



THIRUVALLUVAR UNIVERSITY
SERKKADU, VELLORE-632115

M. SC MICROBIOLOGY

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

TANSICHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	M.Sc., Microbiology
Programme Code	
Duration	PG – 2 YEARS
Programme Outcomes (Pos)	<p>PO1: Problem Solving Skill</p> <p>Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.</p> <p>PO2: Decision Making Skill</p> <p>Foster analytical and critical thinking abilities for data-based decision-making.</p> <p>PO3: Ethical Value</p> <p>Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.</p> <p>PO4: Communication Skill</p> <p>Ability to develop communication, managerial and interpersonal skills.</p> <p>PO5: Individual and Team Leadership Skill</p> <p>Capability to lead themselves and the team to achieve organizational goals.</p> <p>PO6: Employability Skill</p> <p>Inculcate contemporary business practices to enhance employability skills in the competitive environment.</p> <p>PO7: Entrepreneurial Skill</p>

	<p>Equip with skills and competencies to become an entrepreneur.</p> <p>PO8: Contribution to Society</p> <p>Succeed in career endeavors and contribute significantly to society.</p> <p>PO 9 Multicultural competence</p> <p>Possess knowledge of the values and beliefs of multiple cultures and</p> <p>a global perspective.</p> <p>PO 10: Moral and ethical awareness/reasoning</p> <p>Ability to embrace moral/ethical values in conducting one's life.</p>
<p>Programme Specific Outcomes (PSOs)</p>	<p>PSO1 – Placement</p> <p>To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p>PSO 2 - Entrepreneur</p> <p>To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.</p> <p>PSO3 – Research and Development</p> <p>Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p> <p>PSO4 – Contribution to Business World</p> <p>To produce employable, ethical and innovative professionals to</p>

	<p>sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society</p> <p>To contribute to the development of the society by collaborating with stakeholders for mutual benefit.</p>
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Semester-I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester-IV	Credit
Core-I	5	7	2.1. Core-IV	5	6	3.1. Core-VII	5	6	4.1. Core-XI	5
Core-II	5	7	2.2 Core-V	5	6	3.2 Core-VIII	5	6	4.2 Core-XII	5
Core – III	4	6	2.3 Core – VI	4	6	3.3 Core – IX	5	6	4.3 Project with viva voce	7
Discipline Centric Elective -I	3	5	2.4 Discipline Centric Elective – III	3	4	3.4 Core – X	4	6	4.4 Elective - VI (Industry / Entrepreneurship) 20% Theory 80% Practical	3
Generic Elective-II:	3	5	2.5 Generic Elective -IV:	3	4	3.5 Discipline Centric Elective - V	3	3	4.5 Skill Enhancement course / Professional Competency Skill	2
			2.6 NME I	2	4	3.6 NME II	2	3	4.6 Extension Activity	1
						3.7 Internship/ Industrial Activity	2	-		
	20	30		22	30		26	30		23

Total Credit Points -91

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Post – Graduate Courses including Lab Hours

First Year – Semester – I

Part	List of Courses	Credits	No. of Hours
	Core – I	5	7
	Core – II	5	7
	Core – III	4	6
	Elective – I	3	5
	Elective – II	3	5
		20	30

Semester-II

Part	List of Courses	Credits	No. of Hours
	Core – IV	5	6
	Core – V	5	6
	Core – VI	4	6
	Elective – III	3	4
	Elective – IV	3	4
	Skill Enhancement Course [SEC] - I	2	4
		22	30

Second Year – Semester – III

Part	List of Courses	Credits	No. of Hours
	Core – VII	5	6
	Core – VIII	5	6
	Core – IX	5	6
	Core (Industry Module) – X	4	6
	Elective – V	3	3
	Skill Enhancement Course - II	2	3
	Internship / Industrial Activity [Credits]	2	-

		26	30
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Semester-IV

Part	List of Courses	Credits	No. of Hours
	Core – XI	5	6
	Core – XII	5	6
	Project with VIVA VOCE	7	10
	Elective – VI (Industry Entrepreneurship)	3	4
	Skill Enhancement Course – III / Professional Competency Skill	2	4
	Extension Activity	1	-
		23	30

