D.K.M COLLEGE FOR WOMEN (AUTONOMOUS) VELLORE-1
B.Sc MICROBIOLOGY SYLLABUS TEMPLATE 2024-2025

S. NO	Part	Study Components		Ins. Hrs/ Week	Credit	Title of the Paper	Max Marks		
		Course Title					CIA	Sem. Exam	Total
SEMESTER I									
1	I	Language	Paper I	6	3	Tamil-I	25	75	100
2	II	English	Paper I	6	3	English –I	25	75	100
3	III	Core I	Paper I	5	5	Fundamentals of Microbiology and Microbial diversity CC I	25	75	100
4	III	Core II	Practical I	3	3	Fundamentals of Microbiology and Microbial diversity - Practical CC II	25	75	100
5	III	Generic Elective I	Paper I	3	3	Biochemistry I	25	75	100
6	III	Generic Elective	Practical	3	-	Biochemistry	-	-	-
7	IV	Skill Enhancement Course	SEC-1:	2	2	Social and Preventive medicine	25	75	100
8	IV	Foundation Course	FC	2	2	Introduction to Microbial world	25	75	100
				30	**21**		**175**	**525**	**700**
SEMESTER II							**CIA**	**Sem.Exam**	**Total**
9	I	Language	Paper II	6	3	Tamil-II	25	75	100
10	II	English	Paper II	6	3	English-II	25	75	100
11	III	Core III	Paper II	5	5	Microbial Physiology and Metabolism	25	75	100
12	III	Core IV	Practical II	3	3	Microbial Physiology and Metabolism – Practical	25	75	100
13	III	Generic Elective II	Paper II	3	3	Biochemistry II	25	75	100
14	III	Generic Elective	Practical	3	2	Biochemistry Practical	25	75	100

15	IV	Skill Enhance ment Course	SEC-2:	2	2	Nutrition and health hygiene	25	75	100
16	IV	Skill Enhance ment Course	SEC-3	2	2	(Discipline Specific) Sericulture	25	75	100
				30	**23**		**200**	**600**	**800**
SEMESTER III							**CI A**	**Sem.E xam**	**Total**
17	I	Language	Paper	6	3	Tamil-III	25	75	100
18	II	English	Paper	6	3	English-III	25	75	100
19	III	Core V	Paper III	5	5	Molecular Biology and Microbial Genetics	25	75	100
20	III	Core VI	Practical III	3	3	Molecular Biology and Microbial Genetics – Practical	25	75	100
21	III	Generic Elective III	Paper III	3	3	Bioinstrumentation	25	75	100
22	III	Generic Elective	Practical	3	-	Bioinstrumentation Practical	-	-	-
23	IV	Skill Enhance ment Course	SEC-4	1	1	Organic farming and Biofertilizer technology	25	75	100
24	IV	Skill Enhance ment Course	SEC-5	2	2	(Discipline Specific) Aquaculture	25	75	100
25	IV			1	-	EVS	-	-	-
				30	**20**		**175**	**525**	**700**
SEMESTER –IV							**CIA**	**Sem.E xam**	**Total**
26	I	Language	Paper IV	6	3	Tamil-IV	25	75	100
27	II	English	Paper IV	6	3	English-IV	25	75	100

28	III	Core VII	Paper IV	5	5	Immunology and Immunotechnology	25	75	100
29	III	Core VIII	Practical IV	3	3	Immunology and Immunotechnology - Practical	25	75	100
30	III	Generic Elective IV	Paper IV	3	3	Clinical Laboratory techniques	25	75	100
31	III	Generic Elective	Practical	2	2	Bioinstrumentation Practical	25	75	100
32	IV	Skill Enhancement Course	SEC-6	2	2	Vaccine Technology	25	75	100
33	IV	Skill Enhancement Course	SEC-7	2	2	(Discipline Specific) Apiculture	25	75	100
34	IV			1	2	EVS	25	75	100
				30	**25**		**200**	**600**	**900**

SEMESTER –V							**CIA**	**Sem.Exam**	**Total**
35	III	Core IX	Paper V	5	5	Bacteriology and Mycology	25	75	100
36	III	Core X	Paper VI	5	5	Virology and Parasitology	25	75	100
37	III	Core XI	Practical V	5	4	Medical Microbiology - Practical	25	75	100
38	III	Core	Project	5	4	Project with viva-voce	25	75	100
39	III	Elective I	Paper I	4	3	Recombinant DNA technology	25	75	100
40	III	Elective II	Paper II	4	3	Biosafety and Bioethics	25	75	100
41	IV		Paper II	2	2	Value Education	25	75	100
42	IV			-	2	Internship / Industrial Visit / Field Visit (Carried out in II	25	75	100
				30	**28**		**200**	**600**	**800**

SEMESTER-VI							CIA	Sem. Exam	Total
43	III	Core XIII	Paper VII	6	5	Environmental and Agricultural Microbiology	25	75	100
44	III	Core XIV	Paper VIII	6	5	Food, Dairy and Probiotic Microbiology	25	75	100
45	III	Core XV	Practical VI	4	4	Applied Microbiology - Practical	25	75	100
46	III	Elective III	Paper III	6	3	Pharmaceutical Microbiology	25	75	100
47	III	Elective IV	Paper IV	6	3	Entrepreneurhip and Biobusiness	25	75	100
48	IV	Professional Competency Skill		2	2	Microbial Quality control and testing	25	75	100
49	V			-	1	Extension Activity	-	-	100
				30	**23**		**150**	**450**	**700**
		Total			**140**				

Programme Educational Objectives (PEOs)

PEO1: Attain Academic and Professional Excellence

Build a strong academic foundation and skill set that will enable success in higher education, competitive examinations, teaching, research, industry, and entrepreneurial ventures.

