HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam -625533.

DEPARTMENT OF MICROBIOLOGY

BACHELOR OF SCIENCE – MICROBIOLOGY

SYLLABUS (I Year)

Choice Based Credit System – CBCS

(As per TANSCHE/MKU Guidelines)

With

Outcome Based Education (OBE)

(with effect from Academic year 2023 -2024 onwards)

HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd 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, duly-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 continuous forever.

HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd 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.

SYLLABUS FOR B.Sc. MICROBIOLOGY

CBCS SEMESTER PATTERN

(with effect from the academic year 2023-2024 onwards)

1. Introduction of the programme

This three-year Bachelor of Science course in Microbiology deals with the study of microorganisms comprising Bacteria, Fungi, Protozoans, Algae and Virus; and its association with the environment, plants, animals and humans. Candidates undertaking this curriculum will understand the basic and applied concepts of Microbiology. This includes the beneficial and harmful role of microorganism in the production of commercially important products and its role in various diseases respectively. Basic concepts of Immunology of the host and its interaction with infectious microorganisms are also included in the syllabus. The scope of this course is wide which enables the candidate to get placed in diagnostics, pharma, fermentation, dairy, food and medical arena.

2. Objectives of the Programme

- To inculcate the basic and advanced concepts of Microbiology including taxonomy, physiology, Immunology, biomolecule interactions, genomics, proteomics and rDNA technology.
- To impart the scope for the application of concepts learned in the subject.
- To introduce about the recent advances in the field of Microbiology and its importance in research.

3. Outcome of the programme:

At the end of this three year course, a candidate will have a thorough understanding on the basic concepts of Microbiology and its applications in the various fields of science and technology. Through the knowledge and hands-on experience imparted during the practical subjects, the candidate will get conveniently placed in the diagnostics, production and R&D units of various hospitals and industries respectively. This course will also lay a strong foundation to build the individual research caliber in the aspirants of Bachelor of Science in Microbiology.

4.Unitization: Content of every paper divided in to FIVE units.

Programme	**B.Sc. MICROBIOLOGY**
Programme code:	
Duration:	**3years**[UG]
Programme Outcomes	**PO1: Disciplinary Knowledge:** Acquire detailed knowledge and expertise in all the disciplines of the subject **PO2: Communication skills:** Able to communicate scientific information, concepts, experiments and significance. **PO3: Ethical value:** Apply knowledge on ethical and legal based issues **PO4: Analytical reasoning:** Familiarize to collect, analyze and interpret scientific data **PO5: Contribution to society:**

	Solve public issues concerned with public health and safety for the welfare of the society **PO6: Scientific reasoning** Solve problems understanding the issues, and find solutions, in day-to-day life **PO7: Employability skill** Equip with skills, based on current trends and future expectations for career development and placements. **PO8: Entrepreneurial skill** Equip with skills and competency to become a successful entrepreneur **PO9: Research related skill** ProficientskillsandcompetencetomakeaprospectivecareerinResearch&Development. **PO10: Lifelonglearning** Identify the need for skills necessary to be successful in future **PO11: Instrumentation skill** Handle laboratory experiments following safety precautions and standards
Programme Specific Outcome	**PSO-1: Placement** Prepare the students in all disciplines like agriculture, industry - medical, pharma, dairy, hotel, food and food processing, immunological, cosmetics, vermin technology and water treatment for effective and respectful placement.
	PSO-2: Entrepreneur To create effective entrepreneur by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO-3: Research and Development** Design and implement HR systems that comply with good laboratory practices, following ethical values, leading the organization towards growth and development. **PSO-4: Contribution to society** To contribute to the development of society and produce microbiological products, by collaborating with stakeholders, related to the betterment of environment and mankind at the national and global level.

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.

- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.

State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome/ Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective	➢ Instill confidence among students ➢ Create interest for the subject
I,II,III,IV	**Skill Enhancement papers** (Discipline centric /Generic/Entrepreneurial)	➢ Industry ready graduates ➢ Skill edhumanre source ➢ Students are equipped with essential skills to Make the employable

		➢ Training on language and communication skills enable the students gain knowledge and Exposure in the competitive world.
		➢ Discipline centric skill will improve the Technical knowhow of solving real life problems.
III,IV,V& VI	Elective papers	➢ Strengthening the domain knowledge Introducing the stake holders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature ➢ Emerging topics in higher education/ industry/ communication network/health sector etc. are introduced with hands-on-training.