Total 91 Credits for PG Courses

Credit Distribution for PG Courses
First Year
Semester-I

Part	Course	Course Title	Credit	No. of Hours
	Core I	General Microbiology and Microbial Diversity	5	7
	Core II	Immunology, Immunomics and Microbial Genetics	5	7
	Core III	Practical-I	4	6
	Elective I	Forensic Science/ Health Hygiene/ Microalgal Technology (Among the three choices anyone can be chosen by the student)	3	5
	Elective II	Bioinstrumentation/ Herbal Technology and Cosmetic Microbiology / Essentials of Laboratory Management and Biosafety (Among the three choices anyone can be chosen by the student)	3	5
	Total		20	30

**First Year
Semester-II**

Part	Course	Course Title	Credit	No. of Hours
	Core IV	Medical Bacteriology and Mycology	5	6
	Core V	Medical Virology and Parasitology	5	6
	Core VI	Practical-II	4	6
	Elective III	Epidemiology/ Clinical Diagnostic Microbiology/ Bioremediation (Among the three choices anyone can be chosen by the student)	3	4
	Elective IV	Bioinformatics/ Nanobiotechnology/ Clinical Research and Clinical Trials (Among the three choices anyone can be chosen by the student)	3	4

	Skill Enhancement Course I	Vermitechnology	2	4
	Total		22	30

**Second Year
Semester-III**

Part	Course	Course Title	Credit	No. of Hours
	Core VII	Soil and Environmental Microbiology	5	6
	Core VIII	Recombinant DNA Technology and Biotechnology	5	6
	Core IX	Practicals III	5	6
	Core X Industry Module	Fermentation Technology and Pharmaceutical Microbiology	4	6
	Elective V	Biosafety, Bioethics and IPR/ Toxinology/ Water Conservation and Water Treatment (Among the three choices anyone can be chosen by the student)	3	3
	Skill Enhancement Course II	Organic Farming and Biofertiliser Technology	2	3
		Internship / Industrial Activity	2	-
			26	30

**Second Year
Semester-IV**

Part	Course	Course Title	Credit	No. of Hours
	Core XI	Food & Dairy Microbiology	5	6
	Core XII	Research Methodology & Biostatistics	5	6
	Project	Project with Viva Voce	7	10
	Elective VI	Bioenergy/ Marine Microbiology/ Life Science for Competitive Examinations (Among the three choices anyone can be chosen by the student)	3	4
	Skill Enhancement Course	Microbial Quality Control and Testing	2	4
	Extension Activity		1	-
			23	30

**FIRST YEAR
SEMESTER-I**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GCT1	General Microbiology and Microbial Diversity	Core Course I	Y	Y	-	-	4	6	25	75	100
Course Objectives											
CO1	Acquire knowledge on the principles of different types of microscopes and their applications.										
CO2	Compare and contrast the structure of bacteria and fungi. Illustrate nutritional requirements and growth in bacteria.										
CO3	Exemplify, isolate and cultivate microalgae from diverse environmental sources.										
CO4	Explain various pure culture techniques and discuss sterilization methods.										
CO5	Discuss the importance and conservation of microbial diversity.										
UNIT	Details								No. of Hours	Course Objectives	
I	History and Scope of Microbiology. Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.								20	CO1	
II	Bacterial Structure, properties and biosynthesis of cellular components – Cell wall. Actinomycetes and Fungi - Distribution, morphology, classification, reproduction and economic importance. Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.								20	CO2	
III	Algae - Distribution, morphology, classification, reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation. Life cycle - <i>Chlamydomonas</i> , <i>Volvox</i> (Green algae), <i>Nostoc</i> (Cyanobacteria), <i>Sargassum</i> (Brown algae), <i>Polysiphonia</i> , (Red algae).								15	CO3	
IV	Microbial techniques - Sterilization, Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and								15	CO4	