PEO2: Emerge as Empowered Individuals

Develop into confident, self-reliant, and economically independent women capable of applying scientific knowledge to enhance personal growth, family welfare, and community development.

PEO3: Advance Research and Innovation

Demonstrate the ability to investigate real-world challenges and contribute contextually relevant, research-driven, and innovative solutions across scientific disciplines.

PEO4: Uphold Ethical and Cultural Values

Adhere to high ethical standards, respect cultural diversity, and engage responsibly in scientific practices that contribute to a just and inclusive society.

PEO5: Respond to Societal and National Needs

Utilize scientific understanding to support public health, environmental conservation, and technological advancement, fostering inclusive regional and national progress.

PEO6: Exhibit Leadership and Social Responsibility

Lead scientific and community initiatives with integrity, inspire collaborative action, and actively contribute to positive social transformation at local and global levels.

PEO7: Engage in Lifelong and Global Learning

Pursue continuous personal and professional development while staying abreast of global trends, innovations, and interdisciplinary scientific advancements.

Programme Outcomes (POs)

PO1: Comprehend and Apply Scientific Knowledge

Acquire and apply core knowledge from scientific disciplines to understand natural phenomena, solve complex problems, and support innovation across various domains of life and industry.

PO2: Demonstrate Analytical and Critical Thinking

Develop the ability to think critically and analytically by formulating hypotheses, interpreting experimental results, evaluating scientific literature, and drawing evidence-based conclusions.

PO3: Exhibit Technical and Laboratory Competency

Gain proficiency in laboratory techniques, handling of scientific instruments, and use of software tools, while adhering to safety protocols, accuracy, and reproducibility in experimental work.

PO4: Communicate Effectively

Present scientific concepts and findings clearly and coherently through oral presentations, technical writing, and the use of digital tools, adapting to both academic and professional contexts.

PO5: Uphold Ethical Values and Environmental Consciousness

Integrate ethical principles and environmental awareness into scientific practices, promoting sustainable solutions and a sense of accountability towards society and nature.

PO6: Engage in Lifelong Learning

Cultivate an inquisitive mindset and adaptability to emerging scientific advancements, technologies, and interdisciplinary approaches, thereby remaining relevant and competent throughout life.

PO7: Collaborate and Lead in Scientific and Social Contexts

Participate effectively in collaborative scientific projects and community-based activities, demonstrating leadership, decision-making, and commitment to women's empowerment and societal progress.

Programme Specific Outcomes (PSOs) – B.Sc. Microbiology

PSO1:Understand Core Microbiological Concepts

Demonstrate foundational knowledge in microbiology, including microbial physiology, genetics, immunology, and pathogenesis, and apply these principles to understand microbial roles in nature and human health.

PSO2: Apply Practical and Technical Skills in Laboratory Settings

Gain hands-on experience in microbial cultivation, staining techniques, biochemical assays, sterilization, and microscopy, with emphasis on accuracy, safety, and documentation.

PSO3: Analyze and Interpret Scientific Data

Critically evaluate experimental results, perform microbial data analysis, and use statistical and computational tools to draw meaningful scientific conclusions.

PSO4: Demonstrate Awareness of Environmental and Health Issues

Identify the roles of microorganisms in environmental sustainability, public health, and disease control, promoting eco-conscious and ethical microbiological practices.

PSO5. Communicate Scientific Knowledge Effectively

Present microbiological findings in academic, industrial, and social settings using appropriate formats such as research reports, posters, and presentations.

PSO6: Engage in Team-based and Community-oriented Scientific Endeavours

Participate in interdisciplinary and community outreach programs focused on hygiene, sanitation, food safety, and women's health, contributing to societal well-being.

PSO7: Prepare for Higher Studies and Professional Careers

Equip students for postgraduate education, competitive exams, and entry-level positions in research labs, hospitals, food industries, and diagnostic centers.

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 Preservation of pure culture, culture collection centers	6	CO4
V	Techniques used to study microorganisms (10 Hours) Microscopy- Principles of Microscopy, magnification and resolving power. Light microscopy: simple and compound	6	CO5

	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		
	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,2nd Edition., Times Mirror, Mosby College Publishing, St Louis
5.	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., 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		
	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	

Internal Evaluation	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 0	
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
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	M				S						
CO3	S				S						
CO4							S	S		S	
CO5					S		S	S			

SEMESTER III

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Molecular Biology and Microbial Genetics	**Core Course V - Theory**	**Y**	**Y**	**-**	**-**	**5**	**5**	**25**	**75**	**100**

Learning Objectives	
CO1	Provide knowledge on structure and replication of DNA.
CO2	Illustrate the significance and functions of RNA in protein synthesis.
CO3	Explain the cause and types of DNA mutation and DNA repair mechanisms.
CO4	Outline the role of plasmids and phages in genetics.
CO5	Examine mechanisms of gene transfer and recombination.