IV	Elective Papers	➢ Exposure to industry moulds students in to solution providers ➢ Generates Industry ready graduates ➢ Employment opportunities enhanced
V	Elective papers	➢ Self-learning is enhanced ➢ Application of the concept to real situation is conceived resulting Intangible outcome
VI	Elective papers	➢ Enriches the study beyond the course. ➢ Developing a research frame work and Presenting their independentand intellectual ideas effectively.
Extra Credits: For Advanced Learners/Honors degree		➢ To cater to the needs of peer learners/research aspirants
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability,ProfessionalCompetency,ProfessionalCommunicationandTransferrable Skill

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/Comprehend(K2)	MCQ, True/False, Short essays, Concept explanations , Short summary or overview
Application (K3)	Suggest idea/concept with examples, suggest for mulae, Solve problems, Observe, Explain
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate
	Between various ideas, Map knowledge

Evaluate(K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create(K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

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 papers – Tamil/Arabic in semesters I, II, III and IV respectively
- Part II - Language papers - English in semesters I, II, III, IV respectively
- Part III - Core papers in semesters I, II, III, IV, V and VI respectively
- Part III - Elective papers (Discipline / Generic) in semesters I, II, III, IV, V and VI respectively
- Part IV – Skill Enhancement Course (NME) papers in semesters I and II respectively
- Part IV - Skill Enhancement Course papers in semesters I, II, III, and IV respectively
- Part IV - Skill Enhancement Course (Foundation Course) paper in semester I respectively
- Part IV - Skill Enhancement Course (Professional Competency Skill) in semester VI respectively
- Part IV - Value Education paper in semester V respectively
- Part IV - Environmental Studies paper in semesters III and IV respectively
- Part IV – Summer Internship/Industrial Training paper in semester V respectively
- Part V - Extension activity in semester VI respectively

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 (Elective & Skill Enhancement Course Subject)

Section – A (10 X 1 = 10 Marks) Answer ALL questions.

- Questions 1 - 10

- Two questions from each UNIT
- Multiple choice questions and each question carries Four choices

Section – B (5 X 7 = 35 Marks)
Answer ALL questions choosing either A or B.

- Questions 11 - 15
- Two questions from each UNIT (either…. or…. type)
- Descriptive Type

Section – C (3 X 10 = 30 Marks)
Answer any THREE out of five questions.

- Questions 16 - 20
- One question from each UNIT
- Descriptive Type

External Examinations Question Paper Pattern for 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)
- Descriptive Type

Section – B (3 X 15 = 45 Marks)
Answer any THREE out of five questions.

- Questions 6 – 10
- One question from each UNIT
- Descriptive Type

Part V (Extension 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
Total – 100 marks
Passing minimum is **40%**

Semester-I

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part I	23UTALL11	பொதுத்தமிழ் - 1 தமிழ் இலக்கிய வரலாறு - 1	6	25	75	100	3
	23UARLL11	Paper I : Prose	6	25	75	100	3
	23UMMLL11	Prose, Composition and Translation	6	25	75	100	3
Part II	23UENLL11	General English - I	6	25	75	100	3
Part – III	23UMBCC11	Fundamentals of Microbiology and Microbial Diversity	4	25	75	100	4
	23UMBCC1P	Fundamentals of Microbiology and Microbial diversity Practical	4	40	60	100	4
	23UCHGE11	Chemistry For Biological Sciences - I	4	25	75	100	3
	23UCHGE1P	Chemistry Practical For Physical And Biological Sciences - I	2	40	60	100	2
Part IV	23UMBSE11	SEC-1(NME) Social and Preventive medicine	2	25	75	100	2
	23UMBFN11	Introduction to Microbial world	2	25	75	100	2
Total			**30**				**23**

Semester-II

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part–I	23UTALL21	பொதுத்தமிழ் - 2 தமிழ் இலக்கிய வரலாறு - 2	6	25	75	100	3
	23UARLL21	Paper II : Grammar	6	25	75	100	3
	23UMMLL21	Office Communication Malayalam	6	25	75	100	3
Part–II	23UENLL21	General English- II	6	25	75	100	3
Part-III	23UMBCC21	Microbial Physiology and Metabolism	5	25	75	100	5
	23UMBCC2P	Microbial Physiology and Metabolism Practical	3	40	60	100	3
	23UCHGE21	Chemistry For Biological Sciences -II	4	25	75	100	3
	23UCHGE2P	Chemistry Practical For Physical and Biological Sciences - II	2	40	60	100	2
Part–IV	23UMBSE21	Nutrition & Health Hygiene	2	25	75	100	2
	23UMBSE22	SEC-3 Sericulture	2	25	75	100	2
			30				**23**

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBCC11	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	Core	4	4	25	75	100

Learning Objectives		
L1	Learn the fundamental principles about different a spects of Microbiology including recent developments in the area.	
L2	Describe the structural organization, morphology and reproduction of microbes.	
L3	Explain the methods of cultivation of micro be and measurement of growth.	
L4	Understand the microscopy and other basic laboratory techniques–culturing , disinfection and sterilization in Microbiology.	
L5	Compare and contrast the different methods of sterilization.	
UNIT	**Contents**	**No. of Hours**
I	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.	12
II	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.	12
III	Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture	12
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM&SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.	12
V	Sterilization– moist heat- autoclaving, dry heat– Hot air oven, radiation– UV, Ionization, filtration–membrane filter and disinfection ,antiseptic; Antimicrobial agents	12
	Total	**60**