	International.		
V	Biodiversity - Introduction to microbial biodiversity – Classification and applications of Thermophiles , Alkaliphiles Acidophiles , Barophiles and Halophiles. Methanogenes / Conservation of Biodiversity.	20	CO5
	Total	90	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Examine various microbes employing the microscopic techniques learnt. Measure and compare the size of microbes.	PO1, PO4, PO11	
CO2	Differentiate and appreciate the anatomy of various microbes. Plan the growth of microbes for different environmental conditions.	PO1, PO4	
CO3	Identify and cultivate the algae understanding their habitat. Analyze the morphology, classify and propagate depending on its economic importance.	PO7, PO8, PO9	
CO4	Create aseptic conditions by following good laboratory practices.	PO3, PO4,PO7	
CO5	Categorize and cultivate a variety of extremophiles following standard protocols for industrial applications.	PO5, PO7, PO8, PO9	
Text Books			
1.	Kanunga R. (2017). Ananthanarayanan and Panicker’s Text book of Microbiology. (10 th Edition). Universities Press (India) Pvt. Ltd.		
2.	Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2010). Microbiology. (5 th Edition). Mc.Graw Hill. Inc, New York.		
3.	Prescott L. M., Harley J. P. and Klein D. A. (2004). Microbiology. (6 th Edition). McGraw - Hill company, New York.		
4.	White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.		
5.	Dubey R.C. and Maheshwari D. K. (2009). Textbook of Microbiology. S. Chand, Limited.		
REFERENCES BOOKS			
1.	Tortora G. J., Funke B. R. and Case C. L. (2015). Microbiology: An Introduction (12 th Edition).Pearson, London, United Kingdom		
2.	Webster J. and Weber R.W.S. (2007). Introduction to Fungi. (3 rd Edition). Cambridge University Press, Cambridge.		
3.	Schaechter M. and Leaderberg J. (2004). The Desk encyclopedia of Microbiology. Elseiver Academic Press, California.		
4.	Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology. (2 nd Edition). Books / Cole Thomson Learning, UK.		
5.	Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl (2018) Brock Biology of Microorganisms. (15 th Edition). Pearson.		
Web Resources			
1.	http://sciencenetlinks.com/tools/microbeworld		
2.	https://www.microbes.info/		

3.	https://www.asmscience.org/VisualLibrary	
4.	https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404	
5.	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	M			M							S			
CO2	L			S										
CO3							S	S	M					
CO4			S	S			S							
CO5					S		S	S	S					

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CI A	External	Total
22MBPGCT 2	Immunology , Immunomics and Microbial Genetics	Core Course II	Y	Y	-	-	4	6	25	75	100
Course Objectives											
CO1	Discuss immunity, organs and cells involved in immunity. Compare the types of antigens and their properties.										
CO2	Describe immunoglobulin and its types. Categorize MHC and understand its significance.										
CO3	Elucidate the mechanisms of different hypersensitivity reactions. List out the Vaccines and discuss their development.										
CO4	Acquire knowledge the structure DNA in prokaryotes and eukaryotes										
CO5	Explain out gene transfer studies in microbes.										
UNIT	Details								No. of Hours	Course Objectives	
I	Introduction to biology of the immune system – Cells and organs of Immune System. T and B lymphocytes – Origin, development, differentiation, lymphocyte subpopulation in humans. Innate immunity and Acquired immunity – Active and Passive immunity. Antigens - features associated with antigenicity and immunogenicity. Basis of antigen specificity. MHC genes and products, Structure of MHC molecules. Antigen processing and presentation to T- lymphocytes.								20	CO1	
II	Immunoglobulins. Theories of antibody production. Class switching and generation of antibody diversity. Monoclonal and polyclonal antibodies. Complement system – mode of activation- Classical, Alternate and Lectin pathways, biological functions. Antigen recognition – TCR. Physiology of acquired immune response – various phases of HI, CMI – Cell mediated cytotoxicity, DTH response.								20	CO2	
III	Hypersensitivity – Types and mechanisms, Autoimmunity, Tumor Immunity and Transplantation immunology. Immunodeficiency-Primary immunodeficiency and Secondary immunodeficiencies. Genetics of Immunohematology – Genetic basis and significance of ABO and Rh System. Diagnostic Immunology - Precipitation reaction, Immunodiffusion methods - SRID, ODD. Immunoelectrophoresis - Rocket and Counter current								25	CO3	