Unit	Details	No. of Hours	Course Objectives
I	Structure Of Nucleic Acids Dna Structure, Forms Of DNA.RNA Structure tRNA rRNA mRNA. Replication of DNA in prokaryotes Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, and primase.	15	CO1
II	Transcription in Prokaryotes. Concept of transcription. Types of RNA Polymerases -. Translation in prokaryotes - Translational machinery - ribosome structure, tRNA structure and processing.	15	CO2
III	Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.	15	CO3
IV	Plasmid, Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2µ plasmid. Bacteriophage- Lytic and Lysogenic cycle.	15	CO4
V	Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence. Transposition and Types of Transposition reactions. Mechanism of transposition. Transposable elements - Prokaryotic transposable elements. Uses of transposons.	15	CO5
	Total	75	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Analyze the significance of DNA and elucidate the replication mechanism.	PO4, PO5, PO7, PO9
CO2	Illustrate the types of RNA and protein synthesis machinery.	PO4, PO7, PO9
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.	PO5, PO7, PO9

CO4	Evaluate the importance of plasmids and phages in genetics.	PO7, PO9
CO5	Analyze gene transfer and recombination methods.	PO5, PO6, PO7, PO9
Text Books		
1.	Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.	
2.	Gardner E. J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.	
3.	Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.	
4.	Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.	
5.	Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.	
References Books		
1.	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.	
2.	Russell P.J. (2010). Genetics - A Molecular Approach, 3rd Edition., Pearson New International edn.	
3.	Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.	
4.	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition, ASM Press Washington-D.C. ASM Press.	
5.	Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing	
Web Resources		
1.	[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in	
2.	https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/	
3.	https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/	
4.	Molecular Biology Notes - Microbe Notes	
5.	Molecular Biology Lecture Notes & Study Materials | Easy Biology Class	

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	M	S	M	S	M	
CO2				S	M	M	S	M	S	L	
CO3				M	S	M	S	M	S	L	
CO4				M	M	M	S	M	S	L	
CO5				M	S	S	S	M	S	L	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Molecular Biology and Microbial Genetics	**Core Course – VI – Practical III**	**-**	**-**	**Y**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives

CO1	Provide knowledge on structure and replication of DNA.
CO2	Elucidate the methods of Genomic and Plasmid DNA isolation.
CO3	Explain methods of protein separation.
CO4	Explain artificial transformation method.
CO5	Outline the role of phages in genetics.

Unit	Details	No. of Hours	Course Objectives
I	Study of different types of DNA and RNA using micrographs and model / schematic representations. Study of semi-conservative replication of DNA through micrographs / schematic representations.	15	CO1
II	Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis – Demonstration. Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement).	15	CO2
III	Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration. UV induced auxotrophic mutant production and isolation of mutants by replica plating technique	15	CO3
IV	Perform artificial Transformation in *E. coli* – Demonstration. Isolation of antibiotic resistant mutants by gradient plate method. - Demonstration	15	CO4
V	Screening and isolation of phages from sewage. Perform RNA isolation – Demonstration. Estimate RNA.	15	CO5
	Total	75	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Illustrate different types of DNA and RNA.	PO4, PO7, PO9, PO11
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.	PO4, PO7, PO9, PO11
CO3	Analyze importance of experimental microbial genetics.	PO4, PO7, PO9, PO11
CO4	Apply the knowledge of molecular techniques in various fields.	PO4, PO7, PO9, PO11
CO5	Investigate the significance of Phages.	PO4, PO7, PO9, PO11
Text Books		
1.	Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi.	
2.	Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.	
3.	Dale J. W., Schantz M. V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.	
4.	Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.	
5.	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.	
References Books		
1	Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.	
2	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.	
3	Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.	
4	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th edition, ASM Press Washington-D.C. ASM Press.	
5	Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.	
Web Resources		
1	https://www.molbiotools.com/usefullinks.html	
2	(PDF) Molecular Biology Laboratory manual (researchgate.net)	
3	https://www.molbiotools.com/usefullinks.html	
4	https://geneticgenie.org3.	
5	https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5	

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	L	M	S	M	S	M	S
CO2				S	L	M	S	M	S	M	S
CO3				S	L	M	S	M	S	M	S
CO4				S	L	M	S	M	S	M	S
CO5				S	L	M	S	M	S	M	S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	BIO INSTRUMENTATION	Generic Elective III	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Course Objectives	
CO1	Understand the analytical instruments and study the basic principles in the field of sciences.
CO2	To gain knowledge about principles of spectroscopy
CO3	Understand the analytical techniques of Chromatography and electrophoresis
CO4	To understand the principle of different types of scans used in medical diagnosis
CO5	To gain information about the principles of radioactivity and its measurements

Unit	Details	No.of Hours	Course Objectives
I	Basic instruments: pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave**,** Hot Air Oven and Incubator. Biochemical calculations-preparations of Molarity, molality and normality solutions.	12	CO1
II	Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy.	12	CO2
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.	12	CO3
IV	Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan.	12	CO4
V	Radioisotope techniques: nature of radioactivity, detection, measurements - Scintillation counter, Geiger Muller counter, Autoradiography. safety aspects, applications.	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Gain knowledge about the basics of instrumentation.	PO1, PO4, PO11
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	PO4, PO10, PO11
CO3	Evaluate by separating and purifying the components.	PO4, PO7, PO11
CO4	Understand the need and applications of imaging techniques.	PO7, PO8, PO11
CO5	Categorize the working principle and applications of fluorescence and radiation.	PO10, PO11

Text Books

1. Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers.

