Course Name: Bachelor of Science

Discipline : Microbiology

CHOICE BASED CREDIT SYSTEM

(For those who joined in June 2024 and after)

Course Objectives:

This course is designed for science majors who need a Microbiology course for their professional preparation, usually in an area of clinical application as pharmacy, nursing, physician's assistant, dental assistant, and others. In addition, this course is required in the Biotechnology program. In order to enhance learning, the laboratory exercises are coordinated with lecture topics within each unit of study. Critical thinking and problem solving skills are developed in both laboratory and lecture.

Eligibility for Admission:

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

Duration of the Course:

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

Core Practicals (100 marks) the duration of Practical Examination for B.Sc. (Microbiology) exam shall be 3 Hrs/Day; 2 Consecutive days (3+3=6 Hours).

Programme – Bachelor of Microbiology

Programme Outcomes:

Undergraduate (B.Sc. Microbiology) is 3-year degree programme with 6 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

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

Proficient skills and competence to make a prospective career in Research & Development.

PO10: Lifelong learning

Identify the need for skills necessary to be successful in future.

PO11: Instrumentation skill

Handle laboratory experiments following safety precautions and standards.

Programme Specific Outcomes:

PSO-1: Placement

Prepare the students in all disciplines like agriculture, industry- medical, pharma, dairy, hotel, food and food processing, immunologicals, cosmetics, vermitechnology 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 stake holders, related to the betterment of environment and mankind at the national and global level.

I year B.Sc. MICROBIOLOGY

SEMESTER I

Semester	Part	Subject Name	Hours	Credit	Int + Ext =Total	Local	Regional	National	Global	Professional Ethics	Gender	Human Values	Environment & Sustainability	Employability	Entrepreneurship	Skill Development	Subject Code	Revised / New / No Change / Interchanged & Percentage of Revision
I	Part I	Tamil	6	3	25+75=100												**U24PT11**	**New**
	Part II	English	6	3	25+75=100												U23PE11	No Change
	Core 1	**Fundamentals of Microbiology and Microbial Diversity**	5	4	25+75=100			✔						✔			**U24MBC11**	**Revised 90%**
	Core 2 Lab	**LAB: Fundamentals of Microbiology and Microbial Diversity**	5	4	40+60=100			✔						✔			**U24MBCP11**	**New**
	Allied 1	General Chemistry I	4	3	25+75=100												**U24CHAY11**	**MarkChange**
	Allied 2 Lab	**LAB:** Volumetric Analysis	2	-	40+60=100												--	--
	SBE1	**Basic Techniques in Microbiology**	2	2	25+75=100		✔									✔	**U24MBS11**	**New**
	Total		**30**	**19**														
II	Part I	Tamil	6	3	25+75=100												**U24PT21**	**New**
	Part II	English	6	3	25+75=100												U23PE21	No Change
	Core 3	**Microbial Physiology and Metabolism**	5	4	25+75=100			✔						✔			**U24MBC21**	**Revised 10%**
	Core 4 Lab	**LAB :** Microbial Physiology and Metabolism	5	4	40+60=100			✔								✔	U23MBCP21	No change
	Allied 3	General Chemistry II	4	3	25+75=100												**U24CHAY21**	**Mark Change**
	Allied 4 Lab	**LAB:** Volumetric Analysis	2	2	40+60=100												U22CHAYP 21	No Change
	SBE2	**Principles of Biochemical Techniques**	2	2	25+75=100		✔									✔	**U24MBS21**	**Revised 90%**
	Total		**30**	**21**														

Year	Part	Subject	Credit	Int = Total	Code
I & II	Part V	NSS / NCC / Physical Education/ YRC / RRC	3	100 = 100	U22NS4 / U22NC4 / U22PS4 / U22YR4 / U22RR4

