B.Sc Microbiology Curriculum Design
Credit Distribution for UG
First Year
Semester- I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	Fundamentals of Microbiology and Microbial diversity CC I	5	5
	Fundamentals of Microbiology and Microbial diversity - Practical CC II	3	3
	Biochemistry EC I	3	3
	Biochemistry Practical	-	3
Part-IV	Skill Enhancement Course SEC-1: Social and Preventive medicine	2	2
	Foundation Course FC	2	2
		21	**30**

Semester-II

Part		Credit	Hours per week (L/T/P)
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	Microbial Physiology and Metabolism CC III	5	5
	Microbial Physiology and Metabolism – Practical CC IV	3	3
	Biochemistry EC II	3	3
	Biochemistry Practical	2	3
Part-IV	Skill Enhancement Course SEC-2: Nutrition and health hygiene	2	2
	Skill Enhancement Course SEC-3 (Discipline Specific) Sericulture	2	2
		23	**30**

Second Year
Semester-III

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	Molecular Biology and Microbial Genetics CC V	5	5
	Molecular Biology and Microbial Genetics – Practical CC VI	3	3
	Bioinstrumentation EC III	3	3
	Bioinstrumentation Practical	-	3
Part-IV	Skill Enhancement Course SEC-4: Organic farming and Biofertilizer technology	1	1
	Skill Enhancement Course SEC-5: (Discipline Specific)Aquaculture	2	2
	EVS	-	1
		20	30

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	Immunology and Immunotechnology CC VII	5	5
	Immunology and Immunotechnology - Practical CC VIII	3	3
	Clinical Laboratory techniques EC IV	3	3
	Bioinstrumentation Practical	2	2
Part-IV	Skill Enhancement Course SEC-6: Vaccine Technology	2	2
	Skill Enhancement Course SEC-7: (Discipline Specific)Apiculture	2	2
	EVS	2	1
		25	**30**

Third Year
Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-III	Bacteriology and Mycology CC IX	5	5
	Virology and Parasitology CC X	4	5
	Medical Microbiology - Practical CC XI	4	5
	Project with viva-voce CC XII	4	5
	Recombinant DNA technology EC V	3	4
	Biosafety and Bioethics EC VI	3	4
Part IV	Value Education	2	2
	Internship / Industrial Visit / Field Visit (Carried out in II YearSummer vacation) (30 hours)	2	-
		27	**30**

Semester-VI			
Part	**List of Courses**	**Credit**	**Hours per week (L/T/P**
Part-III	Environmental and Agricultural Microbiology CC XIII	5	6
	Food, Dairy and Probiotic Microbiology CC XIV	5	6
	Applied Microbiology - Practical CC XV	4	4
	Pharmaceutical Microbiology EC VII	4	6
	Entrepreneurhip and Biobusiness EC VIII	3	6
Part IV	Microbial Quality control and testing Professional Competency Skill	2	2
Part V	Extension Activity	1	-
		24	**30**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	**Core Course – 1**	**Y**	**-**	**-**	**-**	**4**	**5**	**25**	**75**	**100**

Course Objectives	
CO1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
CO2	Describe the structural organization, morphology and reproduction of microbes.
CO3	Explain the methods of cultivation of microbes and measurement of growth.
CO4	Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
CO5	Compare and contrast the different methods of sterilization.

UNIT	Details	No.of Hours	Course Objectives
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 Prokaryotes and eukaryotes and, Archaebacteria.	12	CO1
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.	12	CO2
III	Bacterial culture media and pure culture techniques. Mode of cell division. Anaerobic culture techniques.	12	CO3
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM. Stains and staining methods.	12	CO4
V	Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	PO5, PO6, PO10
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	PO10
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	PO11
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	PO4, PO11
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants**.**	PO4, PO11
Text Books		
1	Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition., McGraw – Hill, New York.	
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.	
3	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc. New York.	
4	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby College Publishing, St Louis.	
References Books		
1	Jeffrey C. 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., MacMillan Press Ltd	
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.	
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.	
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.	
Web Resources		
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-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 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 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 offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					M	M				M	
CO2										M	M
CO3											S
CO4				M							S
CO5				M							S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	**Core Course II-Practical I**	**-**	**-**	**Y**	**-**	**4**	**5**	**25**	**75**	**100**