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	K1,K2,K3,K4
2	Gain Knowledge of detailed structure and functions of Prokaryotic cell organelles.	K1,K2,K3,K4,K5,K6
3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	K1,K2,K3,K4,K5,K6
4	Explain the principles and working mechanism of different	K1,K2,K3,K4,K5,K6

	microscopes/Microscope, their function and scope of application.	
5	Understand the concept to fasepsis and modes of sterilization and disinfectants**.**	K1,K2,K3,K4,K5
Textbooks		
1	Pelczar.M.J.,ChanE.C.S.andNoel.R.K.(2007).Microbiology.7thEdition.,McGraw–Hill,NewYork.	
2	WilleyJ., SherwoodL.,andWoolvertonC.J.,(2017).Prescott'sMicrobiology.10th Edition.,McGraw-HillInternationaledition.	
3	Tortora,G.J.,Funke,B.R.,Case,C.L.(2013).Microbiology.AnIntroduction11thEdition., A LaCartePearson.	
4	Salle.A.J(1992).FundamentalPrinciplesofBacteriology.7thEdition.,McGrawHill Inc.New York.	
5	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby CollegePublishing,StLouis.	
Reference Books		
1.	JeffreyC.Pommerville.,Alcamo's Fundamentals of Microbiology (9thEdition).Jones & Bartlett learning 2010.	
2.	Stanier R.Y, Ingraham J.L.,Wheelis M.L., and Painter R.R.(2010).General Microbiology, 5thEdition.,MacMillanPressLtd	
3.	Tortora,G.J.,Funke,B.R.and,Case,C.L(2013).Microbiology-AnIntroduction, 11thEdition.,BenjaminCummings.	
4.	Nester E., Anderson D., Roberts C.E., and Nester M.(2006).Microbiology-A Human Perspective, 5thEdition.,McGrawHillPublications.	
5.	Madigan M.T.,Martinko J.M., Stahl D.A, and Clark D.P.(2010).Brock-Biology of Microorganisms,13thEdition Benjamin – Cummings PubCo.	
Web Resources		
1.	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/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/microbial-nutrition/	

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand /Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze(K4)	Problem-solving questions, Finisha procedure in many steps, Differentiate between Various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	2	3	3
CO 2	2	2	2	2	2	2
CO 3	2	2	2	2	2	2
CO 4	2	2	2	3	2	2
CO 5	2	2	2	3	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	2	1
CO2	1	2	1	2	2
CO3	1	2	1	2	3
CO4	1	2	1	2	3
CO5	1	2	1	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBCC1P	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY PRACTICAL	Core	4	4	40	60	100

Learning Objectives		
L1	Acquire knowledge on Cleaning of glassware, GLP and sterilization.	
L2	Gain knowledge on media preparation and cultural characteristics.	
L3	Learn the pure culture technique	
L4	Learn the microscopic techniques and staining methods.	
L5	Acquire knowledge on stain and staining methods	
UNIT	**Contents**	**No. of Hours**
I	Cleaning of glassware's, Micro biological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.	12
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	12
III	Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation-quality control of media, growth supporting properties, sterility check of media. Pure culture techniques: streak plate, pour plate, decimal dilution.	12
IV	Culture characteristics of microorganisms: growth on Different media, growth characteristics, and description. Demonstration of pigment production. Microscopy: light microscopy and bright field microscopy.	12
V	Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining. Study on Microbial Diversity using Hay Infusion Broth-Wet Mount to show different types of microbes, hanging drop.	12
	Total	**60**

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,K4
2	Learn streak plate, pour plate and serial dilution and pigment Production of microbes.	K1,K2,K3,K4,K5,K6
3	Understand Micros copy methods, different Staining Techniques and motility test.	K1,K2,K3,K4,K5,K6
4	Observe culture characteristics of microorganisms.	K1,K2,K3,K4,K5,K6
5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount	K1,K2,K3,K4,K5

Textbooks	
1	James G Cappucino and N.Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2	Kannan.N (1996). Laboratory manual in General Microbiology. Palani Publications.
3	SundararajT(2005).Microbiology Lab Manual(1st edition)publications.

4	Gunasekaran,P.(1996).Laboratory manual in Microbiology.New Age International Ld., Publishers, New Delhi.
5	RC Dubey and DK Maheswari (2002). Practical Microbiology. S. Chand Publishing.
Reference Books	
1.	Atlas.R(1997).Principles of Microbiology,2nd Edition,Wm.C.Brownpublishers.
2.	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3.	Talib V H (2019).Hand book Medical Laboratory Technology.(2nd Edition).CBS
4.	Wheelis M,(2010).Principles of Modern Microbiology, 1stEdition.JonesandBartlett Publication.
5.	Lim D.(1998). Microbiology, 2nd Edition,WCB McGraw Hill Publications.
Web Resources	
1.	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403.
2.	https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3.	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4.	https://microbiologyinfo.com/top-and-best-microbiology-books/
5.	https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview
Application (K3)	Suggest idea/concept with examples, suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create(K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	2	1	2
CO 2	2	1	2	3	2	1
CO 3	1	2	1	3	2	1
CO 4	2	1	2	3	3	1
CO 5	2	1	3	3	1	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	1	2	3
CO2	1	1	1	2	2
CO3	3	3	1	2	3
CO4	2	1	1	2	2
CO5	2	1	1	2	2