III- SEMESTER

Part	Course Code	Course Title	Hours	Credit	Marks			Focus on Employability/ Entrepreneurship/ Skill Development
					I	E	Total	
Part I		Tamil	6	3	25	75	100	
Part II		English	6	3	25	75	100	
Core 5		Immunology & Immunotechnology	4	3	25	75	100	Skill Development
Core 6 Lab		Lab: Immunology & Immunotechnology	2	2	40	60	100	Employability
Allied 5		General Chemistry III	4	4	25	75	100	Skill Development
Allied 6 Lab		Lab: Organic Qualitative Analysis	2	--	--	--	---	Employability
Allied 7		Plant Science	4	4	25	75	100	Employability
Allied 8 Lab		Lab: Plant & Animal Science	2	--	--	--	---	Skill Development
Total			30	19				

IV- SEMESTER

Part	Course Code	Course Title	Hours	Credit	Marks			Focus on Employability/ Entrepreneurship/ Skill Development
					I	E	Total	
Part I		Tamil	6	3	25	75	100	
Part II		English	6	3	25	75	100	
Core 7		Microbial Biochemistry	4	3	25	75	100	Skill Development
Core 8 Lab		Lab: Microbial Biochemistry	2	2	40	60	100	Employability
Allied 8		General Chemistry IV	4	4	25	75	100	Skill Development
Allied 9 Lab		Lab: Organic Qualitative Analysis	2	2	40	60	100	Employability
Allied 10		Animal Science	4	4	25	75	100	Skill Development
Allied 11 Lab		Lab: Plant & Animal Science	2	2	25	75	100	Employability
Total			30	23				

*For III Year UG Microbiology, compulsory Internship/Industrial training should be carried out for 60 hours during IV semester vacation. 2 extra credits will be awarded on completion of the internship with report.

V- SEMESTER

Part	Course Code	Course Title	Hours	Credit	Marks			Focus on Employability/ Entrepreneurship/ Skill Development
					I	E	Total	
Core 9		Medical Microbiology	5	4	25	75	100	Employability
Core 10		Environmental and Agricultural Microbiology	4	4	25	75	100	Employability
Core 11		Molecular Biology and Microbial Genetics	4	4	25	75	100	Skill Development
Core 12 Lab		Lab: Medical, Environmental and Agricultural Microbiology	6	4	40	60	100	Employability
Allied 12		Introduction to Pharmacognosy	4	4	--	--	---	Employability
Allied 13 Lab		Lab: Pharmacognosy and Pharmacology	2	-	40	60	100	Skill Development
SBE 3 **(Swayam courses)**		Cell Biology **or any one of the course chosen by students at the beginning of the semester**	2	2	25	75	100	Employability
SBE 4		Employability Skills	1	1	25	75	100	Employability
NME		Introduction to Microbiology	2	2	25	75	100	Skill Development
Total			30	25				

VI- SEMESTER

Part	Course Code	Subject	Hour	Credit	Marks			Focus on Employability/ Entrepreneurship/ Skill Development
					I	E	Total	
Core 13		Recombinant DNA (rDNA) Technology	4	4	25	75	100	Employability
Core 14		Food & Industrial Microbiology	4	3	25	75	100	Employability
Core 15		Research Methodology and Bioinformatics	4	4	25	75	100	Skill Development
Core16 Lab		LAB: Recombinant DNA (rDNA) Technology, Food and Industrial Microbiology	6	4	40	60	100	Skill Development
Allied 15		Basic concept of Pharmacology	4	4	25	75	100	Employability
Allied16 Lab		LAB: Pharmacognosy and Pharmacology	2	2	40	60	100	Skill Development
SBE 5		Project	4	2	40	60	100	Skill Development
NME 2		Applied Microbiology	2	2	25	75	100	Skill Development
		Total	30	25				

SEMESTER - I

Course Title : Fundamentals of Microbiology and Microbial Diversity	**Total Hours : 75**
Course Code : U24MBC11	**Total Credits : 4**

Course Outcomes:

Cos	CO Statement
CO1	Provide an idea about the major types of microbes
CO2	Evaluate the importance of the contributions to microbiology
CO3	List the characteristics originally used to describe prokaryotic cells
CO4	Describe the characteristics of typical archaeal cell and Eukaryotic cell
CO5	Compare the eukaryotic, bacterial, and archaeal cells in terms of their use of membranes, size, morphological diversity, and organelles.