Course Objectives	
CO1	Acquire knowledge on Cleaning of glass wares, GLP and sterilization.
CO2	Gain knowledge on media preparation and cultural characteristics.
CO3	Learn the pure culture technique
CO4	Learn the microscopic techniques and staining methods.
CO5	Acquire knowledge on stain and staining methods

UNIT	Details	No.of Hours	Course Objectives
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.	12	CO1
II	Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.	12	CO2
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	CO3
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	CO4
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 technique.	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Practice sterilization methods; learn to prepare media and their quality control.	PO4, PO7, PO8, PO9, PO11
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	PO4, PO7, PO8, PO9
CO3	Understand Microscopy methods, different Staining techniques and motility test.	PO4, PO7, PO8, PO9, PO11
CO4	Observeculture characteristics of microorganisms.	PO4, PO7, PO8, PO9
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount	PO4, PO7, PO8, PO9
Text Books		
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	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.	
4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.	
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.	
References Books		
1	Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.	
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India	
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS	
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.	
5	Lim D. (1998). Microbiology, 2ndEdition, 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 Evaluation -Theory		
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 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 offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				M			L	M	L		M
CO2				S			L	L	L		
CO3				S			M	M	L		M
CO4				S			M	L	L		
CO5				S			M	L	L		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Social and Preventive medicine	**Skill enhancement Course SEC - 1 (NME)**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives

CO1	Describe the concepts of health and disease and their social determinants
CO2	Summarize the health management system
CO3	Know about the various health care services
CO4	Outline the goals of preventive medicine
CO5	Gain knowledge about alternate medicine

UNIT	Details	No. of Hours	Course Objectives
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	CO1
II	Health management: Applications of behavioral sciences and psychology in health management- 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	CO2
III	Health care and services: Health care of the community-information, education, communication and training in health-maternal & child health-school health services.	6	CO3
IV	Preventive medicine: Introduction- role of preventive medicine- levels of prevention-surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.	6	CO4
V	Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and	6	CO5

	precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.		
	Total	30	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify the health information system	PO1, PO5, PO6	
CO2	Associate various factors with health management system	PO1, PO2, PO3, PO5, PO6, PO9	
CO3	Choose the appropriate health care services	PO1, PO5, PO6	
CO4	Appraise the role of preventive medicine in community setting	PO4, PO5, PO6	
CO5	Recommend the usage of alternate medicine during outbreaks	PO1, PO5, PO6	
Text Books			
1.	Park. K (2021). Textbook of preventive and social medicine, 26th edition. Banarsi das Bhanot publishers.		
2.	Mahajan& Gupta (2013). Text book of preventive and social medicine, 4thedition. Jaypee brothers medical publishers.		
3.	Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.		
4.	Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatics. 12th edition, Jaypee Brothers Medical Publishers.		
5.	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.		
References Books			
1	Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.		
2	GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.		
3	Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010). Handbook 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		

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 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 offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S				S	S					
CO2	S	S		M	S	S			M		
CO3				M	S	S					
CO4	S			S	S	M					
CO5	S				S	S					

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
	Introduction to Microbial world	**Foundation Course**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives			
CO1	Describe the discovery of microbial world and development of pure culture techniques.		
CO2	Learn about distribution of microorganism in nature, diversity and types of microorganisms.		
CO3	Know about the impact of microorganism in environment- Branches of microbiology		
CO4	Outline the goals of pure culture techniques		
CO5	Gain knowledge about microscopy and staining techniques.		
UNIT	**Details**	**No.of Hours**	**Course Objectives**
I	Discovery of microbial world: Establishment of theory of biogenesis, Discovery of viruses. Developments in pure culture techniques. Establishment of germ theory of diseases and fermentation. Work of Lister and principles of aseptic surgery. Discovery and developments of vaccines and modern chemotherapy. Work of Winogradsky and Beijerinck. Discovery of microorganisms as plant pathogens.	6	CO1
II	Distribution of microorganisms in nature. Diversity in microbial habitat. Types of microorganisms. Introduction to prokaryotic world, eukaryotic microorganisms, viruses and other acellular microorganisms.	6	CO2
III	Impact of microorganisms in environment and its impact on human life. Branches of Microbiology Thrust areas of Microbiology: Genetic Engineering and Biotechnology.	6	CO3
IV	Pure culture techniques Definition: Pure culture and axenic culture. Principles and methods of obtaining pure culture	6	CO4