	electrophoresis. Agglutination- Labeled Assay- Immunofluorescence assay, Radio immunoassay, ELISA. Role of cytokines, lymphokines and chemokines. Introduction to Vaccines and Adjuvants - Types of vaccines. Immunomics - Introduction and Applications. Antigen engineering for better immunogenicity and use for vaccine development-multipitope vaccines. Reverse vaccinology.		
IV	Structure of prokaryotic and eukaryotic genome. Introduction to prokaryotic genomic structure, Eukaryotic Genome - Structure of chromatin, chromosome, centromere, telomere, nucleosome. Modifications- methylation, acetylation, phosphorylation.	13	CO4
V	Gene Transfer Mechanisms- Conjugation and its uses. Transduction, Generalized and Specialized, Transformation– Natural Competence and Transformation. Transposition, Mechanism and Types of Transposition reactions.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Categorize the immune response to a variety of antigens. Identify different immune cells involved in immunity.	PO1, PO4, PO6, PO7, PO9	
CO2	Justify the significance of MHC molecules in immune response and antibody production.	PO1, PO4, PO5,PO6, PO9	
CO3	Design antibodies and evaluate immunological assays in patient samples.	PO4, PO6, PO7, PO8, PO9, PO10	
CO4	Analyze genomic DNA of prokaryotes and eukaryotes.	PO4,PO5, PO6, PO7, PO9, PO10	
CO5	Summarize gene transfer mechanisms for experimental study.	PO4,PO5, PO6, PO7, PO9, PO10	
Text Books			
1.	Coico R., Sunshine G. and Benjamini E. (2003). Immunology – A Short Course. (5 th Edition). Wiley-Blackwell, New York.		
2.	Owen J. A., Punt J., Stranford S. A. and Kuby J. (2013). Immunology, (7 th Edition). W. H. Freeman and Company, New York.		
3.	Abbas A. K., Lichtman A. H. and Pillai S. (2021). Cellular and Molecular Immunology. (10 th Edition). Elsevier.		
4.	Malacinski G.M. (2008). Freifelder’s Essentials of Molecular Biology. (4 th Edition). Narosa Publishing House, New Delhi.		
5.	Gardner E. J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. (8 th Edition). Wiley India Pvt. Ltd.		
References Books			

1.	Travers J. (1997). Immunobiology - The Immune System in Health and Disease. (3 rd Edition). Current Biology Ltd. New York.	
2.	Delves P.J., Martin S., Burton D. R. and Roitt I. M. (2006). Roitt's Essential Immunology. (11 th Edition). Wiley-Blackwell.	
3.	Hay F. C. and Westwood O. M. R. (2002). Practical Immunology (4 th Edition). Wiley-Blackwell.	
4.	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5 th Edition). ASM Press.	
5.	Russell P.J. (2010). Genetics - A Molecular Approach. (3 rd Edition). Pearson New International 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.	[PDF] Lehninger Principles of Biochemistry (8 th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in	
5.	https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	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	
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	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	S			M		M	S		S					
CO2	S			S	M	S			S					
CO3				S		S	S	S	S	M				
CO4				S	M	S	M		S	M				
CO5				S	M	S	M		S	S				

**FIRST YEAR
SEMESTER-I**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GCP1	Practical I	Core Course III- Practical I	-	-	Y	-	4	6	25	75	100
Course Objectives											
CO1	Gain knowledge on the fundamentals, handling and applications of microscopy, sterilization methods. Identify microbes by different staining methods.										
CO2	Prepare media for bacterial growth. Discuss plating and growth measurement techniques.										
CO3	Acquire adequate skills to perform blood grouping and serological reactions.										
CO4	Provide fundamental skills in preparation, separation and purification of immunoglobulin.										
CO5	Apply the knowledge of molecular biology skills in clinical diagnosis.										
UNIT	Details								No. of Hours	Course Objectives	
I	Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop. Dark field microscopy – Motility. Washing and cleaning of glass wares: Sterilization methods: moist heat, dry heat, and filtration. Quality control check for each method. Staining techniques - Simple staining, Gram's staining, Acid fast staining, Spore, Capsule, Flagella.								20	CO1	
II	Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates. Preparation of basal, enriched, selective and enrichment media. Preparation of Biochemical test media, media to demonstrate enzymatic activities. Microbial Physiology: Purification and maintenance of microbes. Streak plate, pour plate, and slide culture technique. Aseptic transfer. Direct counts – Total cell count, Turbidometry. Viable count - pour plate, spread plate. Bacterial growth curve. Anaerobic culture methods.								20	CO2	
III	Hematological reactions - Blood Grouping – forward and reverse, Rh Typing Identification of various immune cells by morphology –								20	CO3	