Unit I **(15 Hours)**

History and evolution of Microbiology: Three domains - Bacteria, Archaea, and Eukarya. Five kingdom concept - Six kingdom concept - Eight kingdom concept. Microbial biodiversity: Introduction to microbial biodiversity & Conservation of biodiversity.

Unit II **(15 Hours)**

Scope of Microbiology; contributions of Scientists – Robert Hooke, Antony van Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming. Theory of Spontaneous Generation - Abiogenesis.

Unit III **(15 Hours)**

Prokaryotes – Size, Shape, Arrangement and ultra structure (*E.coli*). Bacterial cellular component of structure and functions - Capsule, Golgi apparatus, Mesosomes, Endoplasmic reticulum, Ribosomes, Pili, Flagella.

Unit IV **(15 Hours)**

Bacterial Plasma Membranes – Fluid Mosaic Model of Membrane structure; Bacterial Cell walls – Gram positive and Gram Negative and its comparisons; Difference between prokaryotes and eukaryotes.

Unit V **(15 Hours)**

General structural properties – Virus (TMV), fungi (Yeast), algae (Chlamydomonas) and Protozoa (Paramecium). Basic concepts of Archaebacteria, Eubacteria and its difference.

Text Books:

1. J. M. Willey, L. M. Sherwood, C. J. Woolverton, "Prescott's Microbiology", Published by McGraw-Hill Education, 10th edition, 2017.
2. M. J. Pelczar, E.C.S. Chan and N. R. Kreig, "Microbiology", Tata McGraw Hill Publication, 5th edition, 2001.
3. R. C. Dubey and D. K. Maheshwari, D.K, "A text book of Microbiology", Chand publications, 4th edition, 2015.

Reference Books:

1. Schlegel, H.G.1993.General Microbiology. Cambridge University Press, Cambridge.
2. Stainer, R.Y., Ingraham, Wheelis, M.G. and Paintor, P.R.1986. The Microbial World. PrenticeHall, New Jersey.
3. Tauro, P., Kapoor, K.K. and Yadav, K.S.1989. An Introduction to Microbiology. WilleyPublications. New Delhi.

e- Resources:

1. https://www.bellarmine.edu/faculty/dobbins/Secret%20Readings/Lecture%20Notes%20313/Ch01_.pdf
2. https://www.bellarmine.edu/faculty/dobbins/Secret%20Readings/Lecture%20Notes%20313/Ch03_.pdf
3. http://samples.jbpub.com/9781449635978/05940_pdfx_ch04_pommerville.pdf
4. https://www.bellarmine.edu/faculty/dobbins/Secret%20Readings/Lecture%20Notes%20313/Ch05_.pdf
5. https://www.bellarmine.edu/faculty/dobbins/Secret%20Readings/Lecture%20Notes%20313/Ch06_.pdf

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Course Title : LAB: Fundamentals of Microbiology and Microbial Diversity	**Total Hours : 75**
Course Code : U24MBCP11	**Total Credits : 4**

Course Outcomes:

COs	CO Statement
CO1	To understand about the various applications of light microscope
CO2	To gain knowledge on various microscopic calibrations
CO3	To perform the removal microorganisms by different sterilization techniques
CO4	To observe the microbial morphology through various staining techniques
CO5	To isolate microorganisms by pure culture techniques

1. Principle and applications of compound microscope and its handling.
2. Sterilization techniques – Dry Heat (Hot air oven), Moist Heat (Autoclave)
3. Microbiological Culture Media Preparation – Nutrient agar, Nutrient broth and peptone broth
4. Staining methods: Simple Staining and Gram staining.
5. Endospore staining.
6. Capsular staining.
7. Pure culture techniques: spread plate, pour plate and Streak plate method.
8. Observation of microbial motility by hanging drop method.
9. Fungal staining by lactophenol cotton blue.
10. Microscopic observation of bacteria (Gram positive cocci, Gram negative rod). Cyanobacteria (*Nostoc*, *Spirulina*), algae (*Chlamydomonas*, *Diatoms*), and fungi (*Saccharomyces*, *Rhizopus*, *Aspergillus*, *Mucor*).
11. Diagrammatic observation of TMV, HIV and T4 phage.
12. Industrial visit & Report (visiting nearby institute for instrumentation facility).

