemistry</i> , New Central Book Agency (p) ltd, London, 2011, 10th edition.	
Reference Books		
1.	Albert L Lehninger, David L Nelson and Michael M Cox, <i>Principles of Biochemistry</i> , Wiley publisher, 2010, 2nd edition.	
2.	Rajagopal G, <i>Concise textbook of biochemistry</i> , Ahuja Publishing House, 2010, 2nd edition.	
3.	Reginald H Garrett and Charles M Grisham, <i>Biochemistry</i> , Brooks Cole publishers, 2012, 5th edition.	
e-Resources		

1.	<a href="https://microbenotes.com/protein-structure/">https://microbenotes.com/protein-structure/</a>
2.	<a href="https://en.wikipedia.org/wiki/Nucleic_acid_structure">https://en.wikipedia.org/wiki/Nucleic_acid_structure</a>

### Mapping with Programme Outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5
C01	3	2	3	2	2
C02	3	2	3	2	2
C03	2	2	2	3	2
C04	3	2	3	2	3
C05	2	2	2	1	1

**Strong-3      Medium-2      Low-1**

### Level of Correlation between PSO's and CO's

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	3	3	3	3	2
C02	2	2	2	2	2
C03	2	1	3	2	3
C04	2	2	2	1	3
C05	1	2	1	2	3

**Strong-3      Medium-2      Low-1**

### COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
<b>UNIT - I</b>		
1.1	Introduction–Water, pH and Buffers. Carbohydrates-Classification Monosaccharides (glucose, fructose)	5
1.2	Disaccharides (lactose, sucrose) Polysaccharides(starch, cellulose)	4
1.3	Metabolism - Embden- Meyerhof- Parnas, Entner-Doudoroff,	3
1.4	Pentose Phosphate pathways –TCA cycle	3
<b>UNIT - II</b>		
2.1	Lipids: Physical and Chemical properties of fatty acids	3
2.2	Nomenclature of fatty acids-Phospholipids	5
2.3	Sphingolipids Lipoproteins	4
2.4	Oxidation of fatty acids ( $\beta$ -Oxidation)	3
<b>UNIT - III</b>		
3.1	Proteins: Structure, classification, properties of proteins	5
3.2	Configurations of Proteins- Primary,secondary,	5
3.3	Configurations of Proteins- Tertiary and quaternary	5
<b>UNIT - IV</b>		

4.1	Nucleic acids – Definition- Double helical structure	5
4.2	Types of DNA	2
4.3	Structure of RNA	3
4.4	Types of RNA (mRNA, tRNA, rRNA).	5
<b>UNIT - V</b>		
5.1	Vitamins – Definitionsources, deficiency syndromes and functions	5
5.2	Fat soluble vitamins (A,D, E and K)	5
5.3	Water soluble vitamins B1, B2, B3, B9 and C.	5
<b>Total</b>		<b>75</b>

**Course Designer**

**Name: Ms. M. Musbira Banu**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBCC2P	BIOCHEMISTRY AND MICROBIAL PHYSIOLOGY PRACTICAL	Core - IV	3	3	40	60	100

Course Objectives		
<ul style="list-style-type: none"> <li>To familiarize the basic techniques in Biochemistry.</li> <li>To understand the factors affecting microbial growth.</li> </ul>		
UNIT	Contents	No. of Hours
I	Preparation of Normal, Molar, and Percentage Solutions, Preparation of Buffer, pH meter- principle and measurements , Beer – Lambert law verification.	9
II	Estimation of Carbohydrates by Anthrone method- Estimation of sugar by Folin Wu method-	9
III	Estimation of Proteins (Lowry's method) - Separation of amino acids by Paper chromatography.	9
IV	Bacterial growth curve, Effect of pH on bacterial growth, Effect of temperature on bacterial growth, Effect of radiation on bacterial growth, Effect of salinity on bacterial growth.	9
V	Biochemical reactions of bacteria - Indole test, Methyl Red test, VogesProskayer test, Citrate utilization test, TSI test, Oxidase test, Catalase test, Urease test and Carbohydrate fermentation test.	9
<b>Total</b>		<b>45</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Practice preparation of Molar solutions, Buffer.	K1, K2,K3
2	Familiarise estimation of Carbohydrates	K1 ,K3
3	Learn to estimate Protein and Paper chromatography.	K1, K2
4	Understand effect of environmental parameters on Bacterial growth	K1, K2, K3,K4
5	Study on Biochemical reactions of bacteria.	K1, K2, K3,K4
Textbooks		
1.	Jayaraman J., <i>Laboratory manual in Biochemistry</i> , 5/e New age international Publishers, 1996.	
2.	Kannan. N (1996). <i>Laboratory manual in General Microbiology</i> . Palani Publications.	
3.	Sundararaj T (2005). <i>Microbiology Lab Manual</i> (1 <sup>st</sup> edition) publications.	
4.	Gunasekaran, P. (1996). <i>Laboratory manual in Microbiology</i> . New Age International Ld., Publishers, New Delhi.	
5.	R C Dubey and D K Maheswari (2002). <i>Practical Microbiology</i> . S. Chand Publishing.	