	Leishman staining. Agglutination Reactions- Latex Agglutination reactions- RF, ASO. Detection of HBs Ag by ELISA. Precipitation reactions in gels– Ouchterlony double immunodiffusion (ODD) and Mancini's single radial immunodiffusion (SRID) Immuno-electrophoresis - Rocket immuno electrophoresis and counter current immuno electrophoresis.		
IV	Preparation of lymphocytes from peripheral blood by density gradient centrifugation.	10	CO4
V	Western Blotting – Demonstration. Isolation of genomic DNA from <i>E. coli</i> and analysis by agarose gel electrophoresis Estimation of DNA using colorimeter (Diphenylamine reagent) Separation of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) UV induced mutation and isolation of mutants by replica plating technique. Plasmid DNA isolation from <i>E.coli</i> . RNA isolation from yeast. RNA estimation by Orcinol method.	20	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Apply microscopic techniques and staining methods in the identification and differentiation of microbes.	PO1, PO6, PO7, PO8, PO9, PO11	
CO2	Apply the knowledge on the sterilization of glass wares and media by different methods and measurement of cell growth.	PO1, PO6, PO7, PO8, PO9, PO11	
CO3	Perform and evaluate immunological reactions to aid diagnosis.	PO5, PO7, PO8, PO9, PO11	
CO4	Assess the level of lymphocytes in a blood sample and purify immunoglobulin employing appropriate techniques.	PO6, PO7, PO8, PO9, PO11	
CO5	Perform DNA extraction and gene transfer mechanisms, analyze and identify by gel electrophoresis	PO6, PO7, PO8, PO9, PO11	
Text Books			
1.	Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand.		
2.	Cappuccino, J. and Sherman, N. (2002). Microbiology: A Laboratory Manual, (6 th Edition). Pearson Education, Publication, New Delhi.		

3.	Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2 nd Edition). - Taylor & Francis.	
4.	Rich R. R., Fleisher T. A., Shearer W. T., Schroeder H, Frew A. J. and Weyand C. M. (2018). Clinical Immunology: Principles and Practice. (5 th Edition). Elsevier.	
5.	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5 th Edition). ASM Press.	
References Books		
1.	Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14 th Edition). Elsevier, New Delhi.	
2.	Gupta P. S. (2003). Clinical Immunology. Oxford University Press.	
3.	Brown T.A. (2016). Gene Cloning and DNA Analysis. (7 th Edition). John Wiley and Jones, Ltd.	
4.	Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3 rd Edition). John Wileys and Sons Ltd. 2012.	
5.	Maloy S. R., Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. (2 nd Edition). Narosa Publishing Home Pvt Ltd.	
Web Resources		
1.	http://textbookofbacteriology.net/	
2.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC149666/	
3.	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/	
4.	[PDF] Lehninger Principles of Biochemistry (8 th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in	
5.	https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	40 Marks
	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	
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	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	M					S	M	M	S		M			
CO2	M					S	M	M	S		M			
CO3					S		S	M	S		M			
CO4						S	S	M	S		S			
CO5						S	S	M	S		S			

FIRST YEAR SEMESTER-I

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBPGE 1A	Forensic Science	Elective Course I (Choice -1)	3	1	-	-	3	4	25	75	100
Course Objectives											
CO1	Understand the Scope, need and learn the tools and techniques in forensic science.										
CO2	Comprehend organizational setup of a forensic science laboratory.										
CO3	Identify and Examine body fluids for identification.										
CO4	Extract DNA from blood samples for investigation.										
CO5	Recognize medico legal post mortem procedures and their importance.										
UNIT	Details								No. of Hours	Course Objectives	
I	Forensic Science - Definition, history and development of forensic science. Scope and need of forensic science in present scenario. Branches of forensic science. Tools and techniques of forensic science. Duties of a forensic scientist.								12	CO1	
II	Forensic science laboratories - Organizational setup of a forensic science laboratory. Central and State level laboratories in India. Mobile forensic science laboratory and its functions. Forensic microbiology - Types and identification of microbial organisms of forensic significance.								12	CO2	
III	Forensic serology - Definition, identification and examination of body fluids - Blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.								12	CO3	
IV	DNA profiling - Introduction, history of DNA typing. Extraction of DNA from blood samples - Organic and Inorganic extraction methods. DNA fingerprinting - RFLP, PCR, STR. DNA testing in disputed paternity.								12	CO4	