Text books:

1. J.G.Cappuccino and N.Sherman, Microbiology: A laboratory manual, AdditonWesley,2002.
2. P.Gunasekaran, Microbiology: A laboratory manual, New Age international publishers,1996.
3. N.Kannan, Laboratory manual in General Microbiology, Panima publishers, 2002.
4. Harley−Prescott: Laboratory Exercises in Microbiology, Fifth Edition, The McGraw−Hill Companies, 2002.

Reference Book:

1. Betstir, L.1996.Microbiology in Practice (6^{th}Edition) Adeland Wesley, Langman, NewYork.
2. Benson, J.H. 1996 Microbiological applications: A laboratory Manual in General Microbiology (6^{th} Edition) En. C.Brown Publication IOWK USA.
3. James G.C and Sharman, N 1996. Microbiology: A laboratory Manual (4^{th}Edition) the Benjamin/Cummings Publishing Company, International USA.
4. Atlas R.M. Microbiology-Fundamentals and applications, Macmillan Publishing Company, New York.
5. Dubey,R.C. and O.K.Maheshwari, (2005).Practical Microbiology 1^{st} Edition). S.Chand and Co.Ltd.,New Delhi.

SEMESTER I

Part III — **Allied** Subject — **GENERAL CHEMISTRY-I for Biological Science**

Hours per week: 4 Subject Code: U24CHAY11 Credits: 3

(For those who joined from June 2024 onwards)

Course Outcomes

CO1: To study fundamental ideas on organic chemistry.
CO2: To know the basic properties of hydrogen, hydrides & oxides
CO3: To search out an idea on colloids.
CO4: To learn some important petroleum processes and fertilizers
CO5: To acquire a knowledge on polymers.

Unit I: Basic concepts of organic chemistry — 12 Hours

Organic compounds — general properties and classification of organic compounds — functional groups — homologous series. Isomerism — structural isomerism and stereoisomerism — examples — Types of organic reactions: substitution, addition and elimination with examples.

Unit II: Hydrogen, Hydrides and Oxides — 12 Hours

Hydrogen:

Isotopes of hydrogen — preparation, properties and uses of heavy hydrogen — ortho and para hydrogen.

Hydrides:

Definition — classification of hydrides (Saline hydrides, Metallic hydrides, Molecular hydrides and Polymeric hydrides.) — Nature of hydrides and position of hydrogen in the periodic table.

Oxides:

Definition — classification — examples.

Unit III: Colloids — 12 Hours

Colloidal state of matter — various types — classification. Sols — dialysis — electroosmosis- electrophorosis — stability of colloids — protective action — Hardy Schulze law — gold number.

Emulsion: types of emulsion — emulsifier.

Gels: Classification, preparation — application of colloids.

Unit IV: Petroleum and fertilizers — 12 Hours

Refining of petroleum — composition and uses of petroleum fractions — thermal and catalytic cracking — octane number, cetane number — antiknocking agents - unleaded petroleum — petrochemicals — synthetic petrol.

Fertilizers — classification — important manures — manufacture and uses of urea — super phosphate — calcium ammonium nitrate (CAN) fertilizer.

Unit V: Polymers — 12 Hours

Polymers — general characteristics — plastics — elastomers and fibres — thermoplastics and thermosetting plastics - methods of polymerization — bulk — suspension and solution polymerization. Uses of polycarbonates — polyurethanes — epoxy resins and teflons (PTFE).

Text Books:

Unit I

1. B.S.Bah1 and Arun Bah1, Advanced Organic Chemistry, S.Chand & Co., Ltd., 2008.

Unit II & III

1. B.R.Puri, L.R.Sharma and K.C.Kalia, Principles of Inorganic Chemistry, Villabh Publishing , 2003.

Unit-IV & V

1. M.K. Jain and S.C.Sharma, Modern Organic Chemistry, Vishal Publishing Co., 2011.

Reference Books:

Unit I

1. M.K. Jain and S.C.Sharma, Modern Organic Chemistry, Vishal Publishing Co., 2011.

Unit II

1. R.D.Madan, Satya Prakash's Modern Inorganic Chemistry, S.Chand & Co., Ltd., 2008.
2. P.L.Soni and Mohan Katiyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, 2008.