	Preservation of pure culture, culture collection centers		
V	Techniques used to study microorganisms (10 Hours) Microscopy- Principles of Microscopy, magnification and resolving power. Light microscopy: simple and compound microscope. Bright field and dark field microscopy. Principles and application of phase contrast and fluorescent microscopy. Electron microscopy: general principles. Types of electron microscopy, their principles working and limitations. Staining Dyes and stains: Definition, acidic basic dyes and leucocompounds. Smear: Fixation use of mordent, intensifiers and decolorizer. Mechanism of staining. Types of staining: simple and differential staining. Application of stains and dyes in study of microbiology	6	CO5
	Total	30	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Study the historical events that led to the discoveries and inventions.	PO1, PO5, PO6
CO2	Gain Knowledge of detailed habitat of microbes. Study the prokaryotic and eukaryotic world.	PO1, PO2, PO3, PO5, PO6, PO9
CO3	Understand the impacts of microorganism in environment.	PO1, PO5, PO6
CO4	Learn about pure culture techniques.	PO4, PO5, PO6
CO5	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application	PO1, PO5, PO6

Text Books	
1.	Pelczar MJ, Chan ECS and Kreig NRT ata Mc Graw Hill

2.	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
3.	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition
4.	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby College Publishing, St Louis
5.	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc. New York.
References Books	
1	General Microbiology: RY Stanier, Adelberg EA and JL Ingraham, MacMillan PressInc.
2	Introduction to microbiology: Ingraham JL and Ingraham CA Thomson Brooks/ Cole
3	Principles of microbiology: RM Atlas WMC Brown Publishers
4	Brock's Biology of Microorganisms **:** Madigan MT and Martinko JM Pearson Education Inc
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/

SEMESTER II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIAL PHYSIOLOGY AND METABOLISM	**Core Course III**	**Y**	**-**	**-**	**-**	**4**	**5**	**25**	**75**	**100**

Course Objectives	
CO1	Study the basic principles of microbial growth.
CO2	Understand the basic concepts of aerobic and anaerobic metabolic pathways.
CO3	Analyze the role of individual components in overall cell function.
CO4	Provide information on sources of energy and its utilization by microorganisms.
CO5	Study the different types of metabolic strategies.

Unit	Details	No.of Hours	Course Objectives
I	Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	12	CO1
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.	12	CO2
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.	12	CO3
IV	Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.	12	CO4
V	Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction.	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe microorganisms based on nutrition.	PO6, PO9
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	PO6, PO7, PO9
CO3	Explain the methods of nutrient uptake.	PO6, PO9
CO4	Describe anaerobic and aerobic energy production.	PO6, PO9
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.	PO6, PO9
Text Books		
1	Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.	
2	Rajapandian K. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.	
3	MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.	
4	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.	
5	S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.	
References Books		
1	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.	
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, 3rd edition. 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/microbial physiologyoddsem/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 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 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 offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M			M		
CO2						M	L		M		
CO3						M			M		
CO4						M			M		
CO5						M			M		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIAL PHYSIOLOGY AND METABOLISM	**CCIV-CORE PRACTICAL II**	**-**	**-**	**Y**	**-**	**4**	**5**	**25**	**75**	**100**

Course Objectives

CO1	Understand the principles of motility test.
CO2	Understand the basic concepts of staining methods.
CO3	Learn the bacterial count using different methods and anaerobic culture.
CO4	Study the morphological demonstration of microorganisms and identification.
CO5	Study the biochemical identification of the bacteria.