3	Veerakumari, L (2009). Bioinstrumentation- 5 thEdition -.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.
References Books	
1	Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B. SaundersCo., 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.7thEdition. Cambridge University Press.
5	Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd,Singapore.
Web Resources	
1	http://www.biologydiscussion.com/biochemistry/centrifugation/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

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	L			M							S
CO2				L						M	S
CO3				L			M				S
CO4							S	S			S
CO5										M	S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	ORGANIC FARMING & BIOFERTILISER TECHNOLOGY	**SKILL ENHANCEMENT COURSE – SEC -5 (ENTREPRENEURIAL SKILL)**	**Y**	**-**	**-**	**-**	**1**	**1**	**25**	**75**	**100**

Learning Objectives

CO1	Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve environment.
CO2	To encourage organic farming in urban areas.
CO3	Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective.
CO4	Structure and characteristic features of Cyanobacterial and fungal biofertilizer
CO5	Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers.

Unit	Details	No.of Hours	Course Objectives
I	Principle of organic farming: principles of health, fairness, ecological balance, and care. Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Crop rotation, inter-cropping.	6	CO1
II	Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming) Composting, Vermicomposting	6	CO2
III	Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic features of bacterial biofertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*	6	CO3
IV	Structure and characteristic features of Cyanobacterial biofertilizers- *Anabaena, Nostoc;* Structure and characteristic features of fungal biofertilizers- AM mycorrhiza	6	CO4
V	Production of *Rhizobium, Azotobacter, Anabena*; Biofertilizers - Storage, shelf life, quality control and marketing	6	CO5
	Total	30	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Become an Entrepreneur with wide knowledge about farming and sustainable resources.	PO1, PO2, PO7, PO8, PO10
CO2	Implement organic farming in urban areas with knowledge on compost.	PO1, PO5, PO10
CO3	Gain knowledge about the bacterial biofertilizers and its advantages	PO1, PO5, PO7, PO8, PO10
CO4	Understand the significance about Cyanobacterial and fungal biofertilizers	PO1, PO5, PO7, PO8, PO10
CO5	Understand and implement the use of bio fertilizers.	PO1, PO5, PO7, PO8, PO10

Text Books	
1.	A.K. Sharma (2006). Hand book of Organic Farming
2.	A.C.Gaur (2017). Hand book of Organic Farming and Biofertilizers
3.	N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry (4th Edition) Med tech publisher
4.	SubbaRao, N. S. (2002). Soil Microbiology. Soil Microorganisms and Plant Growth. (4th Edition), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5.	Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.
References Books	
1	Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
2	Sujit Chakrabarty (2018). Organic Home Gardening Made Easy, 1st Edition,
3	Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
4	Bansal M (2019). Basics of Organic Farming CBS Publisher.
5	Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.
Web Resources	
1.	https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html
2.	https://www.fao.org/organicag/oa-faq/oa-faq6/en/
3.	https://www.india.gov.in/topics/agriculture/organic-farming
4.	https://agriculture.nagaland.gov.in/bio-fertilizer/
5.	https://vlab.amrita.edu/index.php?sub=3&brch=272

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:

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	AQUACULTURE	**Skill Enhancement Course -6**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Learning Objectives

CO1	Provide a deeper knowledge in aquaculture systems and methods.
CO2	Explain the significance and functions of design, types and construction of aquaculture ponds.
CO3	Demonstrate the biological characteristics of various aquaculture species.
CO4	Discuss the methods involved in post stocking management.
CO5	Illustrate major cultivatable species for aquaculture.