Unit III

1. P.L.Soni, Textbook of Physical Chemistry, Sultan Chand & Sons, 2008.

Unit IV

1. K.S.Tewari, N.K.Vishnoi and S.N.Mehrota, A Text book of Organic Chemistry, 2nd revised edition, Vikas publishing house PVT LTD, New Delhi, 2005.

Unit V

1. P.L.Soni, Textbook of Physical Chemistry, Sultan Chand & Sons, 2008.

e-Resources:

1. https://www.priyamstudycentre.com/chemistry/organic-compound
2. https://youtu.be/XklMKuEAWdU
3. https://www.adichemistry.com/inorganic/hydrogen/H2/hydrogen.html
4. https://en.m.wikipedia.org/wiki/Isotopes_of_hydrogen
5. https://byjus.com/jee/colloids/
6. https://youtu.be/QAH-cCK1bS8
7. https://en.m.wikipedia.org/wiki/Petroleum_refining_processes
8. https://youtu.be/Dmn1X_z985A
9. https://www.britannica.com/science/polymer/Synthetic-polymers
10. https://youtu.be/t9UtS70GR44

Course Title : Basic Techniques in Microbiology	**Total Hours : 30**
Course Code : U24MBS11	**Total Credits : 2**

Course Outcomes:

Cos	CO Statement
CO1	To make the students aware of the basic rules of microbiological laboratory
CO2	To enable the students to acquire basic knowledge in microbiological techniques
CO3	To understand the basic information about Sterilization
CO4	Recognize the basic principles and applications of the Lab instruments
CO5	Apply the knowledge of microscope

Unit I **(6 Hours)**

Good Microbiological Practices: General Precautions, Rules and regulations - Biosafety level (BSL) 1, 2, 3 and 4 – Containment: Physical, Chemical and Biological.

Unit II **(6 Hours)**

Aseptic transfer of microbial cultures - Preservation and Maintenance of Microbial culture: periodic transfer, refrigeration, cryopreservation. Microbial culture collection centres – American Type Culture Collection (ATCC) and Microbial Type Culture Collection (MTCC).

Unit III **(6 Hours)**

Sterilization: definition and applications - Physical methods: Dry heat – Red heat and flaming, Moist heat – autoclave, Pasteurization – HTST (high temperature short time) and LTHT (low temperature high time) – Filtration: Membrane filtration - Radiation - UV and Chemical methods: Alcohol.

Unit IV **(6 Hours)**

Principles and Applications of Lab instruments: – Analytical balance – pH meter - Incubator – Laminar Air Flow chamber – Hot air Oven – Rotary shaker - Cooling Centrifuge.

Unit V **(6 Hours)**

Microscope – Principle (Resolving power, Numerical aperture) and applications of Bright field microscopy, Dark field microscopy and Phase contrast microscopy.

Text books:

1. Kumaresan, V. 2015. Biotechnology. Saras Publication, Nagercoil, Tamil Nadu.
2. Illuminating DNA – An NCBE, Unilever educational guide.

3. Mani, A., Selvaraj , A.M., Narayanan , L.M. and Arumugam, N. 2014. Microbiology – General and Applied. Saras Publication, Nagercoil, Tamil Nadu.

Reference Books:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2. Dubey, R.C. and Maheshwari, D.K. 2006. A text book of Microbiology. Chand publications, New Delhi.
3. Prescott, Harley and Klein. 2006. Microbiology(6th Edition). The McGraw-Hill Publishing Co., Ltd., New Delhi.
4. Annie. 2000. A text book of Botany. Saras publications, Nagercoil, Tamil Nadu.
5. Prescott, Harley and Klein. 2006. Microbiology(6th Edition). The McGraw-Hill Publishing Co., Ltd., New Delhi.
6. Tauro, P., Kapoor, K.K. and Yadav, K.S.1989. An Introduction to Microbiology. Willey Publications. New Delhi.