V	Forensic toxicology - Introduction and concept of forensic toxicology. Medico legal post mortem and their examination. Poisons - Types of poisons and their mode of action.	12	CO5
	Total	60	
Course Outcomes	On completion of this course, students will;		
CO1	Identify the scope and need of forensic science in the present scenario.	PO1, PO6, PO7, PO8, PO9	
CO2	Plan for the organizational setup and functioning of forensic science laboratories.	PO1, PO6, PO7, PO8, PO9	
CO3	Analyze the biological samples found at the crime scene.	PO1, PO5, PO7, PO8, PO9	
CO4	Perform extraction and identification of DNA obtained from body fluids.	PO1, PO6, PO7, PO8, PO9	
CO5	Discuss the concept of forensic toxicology.	PO1, PO6, PO7, PO8, PO9	
Text Books			
1.	Nanda B. B. and Tewari R. K. (2001) Forensic Science in India: A Vision for the Twenty First Century. Select Publishers, New Delhi. ISBN- 10:8190113526 / ISBN-13:9788190113526.		
2.	James S. H. and Nordby, J. J. (2015) Forensic Science: An Introduction to Scientific and Investigative Techniques. (5 th Edition). CRC Press. ISBN-10:9781439853832 / ISBN-13:978-1439853832.		
3.	Li R. (2015) Forensic Biology. (2 nd Edition). CRC Press, New York. ISBN-13:978-1-4398-8972-5.		
4.	Sharma B.R (2020) Forensic science in criminal investigation and trials. (6 th Edition)Universal Press.		
5.	Richard Saferstein (2017). Criminalistics- An introduction to Forensic Science. (12 th Edition).Pearson Press.		
Reference books			
1.	Nordby J. J. (2000). Dead Reckoning. The Art of Forensic Detection- CRC Press, New York. ISBN:0-8493-8122-3.		
2.	Saferstein R. and Hall A. B. (2020). Forensic Science Hand book, Vol. I, (3 rd Edition). CRC Press, New York. ISBN-10:1498720196.		
3.	Lincoln, P.J. and Thomson, J. (1998). (2 nd Edition). Forensic DNA Profiling Protocols. Vol. 98. Humana Press. ISBN: 978-0-89603-443-3.		
4.	Val McDermid (2014). Forensics. (2 nd Edition). ISBN 9780802125156.		
5.	Vincent J. DiMaio., Dominick DiMaio. (2001). Forensic Pathology (2 nd Edition). CRC Press.		

Web resources		
1.	http://clsjournal.ascls.org/content/25/2/114	
2.	https://www.ncbi.nlm.nih.gov/books/NBK234877/	
3.	https://www.elsevier.com/books/microbial-forensics/budowle/978-0-12-382006-8	
4.	https://www.researchgate.net/publication/289542469_Methods_in_microbial_forensics	
5.	https://cisac.fsi.stanford.edu/events/microbial forensics	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participitation	
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
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	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	L					S	M	M	S					
CO2	M					S	M	M	S					
CO3	L				S		S	M	S					
CO4	M					S	S	M	S					
CO5	M					S	S	M	S					

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GE1B	Health and Hygiene	Elective Course I (Choice- 2)	Y	Y	-	-	3	4	25	75	100
Course Objectives											
CO1	Acquire knowledge on hygiene and live healthy.										
CO2	Provide insights on health laws for food safety and hygiene.										
CO3	Explain health, physical exercises and their importance.										
CO4	Illustrate mental hygiene and involved in mental hygiene.										
CO5	Describe the various health and health education programmes by the government.										
UNIT	Details								No. of Hours	Course Objectives	
I	Introduction to hygiene and healthful live. Factors affecting health, health habits and practices. Recognizing positive & negative practices in the community. Scientific principles related to health.								12	CO1	
II	Nutrition and Health – Balanced diet, Food surveillance, food Fortification, adulteration and preventive measures. Health laws for food safety. Environmental and housing hygiene. Ventilation and lighting.								12	CO2	
III	Physical health, physical exercises and their importance – Walking, jogging, yoga and meditation, stress relief. International control of health, WHO. Personal hygiene, Sun bathing, Colon Hygiene. Health destroying habits and addictions - Pan, supari, ganja, drinking, smoking, tea and coffee.								12	CO3	
IV	Mental hygiene - factors responsible, developmental tasks, basic needs, emotional stability. Mental hygiene and health in infancy, early childhood, adolescence, adulthood and old age. Mental health occupational hazards.								12	CO4	