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE11	Chemistry for Biological Sciences I	Generic Elective	3	4	25	75	100

Learning Objectives		
L1	Basics of atomic orbitals, chemical bonds, hybridization and fundamentals of organic chemistry.	
L2	Nuclear chemistry and industrial chemistry.	
L3	Importance of speciality drugs and	
L4	Separation and purification techniques.	
UNIT	**Contents**	**No. of Hours**
I	**Chemical Bonding and Nuclear Chemistry** Chemical Bonding**:** Molecular Orbital Theory- bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. **Nuclear Chemistry:** Fundamental particles - Isotopes, Isobars, Isotones and Isomers- Differences between chemical reactions and nuclear reactions-group displacement law. Nuclear binding energy- mass defect-calculations. Nuclear fission and nuclear fusion- differences–Stellar energy. Applications of radioisotopes–carbon dating, rock dating and medicinal applications.	12
II	**Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones**:** Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.	12
III	**Fundamental Concepts in Organic Chemistry** Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Polar effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, Hyperconjugation and steric-examples and explanation. Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule) – aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.	12

IV	**Drugs and Speciality Chemicals** Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.	12
V	**Analytical Chemistry** Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques–extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	State the theories of chemical bonding, nuclear reactions and its applications.	K1,K2,K3,K4
2	Evaluate the efficiencies and uses of various fuels and fertilizers.	K1,K2,K3,K4,K5,K6
3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.	K1,K2,K3,K4,K5,K6
4	Demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	K1,K2,K3,K4,K5,K6
5	Analyse various methods to identify an appropriate method for the separation of chemical components.	K1,K2,K3,K4,K5

Textbooks

1	V.Veeraiyan, ***Text book of Ancillary Chemistry***; High mount publishing house, Chennai, first edition, 2009.
2	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur,2006.
3	S.Arun Bahl, B.S.Bahl, ***Advanced Organic Chemistry***; S.Chand and Company, New Delhi, twenty third edition,2012.
4	P.L.Soni, H.M.Chawla, ***Text Book of Organic Chemistry***; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.

Reference Books

1.	P.L.Soni, Mohan Katyal, ***Text book of Inorganic chemistry***; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2.	B.K,Sharma, ***Industrial Chemistry***; GOEL publishing house, Meerut, sixteenth edition,2014.
3.	Jayashree Gosh, ***Fundamental Concepts of Applied Chemistry***; Sultan & Chand, Edition 2006.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE1P	**Chemistry Practical for Physical and Biological Sciences-I**	**Generic Elective**	**2**	**2**	**40**	**60**	**100**

Learning Objectives	
L1	Basics of preparation of solutions.
L2	Principles and practical experience of volumetric analysis.

VOLUMETRIC ANALYSIS

- Estimation of sodium hydroxide using standard sodium carbonate.
- Estimation of hydrochloric acid using standard oxalic acid.
- Estimation of ferrous sulphate using standard Mohr's salt.
- Estimation of oxalic acid using standard ferrous sulphate.
- Estimation of potassium permanganate using standard sodium hydroxide.
- Estimation of magnesium using EDTA.
- Estimation of ferrous ion using diphenylamine as indicator.

Total Hours: 30

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Gain an understanding of the use of standard flask and volumetric pipettes, burette.	K1,K2,K3,K4
2	Design, carryout, record and interpret the results of volumetric titration.	K1,K2,K3,K4,K5,K6
3	Apply their skill in the analysis of water/hardness.	K1,K2,K3,K4,K5,K6
4	Analyze the chemical constituents in allied chemical products.	K1,K2,K3,K4,K5,K6
5	Estimate the weight of magnesium using EDTA.	K1,K2,K3,K4,K5
Reference Books		
1	V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, ***Basic Principles of Practical Chemistry***; Sultan Chand & sons, Second edition, 1997.	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE11	Social and Preventive Medicine	NME	2	2	25	75	100

Learning Objectives		
L1	Describe the concepts of health and disease and their social determinants	
L2	Summarize the health management system	
L3	Know about the various health care services	
L4	Outline the goals of preventive medicine	
L5	Gain knowledge about alternate medicine	
UNIT	**Contents**	**No. of Hours**
I	**Introduction to social medicine:** History of social medicine-concepts of health and disease-social Determinants of health and disease-Health and quality of life-Health information system-measures of population health-health policies.	6
II	**Health management:** Applicationsofbehavioralsciencesandpsychologyinhealthmanagement- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.	6
III	**Health care and services:** Health care of the community-information, education, communication and training in health-maternal & child health-school health services-Geriatrics-care and welfare of the aged-Mental health-health services through general practitioners.	6
IV	**Preventive medicine:** Introduction-role of preventive medicine-levels of prevention-Risk assessment in communities and vulnerable population–surveillance, monitoring and reporting of disease out breaks-forecasting and control measures in community setting–early Detection methods.	6
V	**Prevention through alternate medicine:** Unani, Ayurveda, Homeopathy, Naturopathy systems in Epidemic and pandemic out breaks. International health regulations. Infectious disease outbreak case studies and precautionary response During SARS and MERS corona virus, Ebola and novel SARS-COV2outbreaks.	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Identify the health information system	K1,K2,K3,K4