II- SEMESTER

Course Title: Microbial Physiology & Metabolism	**Total Hours : 75**
Course Code : U24MBC21	**Total Credits : 4**

Course Outcomes:

Cos	CO Statement
CO1	The students will gain knowledge about role of macronutrients and micronutrients in growth of microbes.
CO2	Acquire knowledge on prokaryotic and eukaryotic cell structure and its function
CO3	To develop the techniques in involved in microbial growth
CO4	Concern the regulation of metabolism by various pathways.
CO5	Understand about the various pigments essential for photosynthesis

Unit I **(15 Hours)**

Common nutrient requirements of Bacteria – Major Nutritional types of microorganisms: Sources of Carbon, Energy, Electrons - Growth factors (vitamins) - Culture media - Types of media: Synthetic media, Defined media and Complex media

Unit II **(15 Hours)**

Microbial growth – Growth curve of bacteria – Generation time and specific growth rate. Measurement of microbial growth: total count, viable count and turbidity method – Factors affecting microbial growth: temperature, pH, osmotic pressure and oxygen

Unit III **(15 Hours)**

Uptake of nutrients by cell – Membrane transport system – Passive and Facilitated diffusions, Primary and Secondary active transports – Group translocation – Symport, antiport and uniport.

Unit IV **(15 Hours)**

Respiratory metabolism: Embden-Mayer Hoff pathway, Entner- Doudoroff pathway, Kreb's cycle, Oxidative level phosphorylation, Electron Transport Chain (ETC).

Unit V **(15 Hours)**

Bacterial Photosynthesis: Oxygenic and Anoxygenic photosynthesis - Microbial photosynthetic and accessory pigments: Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobilins. Bioluminescence – Definition and its applications.

Text books:

1. Prescott, Harley and Klein. 2006. Microbiology (6th Edition). The McGraw-HillPublishing Co., Ltd., New Delhi.
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Dubey, R.C. and Maheshwari, D.K. 2006. A Text book of Microbiology (3rd Edition). Chand publications, New Delhi.
4. Schlegel, H.G.1993.The text book of General Microbiology. Cambridge University Press, Cambridge.

Reference Books:

1. Annie. 2000. A text book of Botany. Saras publications, Nagercoil, Tamil Nadu.
2. Stainer, R.Y., Ingraham, Wheelis, M.G. and Paintor, P.R.1986. The Microbial World. PrenticeHall, New Jersey.
3. Michael T. Madigan, John M. Martinko. Jack Parker. 1997. Brocks Biology ofMicroorganisms (8th Edition). Prentice Hall, New Jersey.
4. Thomas D. 2001. Brock Thermophiles. General, Molecular and Applied Microbiology. WileyInterscience Publication, New York.
5. Atlas, R.M., 2001. Principles of Microbiology (2nd Edition), Moshby year Book Inc., United States.

e- Resources:

1. https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/
2. https://www.youtube.com/watch?v=MWRowUYh5po
3. https://www.ramauniversity.ac.in/online-study-material/pharmacy/bpharma/iiisemester/pharmaceuticalmicrobiology/lecture-5.pdf
4. https://www.youtube.com/watch?v=Yl1EZi0qX1Q

5. https://www.onlinebiologynotes.com/membrane-transport-system-passive-active-transport/#:~:text=Membrane%20transport%20system%20is%20the,Cells%20have%20various%20transport%20mechanism.
6. https://www.youtube.com/watch?v=J5pWH1r3pgU
7. https://www.youtube.com/watch?v=7Lh-M-rX86Q
8. https://www.airtekenv.com/2017/06/15/factors-affecting-microbial-growth/#:~:text=Warmth%2C%20moisture%2C%20pH%20levels%20and,chemical%20factors%20affecting%20microbial%20growth.
9. https://www.biotecharticles.com/Biology-Article/The-Process-of-Bacterial-Photosynthesis-and-its-Importance-671.html#:~:text=Process%20of%20bacterial%20photosynthesis%3A%20Bacterial,molecule%20to%20an%20excited%20state.
10. https://oceanservice.noaa.gov/facts/biolum.html
11. https://www.youtube.com/watch?v=oKjFVBVGad0