Reference Books	
1.	Palanivelu. P. <i>Analytical Biochemistry &amp; Separation Techniques</i> , 21 <sup>st</sup> century publications, Madurai, 3 <sup>rd</sup> edition. 2009.
2.	Amita J, Jyotsna A and Vimala V (2018). <i>Microbiology Practical Manual</i> . (1 <sup>st</sup> Edition). Elsevier India
3.	Talib VH (2019). <i>Handbook Medical Laboratory Technology</i> . (2 <sup>nd</sup> Edition). CBS
4.	Wheelis M, (2010). <i>Principles of Modern Microbiology</i> , 1st Edition. Jones and Bartlett Publication.
5.	Lim D. (1998). <i>Microbiology</i> , 2 <sup>nd</sup> Edition, WCB McGraw Hill Publications.

### Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
C01	2	3	3	2	3
C02	3	2	2	2	1
C03	2	2	3	3	2
C04	1	3	1	3	3
C05	2	2	3	1	2

Strong-3      Medium-2      Low-1

### Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	2	2	2	2	3
C02	3	2	3	3	2
C03	2	3	2	2	3
C04	3	2	2	3	3
C05	1	2	1	2	3

Strong-3      Medium-2      Low-1

### COURSE CONTENTS AND LAB SCHEDULE

Module No.	Topic	No. of Hours
<b>UNIT - I</b>		
1.1	Preparation of Normal, Molar, and Percentage Solutions	3
1.2	Preparation of Buffer	2
1.3	pH meter- principle and measurements	2
1.4	Beer – Lambert law verification	2
<b>UNIT - II</b>		
2.1	Estimation of Carbohydrates by Anthrone method	5
2.2	Estimation of sugar by Folin Wu method	4
<b>UNIT - III</b>		
3.1	Estimation of Proteins (Lowry's method)	4
3.2	Separation of amino acids by Paper chromatography	5

<b>UNIT - IV</b>		
4.1	Bacterial growth curve	3
4.2	Effect of pH on bacterial growth, Effect of temperature on bacterial growth	2
4.3	Effect of radiation on bacterial growth	2
4.4	Effect of salinity on bacterial growth	2
<b>UNIT - V</b>		
5.1	Biochemical reactions of bacteria - Indole test, Methyl Red test, Voges Proskayer test, Citrate utilization test	4
5.2	TSI test, Oxidase test	2
5.3	Catalase test, Urease test	2
5.4	Carbohydrate fermentation test	1
<b>Total</b>		<b>45</b>

**Course Designer**

**Name: Ms. M. Musbira Banu**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UMBCC22	MICROBIAL PHYSIOLOGY AND METABOLISM	Core-V	4	4	25	75	100