2	Associate various factors with health management system	K1,K2,K3,K4,K5,K6
3	Choose the appropriate health care services	K1,K2,K3,K4,K5,K6
4	Appraise the role of preventive medicine in community setting	K1,K2,K3,K4,K5,K6
5	Recommend the usage of alternate medicine during out breaks	K1,K2,K3,K4,K5
Textbooks		
1	Park.K(2021).Text book of preventive and social medicine, 26th edition. Banarsidas Bhanot publishers.	
2	Mahajan&Gupta(2013).Text book of preventive and social medicine, 4th edition. Jaypee brothers medical publishers.	
3	Chun-SuYuan,EricJ.Bieber,BrentBauer(2006).Text book of Complementary and Alternative Medicine. Second Edition. Routledge publishers.	
4	VivekJain (2020).Review of Preventive and Social Medicine: Including Biostatics.12th edition, Jaypee Brothers Medical Publishers.	
5	Lal Adarsh Pankaj Sunder(2011).Text book of Community Medicine: Preventive and Social Medicine, CBS publisher	
Reference Books		
1.	Howard Waitzkin, Alina Pérez,Matt Anderson(2021).Social Medicine and the coming Transformation. First Edition. Routledge publishers.	
2.	GN Prabhakara(2010).Short Text book of Preventive and Social Medicine. Second Edition. Jaypee publishers.	
3.	Jerry M.Suls,KarinaW.Davidson,RobertM.Kaplan(2010).Hand book of Health Psychology and Behavioral Medicine. Guilford Press.	
4.	Marie Eloïse Muller, Marie Muller, Marthie Bezuidenhout, Karien Jooste(2006).Health Care Service Management. Juta and Company Ltd.	
5.	Geoffrey Rose(2008).Rose's Strategy of Preventive Medicine: The Complete. OUP Oxford.	
Web Resources		
1.	https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php	
2.	https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors	
3.	https://www.futurelearn.com	
4.	https://www.healthcare-management-degree.net	
5.	https://www.conestogac.on.health-care-administration-and-service-management	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	1	3	3
CO 2	3	3	2	2	3
CO 3	3	2	1	2	3
CO 4	3	2	3	3	3
CO 5	3	2	3	1	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	1	3
CO2	3	2	1	2	3
CO3	3	2	2	2	3
CO4	2	2	1	3	2
CO5	3	2	2	2	1

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBFN11	INTRODUCTION TO MICROBIAL WORLD	Foundation Course	2	2	25	75	100

Learning Objectives		
L1	Learn the general characteristics of bacteria	
L2	Describe the general characteristics and morphology of fungi.	
L3	Explain the morphology and beneficial aspects of algae.	
L4	Understand the general characteristics of virus	
L5	Learn about beneficial applications of protozoa	
UNIT	**Contents**	**No. of Hours**
I	General features and economic importance of bacteria- General characteristics and morphology of bacteria, mycoplasma, and archae bacteria. Economic importance of bacteria with examples in antibiotic production (*Streptomyces*).	6
II	General features and economic importance of fungi- General characteristics and morphology of fungi, Economic importance of fungi with examples in biopesticide (*Beauveria*), industry (*Saccharomyces*), medicine (*Penicillium*).	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 (*Spirulina*), soil fertility (*Anabaena*), 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 (*Haemogregarina*). Harmful aspects –diseases (, *Giardia*).	6
	Total	**30**

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Study the general features and economic importance of bacteria	K1,K2,K3,K4
2	Gain Knowledge of general features and economic importance of fungi	K1,K2,K3,K4,K5,K6
3	Understand the general features and economic importance of algae	K1,K2,K3,K4,K5,K6
4	Study the general features and economic importance of virus	K1,K2,K3,K4,K5,K6

5	Understand the general features and economic importance of protozoa	K1,K2,K3,K4,K5
Textbooks		
1	Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw –Hill, 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.	
4	Stanier, R.Y., Doudoroff, M., and Adelberg, E. A. (1957). The Microbial World. ACS publication. US.	
5	Boyd, R.F. (1998). General Microbiology, 2nd Edition., Times Mirror, Mosby College Publishing, St Louis.	
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	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	3	2	2
CO 2	1	2	3	2	1	3
CO 3	3	3	2	2	3	2
CO 4	2	2	1	2	3	2
CO 5	2	2	3	1	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	2	1	2	2
CO2	2	3	2	2	1
CO3	3	2	3	3	2
CO4	2	1	3	2	1
CO5	3	1	2	3	1

Strong-3 Medium-2 Low-1

SEMESTER II

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBCC21	MICROBIAL PHYSIOLOGY AND METABOLISM	Core	5	5	25	75	100