Course Title: LAB - Microbial Physiology & Metabolism	**Total Hours : 75**
Course Code : U23MBCP21	**Total Credits : 4**

Course Outcomes:

Cos	CO Statement
CO1	To understand the identification of bacteria by various biochemical tests
CO2	Provide an idea on cultivation of microbes in selective media
CO3	To understand the cultivation of bacteria using differential media
CO4	Evaluate the importance of the growth curve
CO5	To understand the growth kinetics of microorganisms

1. Differential medium preparation - Eosin Methylene Blue Agar and MacConkey Agar
2. Selective medium preparation – Mannitol Salt Agar
3. Biochemical tests
   - IMViC
   - Carbohydrate fermentation test
   - Catalase test
   - Oxidase test
   - Hydrolysis of Starch
   - Hydrolysis of Casein
   - TSI Test
   - Urease test
4. Bacterial growth curve analysis using *E. coli* by turbidity method.
5. Effect of pH and temperature on bacterial growth.
6. Anaerobic culture technique.

Reference Books:

1. Cappuccino, J.G. and Sherman, N. 2002. Microbiology: A laboratory manual (7th Edition), Addison Wesley, New York.
2. Gunasekaran, P. 1996. Microbiology: A laboratory manual. New Age International Publishers, New Delhi.
3. Kannan, N. 2002.Laboratory Manual in General Microbiology, Panima Publishers, New Delhi.

SEMESTER II

Part III — Allied subject II — GENERAL CHEMISTRY —II for Biological science

Hours per week: 4 **Credits: 3** **Subject Code:** U24CHAY21

Course Outcome:

CO1: To study the separation of chemicals by chromatography techniques.
CO2: To know the classification of proteins, structure and function of nucleic acids and Hormones, and the basics of vitamins
CO3: To learn the basics of chemical calculation
CO4: To acquire a knowledge on detection and estimation of elements
CO5: To gain adequate knowledge on dyes

Unit I: Chromatography **12 Hours**

Basic principles of common types of chromatography — Paper chromatography — thin layer chromatography — column chromatography — Ion exchange chromatography. Applications of each technique.

Unit II: Protein, Nucleic acids, Hormones and vitamins **12 Hours**

Definition — classification of proteins — colour reaction of proteins — Nucleic acids — nucleoside — nucleotides and general structure of DNA. Hormones — classification — structure of some sex hormones — oestrone and testosterone. Vitamins — classification of vitamins — sources and deficiencies of Vitamins A, B1, C, D, E and K (structural elucidation not required).

Unit III: Basic chemical calculation **12 Hours**

Significant numbers — SI Units— calculation of formula weight–understanding Avogadro number — mole concept — mole fraction of the solvent and solute — conversion of grams into moles and moles into grams — stoichiometric equations.

Methods of expressing concentration of the solution: normality, molarity and molality — calculations based on principle of volumetric analysis.

Unit IV: Detection and estimation of elements **12 hours**

Detection of nitrogen, halogens and sulphur (Lassaigne's test) — estimation of carbon and hydrogen (Liebig's method), sulphur and halogens (Carius method) — Determination of empirical and molecular formula — structural formula.

Unit V: Dyes **12 Hours**

Dyes - colour and constitutions — chromophore - auxochrome theory - classification of dyes by structure and methods of applications - preparation of methyl red, Bismarck brown, Malachite green, Indigo and Congo red.

Text Books:

Unit – I

1. B.R.Puri, L.R.Sharma and S.Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 2004.

Unit – II

1. M.K. Jain and S.C.Sharma, Modern Organic Chemistry, Vishal Publishing Co., 2011.

Unit – III

1. P.L.Soni and Mohan Katiyal, Textbook of Inorganic Chemistry, Sultan Chand &Sons, 2008.

Unit – IV

1. P.L.Soni, Textbook of Organic Chemistry, Sultan Chand & Sons, 2008.

Unit – V

1. M.K. Jain and S.C.Sharma, Modern Organic Chemistry, Vishal Publishing Co., 2011
2. B.S.Bahl and Arun Bahl, Advanced Organic Chemistry, S.Chand & Co., Ltd., 2008.