Course Objectives		
<ul style="list-style-type: none"> <li>To create awareness among the students about microbial physiology</li> <li>To understand the importance of microbial metabolism</li> </ul>		
UNIT	Contents	No. of Hours
I	<b>Physiology of microbial growth:</b> Batch- continuous-synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	12
II	<b>Nutritional requirements:</b> Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms - Passive diffusion and Active transport. Factors affecting microbial growth.	12
III	<b>Electron Transport Chain,</b> Mode of regeneration of ATP- Substrate level Phosphorylation, Oxidative Phosphorylation and Photophosphorylation. Fermentation- Homolactic Fermentation, Heterolactic Fermentation, Alcoholic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	12
IV	<b>Photosynthesis:</b> An overview of chloroplast structure. Photosynthetic Pigments, Light Reaction- Cyclic and non-cyclic Photophosphorylation. Dark Reaction- Calvin Cycle.	12
V	<b>Bacterial reproduction:</b> Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi- asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.	12
<b>Total</b>		<b>60</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Describe microorganisms based on nutrition.	K1, K2, K3
2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	K1, K3
3	Explain the methods of nutrient uptake.	K1, K2, K3
4	Describe aerobic and anaerobic energy production.	K1, K3
5	Elaborate on the process of bacterial photosynthesis and reproduction.	K1, K2, K3, K4
Textbooks		
1.	Schlegel, H.G.(1993). <b>General Microbiology</b> , 7 <sup>th</sup> Edition, Press syndicate of the University of Cambridge.	

2.	Rajapandian K.(2010). <b>Microbial Physiology</b> , Chennai: PBS Book Enterprises India.
3.	Meena Kumari. S. <b>Microbial Physiology</b> , Chennai 1 <sup>st</sup> Edition MJP Publishers 2006.
4.	Dubey R.C. and Maheswari, S.(2003). <b>A text book of Microbiology</b> , New Delhi: S. Chand & Co.
5.	S. Ram Reddy, S.M. Reddy (2008). <b>Microbial Physiology</b> . Anmol Publications Pvt Ltd.
<b>Reference Books</b>	
1.	Robert K. Poole (2004). <b>Advances in Microbial Physiology</b> , Elsevier Academic Press, New York, Volume 49.
2.	Kim B.H., Gadd G.M. (2008). <b>Bacterial Physiology and Metabolism</b> . Cambridge University Press, Cambridge.
3.	Daniel R. Caldwell. (1995). <b>Microbial Physiology &amp; Metabolism</b> Wm. C. Brown Communications, Inc. USA.
4.	Moat, A. G and J. W Foaster (1995). <b>Microbial Physiology, 3<sup>rd</sup> edition</b> . Wiley-LISS, A John Wiley & Sons. Inc. Publications.
5.	Bhanu Shrivastava. (2011). <b>Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism</b> . Lambert academic Publication.
<b>e-Resources</b>	
1.	<a href="https://onlinecourses.swayam2.ac.in/cec20_bt14/preview">https://onlinecourses.swayam2.ac.in/cec20_bt14/preview</a>
2.	<a href="http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf">http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf</a>

### Mapping with Programme Outcomes:

CO /PO	PO1	PO2	PO3	PO4	PO5
C01	3	2	3	2	2
C02	3	2	3	2	3
C03	2	3	2	3	3
C04	2	2	2	3	2
C05	1	2	1	2	2

**Strong-3      Medium-2      Low-1**

### Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	1	2	3	2	3
C02	3	2	2	2	2
C03	2	3	2	2	3
C04	2	2	3	3	3
C05	3	3	2	2	3

**Strong-3      Medium-2      Low-1**

### COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
<b>UNIT - I</b>		
1.1	Physiology of microbial growth: Batch–continuous	3
1.2	Synchronous cultures	3
1.3	Growth Curve and measurement method (turbidity, biomass, and cell count)	3
1.4	Control of microbial growth.	3
<b>UNIT - II</b>		
2.1	Nutrition requirements Photoautotrophs	3
2.2	Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria)	3
2.3	Chemoorganotrophs. Nutrition transport mechanisms Passive diffusion and Active transport	3
2.4	Factors affecting microbial growth.	3
<b>UNIT - III</b>		
3.1	Electron Transport Chain,	4
3.2	Mode of regeneration of ATP- Substrate level Phosphorylation , Oxidative Phosphorylation and Photophosphorylation	4
3.3	Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Alcoholic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	4
<b>UNIT - IV</b>		
4.1	Photosynthesis an Overview of chloroplast structure	3
4.2	Photosynthetic Pigments, Light Reaction	3
4.3	Cyclic and non-cyclic Photophosphorylation	3
4.4	Dark Reaction-Calvin Cycle.	3
<b>UNIT - V</b>		
5.1	Bacterial reproduction Binary fission, Budding	3
5.2	Reproduction through conidia, cyst formation, endospore formation	3
5.3	Fungi asexual and sexual reproduction	3
5.4	Microalgae reproduction. Asexual and sexual reproduction of protozoa.	3
<b>Total</b>		<b>60</b>