Learning Objectives		
L1	Study the basic principles of microbial growth.	
L2	Understand the basic concepts of aerobic and anaerobic metabolic pathways.	
L3	Analyze the role of individual components in overall cell function.	
L4	Provide information on sources of energy and its utilization by microorganisms.	
L5	Study the different types of metabolic strategies.	
UNIT	**Contents**	**No. of Hours**
I	Physiology of microbial growth: Batch–continuous-synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	15
II	Nutrition requirements -Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms–Passive diffusion and Active transport. Factors Affecting microbial growth.	15
III	An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.	15
IV	Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction – Cyclic and non – cyclic Photo phosphorylation. Dark Reaction-Calvin Cycle.	15
V	Bacterial reproduction -Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi a sexual and sexual reproduction, Micro algae reproduction. Asexual and Sexual reproduction of protozoa.	15
	Total	75

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Describe microorganisms based on nutrition.	K1,K2,K3,K4
2	Know the concept of microbial growth and identify the factors Affecting bacterial growth.	K1,K2,K3,K4,K5,K6
3	Explain the methods of nutrient up take.	K1,K2,K3,K4,K5,K6
4	Describe anaerobic and aerobic energy production.	K1,K2,K3,K4,K5,K6
5	Elaborate on the process of bacterial photosynthesis and reproduction.	K1,K2,K3,K4,K5

Textbooks

1	Schlegal,H.G.(1993).GeneralMicrobiology.,7thEdition,PresssyndicateoftheUniversity Of Cambridge.
2	RajapandianK.(2010).MicrobialPhysiology,Chennai:PBSBookEnterprisesIndia.
3	MeenaKumari.S.MicrobialPhysiology,Chennai1stEditionMJPPublishers2006.
4	Dubey R.C. and Maheswari, S.(2003).A text book of Microbiology, New Delhi : S. Chand &Co.
5	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, New York,Volume49.
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.	Moat, A.G and J.W Foaster(1995). Microbial Physiology, 3rdedition.Wiley–LISS,A John Wiley & Sons. Inc. Publications.
5.	Bhanu Shrivastava.(2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
Web Resources	
1.	https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents.
2.	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3.	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4.	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5.	https://www..frontiersin.org.microbial-physiology-and-metabolism

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between Various ideas, Map knowledge
Evaluate (K5)	Longer essay /Evaluation essay, Critique or justify with pros and cons
Create(K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	2	1	3	2
CO 2	3	2	1	2	1	2
CO 3	3	3	2	1	3	2
CO 4	2	2	1	3	2	2
CO 5	2	3	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
CO1	3	2	2	1	2
CO2	1	3	2	2	3
CO3	3	2	2	2	3
CO4	2	3	2	1	2
CO5	2	1	2	3	2

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBCC2P	MICROBIAL PHYSIOLOGY AND METABOLISM PRACTICAL	Core	3	3	40	60	100

Learning Objectives		
L1	Understand the principles of motility test.	
L2	Understand the basic concepts of staining methods.	
L3	Learn the bacterial count using different methods and anaerobic culture.	
L4	Study the morphological demonstration of microorganisms and identification.	
L5	Study the biochemical identification of the bacteria.	
UNIT	**Contents**	**No. of Hours**
I	Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining	9
II	Direct counts–Direct cell count (Petroff - Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve.	9
III	Anaerobic culture methods. Antibiotic sensitivity testing: Disc Diffusion test-quality control with standard strains.	9
IV	Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.	9
V	Methods of bacterial identification- morphological, physiological, and bio chemical methods-IMViC test, H2S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.	9
	Total	45

Course Outcomes		Knowledge Level
CO	On completion of this course, students will	
1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	K1,K2,K3,K4
2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	K1,K2,K3,K4,K5,K6
3	Explain antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains.	K1,K2,K3,K4,K5,K6
4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	K1,K2,K3,K4,K5,K6
5	Elaborate on the bacterial identification-morphological, physiological, and biochemical methods.	K1,K2,K3,K4,K5

Textbooks	
1	James G Cappucino and N.Sherman MB(1996). A lab manual Benjamin Cummins, New York .
2	Kannan.N(1996). Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005).Microbiology Lab Manual (1st edition) publications.
4	Gunasekaran.P (2007). Laboratory manual in Microbiology. New age international

	publisher.
5	Elsa Cooper(2018).Microbial Physiology: A Practical Approach. Callisto Reference publisher.
Reference Books	
1.	David White., James Drummond., Clay Fuqua (2012)Physiology and Biochemistry of Prokaryotes. 4thEd. Oxford University Press, New York.
2.	Robert K.Poole (2004).Advances in Microbial Physiology, Elsevier Academic Press, New York,Volume49.
3.	KimB.H.,GaddG.M.(2008).Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4.	Dawes,I.Wand Sutherl and L.W(1992).Microbial Physiology(2nd edition),Oxford Black well Scientific Publications.
5.	Moat,A.GandJ.WFoaster,(1995).Microbial Physiology, 3rd edition.Wiley–LISS, AJohn Wiley & Sons. Inc. Publications.
Web Resources	
1.	https://sites.google.com/site/microbialphysiologyoddsem/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

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between Various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations.