Reference Books:

Unit - I

1. B.R.Puri, L.R.Sharma and S.Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 2004.

Unit - II

1. P.L.Soni, Textbook of Organic Chemistry, Sultan Chand & Sons, 2008.

Unit - III

1. K.S.Tewari, N.K.Vishnoi and S.N.Mehrotra, textbook of organic Chemistry, Vikas house PVT Ltd, New Delhi, 1998.

Unit - IV

1. B.S.Bah1 and Arun Bah1, Advanced Organic Chemistry, S.Chand & Co., Ltd., 2008.

Unit - V

1. R.D.Madan, Satya Prakash's Modern Inorganic Chemistry, S.Chand & Co., Ltd., 2008.

e-Resoursces

1. https://microbenotes.com/chromatography-principle-types-and-applications/
2. https://youtu.be/8m7CeObsTIk
3. https://youtu.be/AUMJwjLXh1M
4. https://simple.m.wikipedia.org/wiki/Vitamin
5. https://en.m.wikipedia.org/wiki/Significant_figures
6. https://chemistryonline.guru/normality-molarity-molality-3/
7. https://youtu.be/aH-Cjyn8V_Y
8. https://www.adichemistry.com/organic/basics/analysis/lassaignes/lassaignes-test.html
9. https://youtu.be/MhBEj32wZqE

10.https://www.britannica.com/technology/dye

Part III — Allied Chemistry Lab I — LAB: VOLUMETRIC ANALYSIS
Hours per week: 2 Subject Code: U22CHAYP21 **Credits: 2**

Course Outcome:
CO1: To acquire the basic principles of volumetric titration,
CO2: To understand the basic knowledge on standard solution, molar and the indicator
CO3: To get the knowledge on the titration between acidimetry and alkalimetry
CO4: To develop the basic knowledge on permanganometry
CO5: To know the fundamental knowledge on iodometry.

(Exam to be conducted at the end of even Semester)
A double titration involving making up of the solution to be estimated or single titration involving making up of the solution to be estimated and the preparation of standard solution.

(a) Acidimetry and alkalimetry
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.

(b) Permanganometry
1. Titrations between potassium permanganate and oxalic acid, ferrous sulphate and ferrous ammonium sulphate.

(c) Iodometry
1. Titrations between sodium thiosulphate with potassium permanganate and potassium dichromate (demonstration only)

Course Title : Principles of Biochemical Techniques	**Total Hours : 30**
Course Code : U24MBS21	**Total Credits : 2**

Course Outcomes:

Cos	CO statement
CO1	Gain proficiency in the use of colorimeter and spectrophotometer in theory basis
CO2	Acquiring knowledge about the chromatographic techniques
CO3	Understand the qualitative and quantitative analysis of imaging techniques
CO4	Basic knowledge about the separation of DNA & Protein through electrophoresis techniques
CO5	Creating awareness about the electron microscope and its application

UNIT I **(6 hours)**

Introduction to Biochemical techniques – Principles and Applications: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy, Ultra Centrifuge.

UNIT II **(6 hours)**

Principles and Applications of Chromatographic Techniques: Paper chromatography, Thin layer chromatography, Column chromatography, High-performance liquid chromatography (HPLC) and Gas chromatography (GC).

UNIT III **(6 hours)**

Principles and Applications of Electrophoresis Techniques: Starch Gel, Agarose gel electrophoresis (AGE), Sodium Dodecyl Sulphate - Polyacrylamide Gel Electrophoresis (SDS-PAGE).

UNIT IV **(6 hours)**

Imaging and radiation based techniques: Principles and applications of Electrocardiogram (ECG), Magnetic resonance imaging (MRI), Computed tomography (CT), Autoradiography.

UNIT V **(6 hours)**

Principles and applications of microscopes: fluorescence microscope, Confocal microscope, Electron Microscope – SEM & TEM.

Text Books:

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

Reference Books:

1. Rodney, F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2. Skoog, A.,West.M (2014). Principles of Instrumental Analysis – 14th Edition W.B.Saunders Co., Philadephia.
3. N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers.
4. Wilson, K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th Edition. Cambridge University Press.
5. Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

e- Resources:

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

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