### Course Designer

**Name: Dr. P. Sivamanikandan**

Assistant Professor of Microbiology

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE21	ALLIED CHEMISTRY - II	Generic Elective -II	4	3	25	75	100

Course Objectives		
To identify the concept of photochemistry, coordination compounds, chromatographic technique, chemotherapy and nuclear chemistry.		
UNIT	Contents	No. of Hours
I	<b>Photochemistry:</b> Comparison of thermal and photochemical reactions – definition of photochemical reactions – laws of photochemistry – Grotthus-Draper law – Einstein law – quantum efficiency – reasons for low and high quantum yield with examples – consequence of light absorption by atoms and molecules – Jablonski diagram – fluorescence – phosphorescence – photosensitization – mechanism – chemiluminescence – bioluminescence – applications of photochemistry.	12
II	<b>Coordination compounds:</b> Definition – nomenclature – definition of various terms involved in coordination chemistry – classification of ligands - Werner's theory, Valence Bond theory (VBT) - EAN rule – Nickel carbonyl – chelates.	12
III	<b>Chromatographic technique:</b> Principle – classification -adsorption and partition chromatography- thin layer chromatography – column chromatography (adsorption) – paper Chromatography – gas-solid and gas-liquid chromatography- applications of each type - ion exchange chromatography.	12
IV	<b>Sulpha drugs:</b> Sulphadiazine – Sulphanilamide – Preparation and applications. <b>Antimalarials:</b> Chloroquine and Plasmoquine. <b>Arsenical drugs:</b> Salvarasan – 606 and Neosalvarasan. <b>Antibiotics:</b> Definition – classification – Penicillin - Amoxicillin – Ampicillin – Tetracyclin- Streptomycin – mode of application – uses only.	12
V	<b>Nuclear Chemistry:</b> Composition of the nucleus – nuclear forces – mass defect – binding energy – nuclear stability – Soddy and Fajan's group displacement law – Nuclear fission: Overview – application of fission – principle of atom bomb - Nuclear fusion: Emission of energy – Stellar energy – hydrogen bomb - Applications of radioactive isotopes.	12
<b>Total</b>		<b>60</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Describe the physical concepts of photochemistry.	K1, K2

2	Explain the basic terms, isomerism and theories involved in coordination compound.	K1, K2
3	Apply the column, thin layer and paper chromatographic techniques to separate and identify the components present in a mixture.	K1, K2, K3
4	Classify the chemotherapy drugs such as sulpha, antimalarials, antibiotics and arsenical drugs.	K1, K2, K3, K4
5	Examine the concept of nuclear chemistry and its applications.	K1, K2, K3, K4
<b>K1-Knowledge</b>		<b>K2-Understand</b>
<b>K3-Apply</b>		<b>K4-Analyze</b>
<b>Text books</b>		
1.	P.L.Soni, Mohan Katyal, <i>Text book of Inorganic chemistry</i> ; Sultan Chand and Company, New Delhi, twentieth edition, 2007.	
2.	S.Vaithyanathan, <i>Text book of Ancillary Chemistry</i> ; Priya Publications, Karur, 2006.	
<b>Reference Books</b>		
1.	B. S. Bahl & Arun Bahl, <i>Advanced Organic Chemistry</i> , S. Chand & Company, New Delhi, 22 <sup>nd</sup> edition, 2022.	
2.	B.R. Puri and L.R. Sharma and Madan S. Pathania, <i>Principles of Physical Chemistry</i> , Vishal Publishing Co., Jalandhar, 50 <sup>th</sup> edition, 2025.	
3.	R.D. Madan, <i>Modern Inorganic Chemistry</i> , S. Chand Publishers, 2013.	
<b>e-Resources</b>		
1.	<a href="https://onlinecourses.nptel.ac.in/">https://onlinecourses.nptel.ac.in/</a>	
2.	<a href="https://swayam.gov.in/course/">https://swayam.gov.in/course/</a>	