Unit	Details	No. of Hours	Course Objectives
I	Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture.	6	CO1
II	Aquaculture Engineering - Design and construction of pond, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.	6	CO2
III	Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio.	6	CO3
IV	Post Stocking Management - Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.	6	CO4
V	Major cultivable species for aquaculture –Culture of Indian Major Carps. Culture of Giant fresh water prawn, *Macrobrachium rosenbergii* - seed collection formation sources. Hatchery management. Culture of tiger shrimp, *Penaeusmonodon* and *Litopenaeus vannamei.* Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.	6	CO5
	Total	30	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Analyze the significance and importance of aquaculture	PO4, PO5, PO7, PO9
CO2	Illustrate the types and construction of aquaculture ponds	PO4, PO7, PO9
CO3	Analyze the biological characteristics of species and choose the best species for aquaculture.	PO5, PO7, PO9
CO4	Follow methods involved for optimal growth of aquaculture species	PO7, PO9
CO5	Summarize major species suitable for aquaculture in a particular environment	PO5, PO6, PO7, PO9
Text Books		
1.	Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019). Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi.	
2.	Stickney, R.R. (2016). Aquaculture: An Introductory Text. 3rd Edition. Centre for Agriculture and Bioscience International Publishing.	
3.	Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principles of Aquaculture. CRC Press.	
4.	Mushlisin Z. A. (2012). Aquaculture. In Tech.	
5.	Akpaniteaku R.C. (2018).Basic Handbook of Fisheries and Aquaculture.AkiNik Publications.	
References Books		
1.	Arumugam N. (2014). Aquaculture. Saras Publication.	
2.	Pillay T. V. R. and Kutty M.N. (2005). Aquaculture: Principles and Practices. 2ndEdition. Wiley India Pvt. Ltd.	
3.	Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra Publishing House.	
4.	Rath R.K. (2011). Fresh Water Aquaculture. 3rdEdition. Scientific Publishers.	
5.	Lucas J. S., Southgate P.C. and Tucker C.S. (2019). Aquaculture: Farming Aquatic Animals and Plants. Wiley Blackwell.	
Web Resources		
1.	Aquaculture: Types, Benefits and Importance (Fish Farming) - Conserve Energy Future (conserve-energy-future.com)	
2.	Fisheries Department - Tamil Nadu (tn.gov.in)	
3.	Aquaculture - Google Books	
4.	aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica	
5.	Fisheries & Aquaculture (investindia.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
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	M	S	M	S	M	
CO2				S	M	M	S	M	S	L	
CO3				M	S	M	S	M	S	L	
CO4				M	M	M	S	M	S	L	
CO5				M	S	S	S	M	S	L	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY I	**Generic Elective III**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Course Objectives	
CO1	Learn the History and Evolution of Microbiology.
CO2	Describe the structural organization, morphology and reproduction of microbes.
CO3	Explain the methods of cultivation of microbes.
CO4	Understand the microscopy and staining techniques
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 and eight kingdom. Spontaneous generation – Biogenesis Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Fleming.	8	CO1
II	General characteristics of microorganisms -Bacteria, Algae, Fungi, Viruses and Protozoa. Differences between prokaryotic and eukaryotic microorganisms. Anatomy of prokaryotes - cell wall, cytoplasmic membrane, cilia, flagella capsule, cytoplasmic inclusions, sporulation.	8	CO2
III	Bacterial culture media and pure culture techniques. Anaerobic culture techniques.	8	CO3
IV	Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM. Staining methods.	8	CO4
V	Sterilization - methods of sterilization and Disinfection. Antimicrobial chemotherapy - tests for sensitivity to antimicrobial agents.	8	CO5
	Total	40	

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 off beat 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

SEMESTER IV

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	IMMUNOLOGY AND IMMUNOTECHNOLOGY	**CORE COURSE – VII**	**Y**	**-**	**-**	**-**	**5**	**5**	**25**	**75**	**100**

Course Objectives	
CO1	To gain knowledge about immune system, organs of immunity and cells involved.
CO2	To distinguish the types of antigens and antibodies; their properties.
CO3	To provide in-depth knowledge on immuno-techniques.
CO4	To discuss the role of MHC system in transplantation; functions of Tumor specific antigens.
CO5	To impart knowledge on immunological disorders.

Unit	Details	No.of Hours	Course Objectives
I	Organs and Cells in Immune System and Immune Response: Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.	12	CO1
II	Antigen and Antibody: Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization;	12	CO2
III	Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, ELISA, Immuno fluorescence techniques	12	CO3
IV	Transplantation and Tumor Immunology - MHC Antigens - structure and function; HLA system. Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immune therapy.	12	CO4
V	Immunological disorders and diseases - Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Auto immune disorders and diseases: organ specific and non-organ specific.	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.	PO1, PO4, PO6, PO9,
CO2	Investigate the structures of Ag and Ab; Immunization.	PO1, PO4, PO5, PO9
CO3	Justify the Immunoassay and Immunotechniques.	PO1, PO4, PO5, PO7
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation	PO1, PO3, PO4, PO5, PO9
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.	PO1, PO4, PO5, PO6

Text Books	
1.	Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
2.	Judith A. Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
3.	Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition., Elsevier.
4.	Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018). Clinical Immunology: Principles and Practice, 5th Edition. Elsevier.
5.	Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

References Books	
1	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
2	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell.
3	William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.
4	Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.
5	Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition.

Web Resources	
1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html
3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | ScienceDirect Topics

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
CO1	S			M		S			M
CO2	S			M	M				M
CO3	S			S	S		S		
CO4	S		M	S	S				M
CO5	S			S	M	M			

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	IMMUNOLOGY AND IMMUNOTECHNOLOGY	CORE COURSE – VIII-PRACTICAL IV	**-**	**-**	**Y**	**-**	**3**	**3**	**25**	**75**	**100**

Course Objectives

CO1	To gain hands-on knowledge to identify Blood group and typing.
CO2	To acquire adequate skill to perform latex agglutination reactions.
CO3	To analyze precipitation reactions in gels.
CO4	To investigate the antigen & antibody reactions in electrophoresis.
CO5	To familiarize with Separation of Lymphocytes.