UNIT	Details	No.of Hours	Course Objectives
I	Motility demonstration: hanging drop, wet mount preparation, semi-solid agar. Staining techniques: Smear preparation, Capsular, and Acid-fast staining	12	CO1
II	Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate.	12	CO2
III	Anaerobic culture methods – Candle jar method. Antibiotic sensitivity testing: Disc diffusion test.	12	CO3
IV	Morphological variations in algae, fungi and protozoa. Micrometry.	12	CO4
V	Methods of bacterial identification- morphological, physiological, and biochemical 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.	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	PO6, PO7, PO8, PO9, PO11
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	PO6, PO7, PO8, PO9, PO11
CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	PO6, PO7, PO8, PO9, PO11
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	PO6, PO7, PO8, PO9, PO11
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	PO6, PO7, PO8, PO9, PO11

Text Books	
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.
References Books	
1	DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4	Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
5	Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
Web Resources	
1	https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	https://www.studocu.com/microbial-physiology-practicals
5	https://www.agr.hokudai.ac.jp/microbial-physiology

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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 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 offbeat situations, Discussion, Debating or Presentations.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M	L	M	L		M
CO2						M	M	L	M		L
CO3						L	M	M	L		M
CO4						L	M	M	M		M
CO5						M	M	M	M		M

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Nutrition & Health Hygiene	**Skill Enhancement Course -SEC-2**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	Learn about nutrition and their importance
CO2	Make student understand the nutritional facts for a better life.
CO3	Learn information to optimize our diet
CO4	Impart knowledge on different health care programs taken up by India
CO5	Learn knowledge on different health indicators and types of hygiene methods

Unit	Details	No.of Hours	Course Objectives
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	5	CO1
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.	5	CO2
III	Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia.	5	CO3
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.	5	CO4
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.	5	CO5
	Total	25	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn the importance of nutrition for a healthy life	PO5, PO6, PO7, PO8, PO10
CO2	Study the nutrition for life cycle	PO5, PO6, PO7, PO8, PO10
CO3	Know the health care programmes of India	PO5, PO6, PO7, PO8, PO10
CO4	Learn the importance of community and personal health & hygiene measures	PO5, PO6, PO7, PO10
CO5	Create awareness on community health and hygiene	PO5, PO6, PO7, PO10

Text Books		
1.	Bamji, M.S., K. Krishnaswamy& G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi	
2.	Swaminathan (1995) Food &Nutrition (Vol I, Second Edition) The Bangalore Printing &Publishing Co Ltd., Bangalore	
3	SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers.	
4	Acharya, Sankar Kr,Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House	
5	Dass (2021).Public Health and Hygiene, Notion Press	
References Books		
1	VijayaKhader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi	
2	Srilakshmi, B., (2010) Food Science, (5^{th} Edition) New Age International Ltd., New Delhi	
3	Arvind Kumar Goel (2005). A College Textbook 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	
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 (KI)	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
Analyse (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 offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					S	M	M	M		S	
CO2					S	M	M	M		S	
CO3					S	M	M	M		S	
CO4					S	S	L			S	
CO5					S	S	M			S	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	SERICULTURE	**Skill Enhancement Course - SEC-3**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives			
CO1	Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant.		
CO2	Describe the morphology and physiology of silkworm.		
CO3	Discuss effective management of silkworm diseases.		
CO4	Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.		
CO5	Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.		
Unit	**Details**	**No.of Hours**	**Course Objectives**
I	General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.	5	CO1
II	Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.	5	CO2
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.	5	CO3
IV	Rearing of silkworm. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.	5	CO4
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.	5	CO5
	Total	25	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	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 Sericulture in Indian conditions.	PO1, PO5, PO7	

CO2	Familiarize with the lifecycle of silk worm.	PO1, PO2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	PO1, PO5
CO4	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.	PO7, PO8, PO10
CO5	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.	PO5, PO7, PO8
Text Books		
1	Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.	
2	Dr. R. K. Rajan & Dr. M. T. Himantharaj (2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.	
3	Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore.	
4	M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty (2010). Advances in Mulberry Sericulture, CVG Publications, Bangalore	
5	T.V. Satheand Jadhav. A.D.(2021). Sericulture and Pest Management, Daya Publishing House.	
References Books		
1	S. Morohoshi (2001). Development Physiology of Silkworms 2nd**E**dition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi	
2	Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.	
3	M.Johnson, M.Kesary (2019).Sericulture, 5th.Edition.Saras Publications.	
4	Manisha Bhattacharyya (2019).Economics of Sericulture, Rajesh Publications.	
5	Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and 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 › Sericulture Handbook	
3	https://www.academic.oup.com	
4	https://www.sericulture.karnataka.gov.in	
5	https://www.silks.csb.gov.in	

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	
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Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S				S		S				
CO2	M				S						
CO3	S				S						
CO4							S	S		S	
CO5					S		S	S			