#### Mapping with Programme Outcomes:

CO /PO	P01	P02	P03	P04	P05
C01	3	3	2	3	3
C02	3	3	3	2	2
C03	3	2	2	3	3
C04	3	2	3	3	3
C05	3	3	3	3	2
<b>Strong-3</b>		<b>Medium-2</b>		<b>Low-1</b>	

#### Level of Correlation between PSO's and CO's

CO /PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	2
C02	3	3	3	2	3
C03	3	2	3	3	3
C04	3	3	2	3	3
C05	3	3	3	2	3
<b>Strong-3</b>		<b>Medium-2</b>		<b>Low-1</b>	

#### COURSE CONTENTS AND LECTURE SCHEDULE

Module No.	Topic	No. of Lectures
------------	-------	-----------------

<b>UNIT - I</b>		
1.1	Comparison of thermal and photochemical reactions - definition of photochemical reactions	2
1.2	Laws of photochemistry - Grotthus-Draper law - Einstein law	2
1.3	Quantum efficiency - reasons for low and high quantum yield with examples	2
1.4	Consequence of light absorption by atoms and molecules - Jablonski diagram - fluorescence - phosphorescence	3
1.5	Photosensitization - chemiluminescence - bioluminescence - applications of photochemistry	3
<b>UNIT - II</b>		
2.1	Coordination compounds: nomenclature - definition of various terms involved in coordination chemistry	4
2.2	Classification of ligands-Werner's theory, EAN rule	4
2.3	Valence Bond theory - Nickel carbonyl - chelates	4
<b>UNIT - III</b>		
3.1	Chromatographic technique: Principle - classification - adsorption and partition Chromatography	4
3.2	Thin layer chromatography - column chromatography (adsorption) - paper Chromatography	4
3.3	Gas-solid and gas-liquid chromatography- ion exchange chromatography- applications.	4
<b>UNIT - IV</b>		
4.1	Sulpha drugs - sulphadiazine - sulphanilamide -preparation and applications	3
4.2	Antimalarials: chloroquine and plasmoquine -preparation and applications	3
4.3	Arsenical drugs: Salvarasan - 606 and neosalvarasan-preparation and applications	3
4.4	Antibiotics: Definition - classification - penicillin - amoxicillin - ampicillin - tetracyclin- streptomycin - mode of application - uses only	3
<b>UNIT - V</b>		
5.1	Nuclear Chemistry: Composition of the nucleus - nuclear forces - mass defect - binding energy - nuclear stability - Soddy's group displacement law - illustration.	4
5.2	Nuclear fission: Definition - application of fission - principle of atom bomb - Nuclear fusion: Definition - emission of energy - Stellar energy - hydrogen bomb	4
5.3	Applications of radioactive isotopes.	4
<b>Total</b>		<b>60</b>

**Course Designer**

**Name: Dr. M. Jannathul Firdhouse**

Assistant Professor of Chemistry

Course Code	Course Title	Category	Hours	Credits	Marks		
					CIAE	TEE	Total
26UCHGE2P	VOLUMETRIC ANALYSIS FOR ALLIED CHEMISTRY LAB	Generic Elective –II (Lab)	2	2	40	60	100

### Course Objectives

To enable the students to acquire the quantitative skills in volumetric analysis and to calibrate burette, pipette and standard flask.