Unit	Details	No.of Hours	Course Objectives
I	Identification of blood group and typing. Coomb's test. TPHA	12	CO1
II	T cell identification (Demonstration) Latex Agglutination reactions- RF, ASO, CRP	12	CO2
III	Ouchterlony's Double Diffusion Method (antigen pattern). Single Radial Immuno Diffusion Method.	12	CO3
IV	Electrophoresis - Serum, Counter and Immuno.	12	CO4
V	Separation of Lymphocytes by gradient centrifugation method. ELISA: Hepatitis/ HIV	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Assess the blood groups and types	PO1, PO5, PO6, PO7, PO8
CO2	Competently perform serological diagnostic tests such as RF, ASO, CRP	PO4, PO5, PO6, PO7, PO8
CO3	Illustrate the antigen antibody reactions in gel.	PO5, PO6, PO7, PO8, PO9
CO4	Compare & contrast antigens and antibodies in electrophoresis	PO5, PO6, PO7, PO8, PO9
CO5	Examine the concept of ELISA.	PO5, PO6, PO7, PO8, PO9

Text Books

1.	**Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.**
2.	Asim Kumar Roy. (2019). Immunology Theory and Practical**,** Kalyani Publications.
3.	Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
4.	Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
5.	Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.
References Books	
1	Frank C. Hay, Olwyn M. R. Westwood. (2008). Practical Immunology, 4th Edition, Wiley-Blackwell.
2	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
3	Rose. (1992). Manual of Clinical Lab Immunology, ASM.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition., Wiley-Blackwell.
Web Resources	
1	https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
2	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
3	https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | ScienceDirect Topics

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
CO1	M				S	S	S	S	
CO2				S	M	M	S	S	
CO3					M	S	S	S	M
CO4					M	M	S	S	M
CO5					M	M	S	S	M

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CLINICAL LABORATORY TECHNOLOGY	**GENERIC ELECTIVE -IV**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Learning Objectives

CO1	Demonstrate ethical and professional conduct with patients, laboratory personnel, health- care professionals, and the public.
CO2	Explain how accurate and reliable information might be obtained about proper procurement, storage, and *handling* of laboratory *specimens*.
CO3	Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.
CO4	Perform a full range of laboratory tests with accuracy and precision.
CO5	Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

Unit	Details	No.of Hours	Course Objectives
I	**Introduction to Clinical Laboratory Science**: Basic laboratory principles - Code of conduct for medical laboratory personnel - Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices.	12	CO1
II	**Specimen collection and processing** - Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.	12	CO2
III	**Introduction to histopathology**-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections.	12	CO3
IV	**Introduction to Haematology**- Laboratory methods used in the investigation of coagulation disorders - coagulation tests, Routine coagulation tests, (prothrombin time, plasma recalcification time, partial thromboplastin time, activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.	12	CO4

V	**Quality Standards in Health Laboratories** – Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team.Practice safety or infection control procedures in the clinical laboratory, properly use safety equipment and maintain a clean, safe work environment.	PO3, PO11
CO2	Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and transmission-based precautions, Engage in the scientific process by understanding the principles and practices of clinical study design, implementation, and dissemination of results.	PO5, PO6, PO11
CO3	Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures. Relate and recognize the histological appearance of affected tissues to the underlying pathology.	PO6, PO8, PO9, PO11
CO4	Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies.	PO5, PO6, PO9, PO11
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies.	PO1,PO10

Text Books

1.	Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata McGrawHill, Delhi.
2.	Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education.

3	RamnikSood (2015).Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2nd Edition, Jaypee Brothers Medical Publishers, NewDelhi.
4.	*S. Ramakrishnan*, KN Sulochana**(2012). Manual of Medical Laboratory Techniques,**Jaypee Brothers Medical Publishers Pvt. Ltd
5.	**Talib V.H. (2019).***Handbook Medical Laboratory Technology, 2nd* Edition, *Directorate of health services, Government of India.*
References Books	
1	Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
2	Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7th Edition, CBS Publishers and Distributors Pvt. Ltd.
3	Godkar (2021). Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House.
4	M.N.Chatterjee and RanaShinde.(2008). Textbook of Medical Biochemistry, 7th Edition, Jaypee Brothers Medical Publishers Pvt. Limited.
5	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.
Web Resources	
1	https://www.jaypeedigital.com › book
2	https://www.pdfdrive.com › wintrobes-clinical-hematology
3	https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5
4	https://vlab.amrita.edu/index.php?sub=3&brch=272
5	https://nptel.ac.in/courses/102105087

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								S
CO2					M	S					S
CO3						S		S		S	S
CO4					M	S			S		S
CO5	M									M	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Vaccine Technology	**Skill Enhancement Course SEC -6**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives

CO1	To provide knowledge on the basics of immunization and induction of immunity.
CO2	To learn the types of vaccines, its immunological effects and regulatory guidelines.
CO3	To learn the role of rDNA in vaccine technology.
CO4	To provide the knowledge on conventional to recent technology of vaccine production
CO5	To learn about ethical issues and regulations in vaccine production and clinical trials