Mapping with Programme Outcomes

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	2	1	2	2
CO 2	3	2	1	2	1	2
CO 3	3	2	3	1	2	1
CO 4	2	3	2	2	1	1
CO 5	2	3	1	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
CO1	1	3	2	2	2
CO2	2	1	2	2	1
CO3	2	2	3	2	2
CO4	2	2	2	2	2
CO5	2	3	2	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE21	**Chemistry for Biological Sciences II**	**Generic Elective**	**3**	**4**	**25**	**75**	**100**

Learning Objectives		
L1	Nomenclature of coordination compounds and carbohydrates.	
L2	Amino Acids and Essential elements of biosystem.	
L3	Understand the concepts of kinetics and catalysis.	
L4	Provide fundamentals of electrochemistry and photochemistry.	
UNIT	**Contents**	**No. of Hours**
I	**Co-ordination Chemistry and Water Technology** Co-ordination Chemistry**:** Definition of terms-IUPAC Nomenclature-Werner's theory-EAN rule-Pauling's theory–Postulates-Applications to $[Ni(CO)_4]$,$[Ni(CN)_4]^{2-}$,$[Co(CN)_6]^3$ Chelation Biological role of Hemoglobin and Chlorophyll(elementary idea)-Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques –BOD and COD.	12
II	**Carbohydrates and Amino acids** Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose–fructose interconversion. Properties of starch and cellulose. Amino acids: Classification-preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).	12
III	**Electrochemistry** Galvanic cells-Standard hydrogen electrode-calomel electrode-standard electrode potentials - electrochemical series. Strong and weak electrolytes-ionic product of water-pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications-electroplating-Nickel and chrome plating–Types of cells-fuel cells-corrosion and its prevention.	12
IV	**Kinetics and Catalysis**	12

	Order and molecularity, Integrated rate expression for I and II (2AProducts) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis –homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.	
V	**Photochemistry** Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield-Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12
	Total	**60**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.	K1,K2,K3,K4
2	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	K1,K2,K3,K4,K5,K6
3	Apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	K1,K2,K3,K4,K5,K6
4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	K1,K2,K3,K4,K5,K6
5	Outline the various type of photochemical process.	K1,K2,K3,K4,K5

Textbooks	
1	V.Veeraiyan, ***Text book of Ancillary Chemistry***; High mount publishing house, Chennai, first edition, 2009.
2	S.Vaithyanathan, ***Text book of Ancillary Chemistry***; Priya Publications, Karur, 2006.
3	Arun Bahl, B.S.Bahl, ***Advanced Organic Chemistry***; S.Chand and Company, New Delhi, twenty third edition,2012.
4	P.L.Soni, H.M.Chawla, ***Text Book of Organic Chemistry***; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
Reference Books	
1.	P.L.Soni, Mohan Katyal, ***Text book of Inorganic chemistry***; Sultan Chand and Company, New Delhi, twentieth edition,2007.
2.	R.Puri, L.R.Sharma, M.S.Pathania, ***Text book Physical Chemistry***; Vishal Publishing Co., New Delhi, forty seventh edition,2018
3.	B.K,Sharma, ***Industrial Chemistry***; GOEL publishing house, Meerut, sixteenth edition,2014.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UCHGE2P	**Chemistry practical for Physical and biological sciences - II**	**Generic Elective**	**2**	**2**	**40**	**60**	**100**

Learning Objectives	
L1	Identification of organic functional groups.
L2	Different types of organic compounds with respect to their properties.
L3	Determination of elements in organic compounds.

The analysis must be carried out as follows:

- Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].
- Detection of elements (N, S, Halogens).
- To distinguish between aliphatic and aromatic compounds.
- To distinguish–Saturated and unsaturated compounds.

Total Hours: 30

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Identify different types of organic functional groups.	K1,K2,K3,K4
2	Analyze the nature of different types of organic compounds with respect to their properties.	K1,K2,K3,K4, K5,K6
3	Determine different elements present in organic compounds.	K1,K2,K3,K4, K5,K6
4	Distinguish between aliphatic and aromatic compounds.	K1,K2,K3,K4, K5,K6
5	Classify between saturated and unsaturated compounds.	K1,K2,K3,K4, K5

Reference Books

1. V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, ***Basic Principles of Practical Chemistry;*** Sultan Chand & sons,Second edition,1997.