UNIT	Contents	No. of Hours
I	The essential apparatus used in the volumetric analysis. Concepts of molecular weight, equivalent weight, normality and calculation. A double titration involving the making up of the given solution to be estimated and the preparation of a primary standard solution.	12
II	<b>Laboratory hygiene and safety:</b> Handling of concentrated acids, bases and hazardous chemicals, Carcinogenic chemicals, Safety precautions, fire hazards and first aid procedures for laboratory accidents - poisoning - universal antidote.	12
III	<b>Acidimetry and Alkalimetry</b> 1. Titration between a strong acid and strong base. 2. Titration between a strong acid and weak base. 3. Titration between a weak acid and strong base.	12
IV	<b>Permanganometry</b> 1. Titration between $\text{KMnO}_4$ and oxalic acid 2. Titration between $\text{KMnO}_4$ and ferrous sulphate 3. Titration between $\text{KMnO}_4$ and Mohr's salt (Ferrous ammonium sulphate)	12
V	<b>Iodometry</b> 1. Titration between sodium thiosulphate and potassium dichromate 2. Titration between sodium thiosulphate and copper sulphate	12
<b>Total</b>		<b>60</b>
Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Simplify basic quantitative skills in volumetric analysis with the use of burette, pipettes and standard flasks.	K1, K2, K3, K4
2	Inspect the laboratory hygiene and safety.	K1, K2, K3, K4
3	Apply acidimetric and alkalimetric method for the quantitative volumetric estimation of acids and bases.	K1, K2, K3
4	Estimate the amount of oxalic acid, ferrous sulphate and Mohr's salt permanganometrically.	K1, K2, K3
5	Analyze quantitatively the potassium dichromate and copper sulphate iodometrically.	K1, K2, K3, K4

K1-Knowledge	K2-Understand	K3-Apply	K4-Analyze
<b>Text books</b>			
1.	O. P. Pandey, D. N. Bajpai & S. Giri, <i>Practical Chemistry (For B.Sc.)</i> – S. Chand Publishing, 2010.		
2.	Sundaram, Krishnan, Raghavan, <i>Practical Chemistry (Part II)</i> , S. Viswanathan Co. Pvt., 1996.		
<b>Reference Books</b>			
1.	Basset, J. Mendham, R.C. Denney, <i>Vogel's Textbook of Quantitative Chemical Analysis</i> , Longman Scientific & Technical, New York, 1989, 5 <sup>th</sup> Edition.		
2.	V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, <i>Basic Principles of Practical Chemistry</i> , Sultan Chand & Sons, New Delhi, 2004, 2 <sup>nd</sup> Edition.		
<b>e-Recourses</b>			
1.	<a href="http://www.federica.unina.it/agraria/analyticalchemistry/volumetric-analysis">http://www.federica.unina.it/agraria/analyticalchemistry/volumetric-analysis</a>		
2.	<a href="https://chemdictionary.org/titration-indicator/">https://chemdictionary.org/titration-indicator/</a>		

**Mapping with Programme Outcomes:**

CO /PO	P01	P02	P03	P04	P05
C01	3	3	3	3	3
C02	3	3	3	2	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	2
<b>Strong-3</b>	<b>Medium-2</b>			<b>Low-1</b>	

**Level of Correlation between PSO's and CO's**

CO /PSO	PS01	PS02	PS03	PS04	PS05
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	2	3	2
C04	3	3	3	3	3
C05	3	3	3	3	3
<b>Strong-3</b>	<b>Medium-2</b>			<b>Low-1</b>	

**COURSE CONTENTS AND LAB SCHEDULE**

Module No.	Topic	No. of Hours
<b>UNIT - I</b>		
1.1	The essential apparatus used in the volumetric analysis.	3
1.2	Concepts of molecular weight, equivalent weight, normality and calculation.	3
1.3	A double titration involving the making up of the solution to be estimated and the preparation of a primary standard.	3
<b>UNIT - II</b>		

2.1	Handling of concentrated acids, bases and hazardous chemicals and Carcinogenic chemicals.	3
2.2	Safety precautions, fire hazards and first aid procedures for laboratory accidents	3
2.3	Poisoning – universal antidote.	3
<b>UNIT - III</b>		
3.1	Titrations between a strong acid versus strong base.	3
3.2	Titrations between a strong acid versus weak base.	3
3.3	Titrations between a weak acid versus strong base.	3
<b>UNIT - IV</b>		
4.1	Titration between $\text{KMnO}_4$ against oxalic acid	3
4.2	Titration between $\text{KMnO}_4$ against ferrous sulphate	3
4.3	Titration between $\text{KMnO}_4$ against Mohr's salt (Ferrous ammonium sulphate)	3
<b>UNIT - V</b>		
5.1	Titration between sodium thiosulphate versus potassium dichromate	6
5.2	Titration between sodium thiosulphate versus copper sulphate	6
<b>Total</b>		<b>60</b>

**Course Designer**

**Name: Ms. A. Ismath Raihana**

Assistant Professor of Chemistry