Unit	Details	No.of Hours	Course Objectives
I	History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity	3hrs	CO1
II	Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine.	6	CO2
III	Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.	5	CO3
IV	Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.	5	CO4
V	Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Quality control Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues. Vaccination schedule.	5	CO5
	Total	24	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.	PO1, PO10
CO2	Understand the types of vaccines.	PO5
CO3	Construct vaccine applying rDNA technology.	PO7, PO10
CO4	Formulate the strategies for developing an innovative vaccine technology with different mode of vaccine delivery.	PO9, PO10
CO5	Evaluate the regulatory issues and guidelines for the management of vaccine production.	PO3, PO5
Text Books		
1.	Ronald W. Ellis.(2001). New Vaccine Technologies.Landes Bioscience.	
2.	Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery.Espicom Business Intelligence.	
3	Male, David. Ed. (2007). Immunology. 7th Edition. Mosby Publication.	
4	Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. (2002). Immunology. 6th Edition, Freeman.	
5	Brostoff J, Seaddin JK, Male D, Roitt IM. (2002). Clinical Immunology. 6th Edition, Gower Medical Publishing.	
References Books		
1	Stanley A. Plotkin, Walter Orenstein& Paul A. Offit.(2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication.	
2	Coico, R. et al. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss.	
3	Parham, Peter. (2005). The Immune System. 2nd Edition, Garland Science.	
4	Abbas, A.K. etal. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier.	
5	Weir, D.M. and Stewart, John (2000). Immunology. 8th Edition, Churchill Pvt. Ltd.	
Web Resources		
1	https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567	
2	https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf	
3	https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_ production_29256323aa_10mar2017.pdf	
4	https://www.sciencedirect.com/science/article/pii/B9780128021743000059	
5	https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing	

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	M									M	
CO2					S						
CO3							M			M	
CO4									L	M	
CO5			L		M						

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	APICULTURE	**SKILL ENHANCEMENT COURSE-SEC – 7**	**Y**	**-**	**-**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives

CO1	To understand the biology of honey bees.
CO2	To study on honey bee colony establishment.
CO3	To develop knowledge on honey extraction.
CO4	To understand the diseases of honey bees and their control.
CO5	To gain information on financial assistance and funding agencies for bee keeping industry.

Unit	Details	No.of Hours	Course Objectives
I	Biology of Bees: Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.	6	CO1
II	Social life in Bees:Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.	6	CO2
III	Bee Rearing:Apiary – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary– Extraction instruments.	6	CO3
IV	Bee Economy: Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.	6	CO4
V	Entrepreneurship: venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.	6	CO5
	Total	30	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the systematic position and life history of honey bee.	PO1, PO2, PO10
CO2	Reveal the different stages and types of bees and discuss about the care and management of apiculture.	PO1, PO2, PO4, PO5
CO3	Describe the practice of bee rearing process and analyze instruments employed in apiary.	PO2, PO4, PO5, PO10, PO11

CO4	Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets.	PO4, PO5, PO7, PO8, PO10
CO5	Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives.	PO5, PO8, PO9, PO10, PO11

Text Books

1.	Dewey M. Caron. (2013). Honey Bee Biology and Beekeeping. Revised Edition. Wicwas Press, Kalamazoo. ISBN 10: 1878075292
2.	R. A. Morse. (1993). Rearing queen honey bees. Wicwas press, NY. ISBN-10 : 1878075055
3.	Ted Hooper. (2010). Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books. Oxford. ISBN 10: 1904846513
4.	Jayashree K. V., Tharadevi C.S. and Arumugam N. (2014) Apiculture. Saras Publication
5.	Raj H. (2020). Vinesh Text Book of Apiculture. S. Vinesh and Co.

References Books

1	Dewey M. Caron. (2020). The Complete Bee Handbook: History, Recipes, Beekeeping Basics, and More, Rockridge Press. ISBN-10: 1646119878
2	Joachim Petterson. (2016). Beekeeping: A Handbook on Honey, Hives & Helping the Bees, Weldon Owen.
3	Eva Crane. (1999). The World History of Beekeeping and Honey Hunting. Routledge. India.ISBN-10 : 0415924677
4	Pagar B. S. (2016). Textbook Of Apiculture. Sahitya Sagar.
5	Sehgal P.K. (2018). Text Book of Sericulture, Apiculture and Entomology. Kalayani.

Web Resources

1	Bee Keeping Basics. Retrieved from:https://denton.agrilife.org/files/2013/08/beekeeping-basics.pdf
2	Beekeeping as an Entrepreneurship, Retrieved from: https://lupinepublishers.com/agriculture-journal/pdf/CIACR.MS.ID.000270.pdf
3	Raising Bumble Bees at Home: A Guide to Getting Started. Retrieved from: https://www.ars.usda.gov/ARSUserFiles/20800500/BumbleBeeRearingGuide.pdf
4	Apiculture – Biology for Everybody (homeomagnet.com)
5	Apiculture: Introduction to Apiculture (iasri.res.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
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		S	S						
CO3		S		S	M					S	S
CO4				S	M		S	S		M	
CO5					S			S	S	S	S

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	MICROBIOLOGY II	**Generic Elective - IV**	**Y**	**-**	**-**	**-**	**3**	**3**	**25**	**75**	**100**

Course Objectives	
CO1	Learn the Bacterial and Viral diseases.
CO2	Understand the Fungal and Protozoan diseases.
CO3	Impart knowledge about the Environmental Microbiology.
CO4	Acquire knowledge about the Food Microbiology
CO5	Familiarize the biofertilizers and biopesticides