V	Health programme and health education – Malaria control, Tuberculosis control, AIDS control programmes and Immunization Programmes. Family planning, Reproductive and Child health programmes (RCH).	12	CO5
	Total	60	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Identify factors affecting health and health habits.	PO1, PO5, PO10
CO2	Execute the knowledge of ventilation and lighting. Justify Health laws for food safety and hygiene.	PO5, PO10
CO3	Follow personal hygiene to avoid diseases and Prevent people from health-destroying habits and addictions.	PO5, PO10
CO4	Explore Mental hygiene and maintain emotional stability.	PO5, PO10
CO5	Participate in health education programmes	PO1, PO5, PO10
Text Books		
1.	Bamji M. S., Krishnaswamy K. and Brahmam G. N. V. (2019). Textbook of Human Nutrition. (4 th Edition). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi	
2.	Swaminathan (1995) Food& Nutrition (Vol I) (2 nd Edition). The Bangalore Printing &Publishing Co Ltd., Bangalore.	
3.	Paniker J. C. K. and Ananthanarayan R. (2017). Textbook of Microbiology. (10 th Edition). Universities Press (India) Pvt. Ltd	
4.	Lindsay Dingwall .(2010). Personal Hygiene Care Print ISBN:9781405163071 Online ISBN:9781444318708 DOI:10.1002/9781444318708	
5.	Walter C. C. Pakes(1900). The Science of Hygiene: a Text-book of Laboratory Practice. (London: Methuen and Co.,).	
References Books		
1.	Khader V. (2000) Food, Nutrition and Health, Kalyan Publishers, New Delhi.	
2.	Srilakshmi, B. (2010) Food Science, (5 th Edition) New Age International Ltd., New Delhi.	
3.	Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand.	
4.	Park K. 2007, Park’s text book of Preventive and Social Medicine, Banarsidas Bhanot publishers, India.	
5.	Srilakshmi, 2002, Dietetics, New Age Publications, India	

Web Resources	
1.	Health and Hygiene - Personal Hygiene, Community Hygiene and Diseases (vedantu.com)
2.	Chapter-32.pdf (nios.ac.in)
3.	Menstrual Health and Hygiene Guide Student Health and Counseling Services (ucdavis.edu)
4.	https://nap.nationalacademies.org/read/11756/chapter/13
5.	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=112325

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	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	
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	PO12	PO13	PO14
CO1	L				S					M				

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GE1C	Microalgal Technology	Elective Course I (Choice -3)	Y	Y	-	-	3	4	25	75	100
Course Objectives											
CO1	Characterize the different groups of algae.										
CO2	Describe the cultivation and harvesting of algae.										
CO3	Identify the commercial applications of various algal products.										
CO4	Apply microalgae for environmental applications.										
CO5	Employ microalgae as alternate fuels.										
UNIT	Details								No. of Hours	Course Objectives	
I	Introduction to Algae - General characteristics. Classification of algae. Salient features of different groups of algae. Distribution - Freshwater, brackish water and marine algae. Identification methods.								12	CO1	
II	Cultivation of freshwater and marine microalgae - Growth media. Isolation and enumeration of microalgae. Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds - Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass.								12	CO2	
III	Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of <i>Spirulina</i> . Microalgae as aquatic, poultry and cattle feed. Microalgal biofertilizers. Value-added products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.								12	CO3	
IV	Microalgae in environmental applications. Phycoremediation - Domestic and industrial waste water								12	CO4	

	treatment. High-rate algal ponds and surface-immobilized systems - Treatment of gaseous wastes by microalgae. Algal blooms, algicides for algal control.		
V	Microalgae as feed stock for production of biofuels - Carbon-neutral fuels. Lipid-rich algal strains - <i>Botryococcus braunii</i> . Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Acquire knowledge in the field of microalgal technology and their characteristics.	PO1	
CO2	Identify the methods of algal cultivation and harvesting.	PO1, PO6	
CO3	Recognize and recommend the use of microalgae as food, feed and fodder.	PO7, PO8, PO9	
CO4	Promote microalgae in phycoremediation.	PO7, PO9, PO11, PO14	
CO5	Compare and critically evaluate recent applied research in these microalgal applications.	PO7, PO8, PO9	
Text Books			
1.	Lee R.E. (2008). Phycology. Cambridge University Press.		
2.	Sharma O.P. (2011). Algae. Tata McGraw-Hill Education.		
3.	Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry.		
4.	Lele. S.S., Jyothi Kishen Kumar (2008). Algal bio process technology. New Age International P(Ltd)		
5.	Das., Mihirkumar. Algal Biotechnology. Daya Publishing House, New Delhi.		
References Books			
1	Andersen R.A. (2005). Algal culturing techniques. Academic Press, Elsevier.		
2	Bux F. (2013). Biotechnological Applications of Microalgae: Biodiesel and Value-added Products. CRC Press.		
3	Singh B., Bauddh K., Bux, F. (2015). Algae and Environmental Sustainability. Springer.		
4	Das D. (2015). An algal biorefinery: An integrated approach. Springer.		
5	Bux F. and Chisti Y. (2016). Algae Biotechnology: Products and Processes. Springer.		
Web Resources			
1	https://www.classcentral.com/course/algae-10442		
2	https://onlinecourses.nptel.ac.in/noc19_bt16/preview		
3	https://freevideolectures.com/course/4678/nptel-industrial-biotechnology/46		
4	https://nptel.ac.in/courses/103103207		
5.	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microalgae		
Methods of Evaluation			