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	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	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23UMBSE21	**Nutrition & Health Hygiene**	**NME**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
L1	Learn about nutrition and their importance
L2	Make student understand the nutritional facts for a better life.
L3	Learn information to optimize our diet
L4	Impart knowledge on different health care programs taken up by India
L5	Learn knowledge on different health indicators and types of hygiene methods

UNIT	Contents	No. of Hours
I	Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins–functions, dietary sources, effects of deficiency. Macro and micro minerals– functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water–functions, sources, requirements and effects of deficiency	6
II	Nutrition for Life Cycle: Balanced diet-Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.	6
III	Improper diets: Definition, Identification, Signs and Symptoms-malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder- hypertension, diabetes, anemia, osteo malacia, cardiovascular disease.	6
IV	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.	6
V	Hygiene–Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.	6
	Total	**30**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Learn the importance of nutrition for a healthy life	K1,K2,K3,K4
2	Study the nutrition for lifecycle	K1,K2,K3,K4,K5,K6
3	Know the health care programmes of India	K1,K2,K3,K4,K5,K6
4	Learn the importance of community and personal health & Hygiene measures	K1,K2,K3,K4,K5,K6
5	Create awareness on community health and hygiene	K1,K2,K3,K4,K5

Textbooks

1	Bamji, M.S., K.Krishnaswamy &G.N.V. Brahmam (2009)Text book of Human Nutrition (3rd edition) Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi
2	Swaminathan (1995) Food & Nutrition (VolI, Second Edition) The Bangalore Printing & Publishing Co Ltd.,,Bangalore
3	SK. Haldar (2022). Occupational Health and Hygiene in Industry.CBS Publishers.
4	Acharya,SankarKr,RamaDas,MinatiSen(2021).Health Hygiene and Nutrition Perception and Practices.Satish Serial Publishing House
5	Dass (2021).Public Health and Hygiene, Notion Press
Reference Books	
1.	VijayaKhader(2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2.	Srilakshmi,B.,(2010)Food Science,(5thEdition)New Age International Ltd., New Delhi
3.	Arvind Kumar Goel(2005).A College Text book of Health & Hygiene, ABD Publishers
4.	Sharma D.(2015).Text book on Food Science and Human Nutrition. Daya Publishing House.
5.	Revilla M.K.F.,Titchenal A. and Draper J.(2020).Human Nutrition. University of Hawaii,Mānoa.
Web Resources	
1.	National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
2.	National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137
3.	Village health sanitation & Nutritional committee https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225
4.	Health Impact Assessment-https://www.who.int/hia/about/faq/en/
5.	Healthy Living https://www.nhp.gov.in/healthylivingViewall

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	2	2	3
CO 2	3	2	1	2	3
CO 3	3	1	2	3	3
CO 4	2	2	3	1	3
CO 5	2	1	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	2	2	2	2	3
CO2	2	2	2	2	3
CO3	2	2	2	2	3
CO4	3	1	3	2	3
CO5	3	2	3	2	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Inst. Hours	Marks		
					CIAE	External	Total
23UMBSE22	SERICULTURE	SEC	2	2	25	75	100

Learning Objectives		
L1	Acquire knowledge on the concepts of origin, growth and study of Seri culture as science and Scientific approach of mulberry plant.	
L2	Describe the morphology and physiology of silkworm.	
L3	Discuss effective management of silkworm diseases.	
L4	Demonstrate field skills in mulberry cultivation and silk worm rearing with an emphasis on technological aspects.	
L5	Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small- Scale enterprises.	
UNIT	**Contents**	**No. of Hours**
I	General introduction to Seri culture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	6
II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm – egg, larva, pupa, and moth.	6
III	Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.	6
IV	Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.	6
V	Entrepreneurship and rural development in sericulture: 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.	6
	Total	30

Course Outcomes		Knowledge Level
CO	**On completion of this course, students will**	
1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Seri culture in Indian conditions.	K1,K2,K3,K4
2	Familiarize with the lifecycle of silkworm.	K1,K2,K3,K4,K5,K6
3	Explain common diseases of silk worm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	K1,K2,K3,K4,K5,K6

4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by- products.	K1,K2,K3,K4,K5 ,K6
5	Plan the facilities required for establishment of insectary. 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.	K1,K2,K3,K4,K5
Textbooks		
1	Ganga,G. and Sulochana Chetty(2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co.Pvt.Ltd.,NewDelhi.	
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	
5	T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.	
Reference Books		
1.	S.Morohoshi(2001).Development Physiology of Silkworms 2nd**E**dition, Oxford & IBH Publishing Co.Pvt.Ltd. NewDelhi	
2.	Hamamura,Y (2001). Silk worm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt.Ltd. New Delhi.	
3.	M.Johnson, M.Kesary(2019).Sericulture,5th.Edition.Saras Publications.	
4.	Manisha Bhattacharyya(2019).Economics of Seri culture, Rajesh Publications.	
5.	Muzafar Ahmad Bhat, Suraksha Chanotra, ZafarIqbal Buhroo, Abdul Azizand Mohd. Azam (2020).A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication	
Web Resources		
1.	https://egyankosh.ac.in›bitstream	
2.	https://archive.org›details›SericultureHandbook	
3.	https://www.academic.oup.com	
4.	https://www.sericulture.karnataka.gov.in	
5.	https://www.silks.csb.gov.in	

Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between Various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create(K6)	Check knowledge in specific or off beat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	3	1	3	3
CO 2	2	2	3	2	3	2
CO 3	3	2	1	3	3	2
CO 4	2	1	3	2	2	1
CO 5	3	2	2	2	3	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	2	1	2	3
CO2	2	1	3	2	2
CO3	2	1	3	2	2
CO4	3	3	3	3	2
CO5	3	3	2	1	3

Strong-3 Medium-2 Low-1