UNIT	Details	No.of Hours	Course Objectives
I	Bacteria diseases – Symptoms and control of Respiratory Diseases: S. pyogenes, *M. tuberculosis* Gastrointestinal Diseases: *E. coli, S. typhi, Vibrio cholerae*. Fungal diseases - Causative organism, Symptoms and control Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis.	8	CO1
II	Viral diseases – Causative organism, Symptoms and control of Polio, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya. Protozoan diseases - Causative organism, Symptoms, mode of transmission and control Malaria, Kala-azar.	8	CO2
III	Microbiology of Air – Sources of air borne organisms, Air borne diseases. Water borne diseases; Purification of water. Sewage treatment – Physical, Chemical and Biological methods.	8	CO3
IV	Sources of contamination and spoilage of foods; Food Preservation; Fermentation products - Bread and Alcoholic beverages (Beer & Wine); Fermented dairy products – Cheese & Yogurt. SCP- *Spirulina* and Mushroom.	8	CO4
V	Biofertilizers – Definition, Types, Importance and Advantages; Nitrogen fixing microorganisms; Phosphate solubilizing microorganisms; Biopesticides	8	CO5
	Total	40	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Gain Knowledge of common bacterial and fungal diseases.	PO5, PO6, PO10
CO2	Gain Knowledge of common viral and protozoan diseases.	PO10
CO3	Understand the air, water and waste water microbiology	PO11
CO4	Understand the food and dairy microbiology	PO4, PO11
CO5	Utilize the knowledge of biofertilizers and biopesticides. for sustainable agriculture.	PO4, PO11
Text Books		
1	Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.	
2	Dubey, R.C. and Maheshwari D.K. (2010). A Text Book of Microbiology. S. Chand & Co.	
3	Rajan S. (2007). Medical Microbiology. MJP publisher.	
4	Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi.	
5	Frazier WC and Westhoff DC (2014). Food Microbiology. Tata McGraw Hill Publishing Company Ltd. New Delhi	
6	Subba Rao. N. S. (2017). Soil Microbiology. (5th Edition). MedTech Publishers.	
7	Daniel. C. J. (2006). Environmental Aspects of Microbiology. (2nd Edition). Bright Sun Publications.	
References Books		
1	Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications.	
2	Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.	
3	Pepper I. L., Gerba C. P. and Gentry T. J. (2014). Environmental Microbiology (1st Edition). Academic Press, Elsevier.	
4	Bitton, G. (2011). Wastewater Microbiology. (4th Edition). Wiley-Blackwell.	
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	http://textbookofbacteriology.net/nd	
2	https://www.adelaide.edu.au/mycology/	
3	https://en.wikipedia.org/wiki/Virology	
4	www.environmentshumail.blogspot.in/	
5	http://www.fsis.usda.gov/	

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 / Sem	Marks		
									CIA	External	Total
	MICROBIOLOGY PRACTICAL	**Generic Elective Practical**	**-**	**-**	**Y**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	Acquire knowledge on cleaning of glass wares 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 to isolate the microorganisms from the environment

UNIT	**Details**
I	Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization of glass wares and media.
II	Media preparation: liquid and solid media. Antibiotic sensitivity testing – Kirby Bauer method
III	Pure culture techniques: streak plate, Serial dilution – spread plate and pour plate.
IV	Staining techniques: smear preparation, simple staining and Gram's staining. Motility demonstration – Hanging drop technique. Fungal identification by Lactophenol cotton blue staining technique.
V	Isolation of microorganisms from air, soil and sewage. Testing the quality of milk - MBRT

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Practice sterilization methods	PO4, PO7, PO8, PO9, PO11
CO2	Learn to prepare different media and their quality control.	PO4, PO7, PO8, PO9
CO3	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	PO4, PO7, PO8, PO9, PO11

CO4	Understand Microscopy methods, different Staining techniques and motility test.	PO4, PO7, PO8, PO9
CO5	Acquire knowledge to isolate bacteria from the environment	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	

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
	BIOINSTRUMENTATION	Generic Elective Practical	**-**	**-**	**Y**	**-**	**2**	**2**	**25**	**75**	**100**

Course Objectives	
CO1	Understand the basic principles in the field of sciences.
CO2	To gain knowledge about the analytical instruments
CO3	Understand the analytical techniques of Colorimeteric and Ultraviolet and Visible Spectroscopy
CO4	Understand the analytical techniques of Chromatography
CO5	Understand the analytical techniques of electrophoresis

Unit	Details	No.of Hours	Course Objectives
I	Preparation of Buffers of biological importance, pH meter,	12	CO1
II	Bio separation of components using Centrifuge. Laminar Air Flow, Autoclave**,** Hot Air Oven and Incubator.	12	CO2
III	Colorimeteric and Ultraviolet and Visible Spectroscopy Experiments	12	CO3
IV	Chromatographic techniques – TLC and Paper chromatography.	12	CO4
V	Electrophoresis Techniques: AGE, PAGE - Demonstration	12	CO5
	Total	60	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Gain knowledge about the preparation of buffers.	PO1, PO4, PO11
CO2	Gain knowledge about the basics of instrumentation.	PO4, PO10, PO11
CO3	Gain knowledge about the colorimetric and spectroscopic techniques	PO4, PO7, PO11
CO4	Evaluate by separating and purifying the components.	PO7, PO8, PO11
CO5	Gain knowledge about the Electrophorosis techniques	PO10, PO11

Text Books

1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi.
2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers.
3	Veerakumari, L (2009). Bioinstrumentation- 5 thEdition -.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.

References Books

1	Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B. SaundersCo., 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.7thEdition. Cambridge University Press.
5	Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd,Singapore.

Web Resources

1	http://www.biologydiscussion.com/biochemistry/centrifugation/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

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	L			M							S
CO2				L						M	S
CO3				L			M				S
CO4							S	S			S
CO5										M	S