Internal Evaluation	Continuous Internal Assessment Tests	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	
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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	S													
CO2	S					M								
CO3							S	S	S					
CO4							S		S		M			M
CO5							M	S	S					

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MB PGE2 A	Bioinstrumentation	Elective Course II (Choice -1)	Y	Y	-	-	3	4	25	75	100
Course Objectives											
CO1	Explain the principles and working mechanisms of laboratory instruments.										
CO2	Discuss chromatography techniques and molecular biology techniques.										
CO3	Illustrate molecular techniques in biological applications.										
CO4	Acquire knowledge on spectroscopic techniques										
CO5	Demonstrate the use of radio isotopes in various techniques.										
UNIT	Details								No. of Hours	Course Objectives	
I	Basic laboratory Instruments. Aerobic and anaerobic incubator – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient; Applications in determination of molecular weight.								12	CO1	
II	General principles of chromatography - Chromatographic Performance parameters; Types- Thin layer chromatography, Paper Chromatography, Adsorption, ion exchange, Gel filtration, affinity. Flash Chromatography and Ultra Performance convergence chromatography. Two dimensional chromatography. Stimulated moving bed chromatography (SEC).								12	CO2	
III	Electrophoresis: General principles - moving boundary electrophoresis - electrophoretic mobility – supportive materials – electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications - paper electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. Blotting techniques -Southern, northern and western blotting.								12	CO3	
IV	Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV- visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, ESR, Emission Flame Photometry and GC-MS. Detection of molecules in living cells - FISH and GISH..								12	CO4	
V	Radioisotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes -								12	CO5	

	radioactive decay; Detection and measurement of radioactivity. Geiger- Muller and Scintillation counters, auto radiography and its applications- safety aspects.		
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Make use of the laboratory instruments- laminar air flow, pH meter, centrifugation methods, biosafety cabinets following SOP.	PO4, PO6, PO7, PO8, P11	
CO2	Apply chromatography techniques in the separation of biomolecules.	PO4, PO6, PO7, PO8, P11	
CO3	Perform molecular techniques like mutagenesis and their detection.	PO4, PO6, PO7, PO8, P11	
CO4	Estimate molecules in biological samples by adopting UV spectroscopic techniques.	PO4, PO6, PO7, PO8, P11	
CO5	Cultivate organisms anaerobically.	PO4, PO6, PO7, PO8, P11	
Text Books			
1.	Sharma B. K. (2014). Instrumental Method of Chemical Analysis. Krishna Prakashan Media (P) Ltd.		
2.	Chatwal G. R and Anand S. K. (2014.) Instrumental Methods of Chemical Analysis. Himalaya Publishing House.		
3.	Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.		
4.	Holme D. Peck H. (1998). Analytical Biochemistry. (3 rd Edition). Prentice Hall.		
5.	Jayaraman J. (2011). Laboratory Manual in Biochemistry. (2 nd Edition). Wiley Easton Ltd., New Delhi.		
References Books			
1.	Pavia D. L. (2012) Spectroscopy (4 th Edition). Cengage.		
2.	Skoog A. and West M. (2014). Principles of Instrumental Analysis. (14 th Edition). W.B.Saunders Co., Philadelphia.		
3.	Miller J. M. (2007). Chromatography: Concepts and Contrasts (2 nd Edition) Wiley-Blackwell.		
4.	Gurumani N. (2006). Research Methodology for Biological Sciences. (1 st Edition) MJP Publishers.		
5.	Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1 st Edition). MJP Publishers.		
Web Resources			
1.	https://norcaloa.com/BMIA		
2.	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction- types-uses-and-other-details-with-diagram/12489		
3.	https://www.watelectrical.com/biosensors-types-its-working-and-applications .		

4.	http://www.wikiscales.com/articles/electronic-analytical-balance/	
5.	https://study.com/academy/lesson/what-is-chromatography-definition-types-uses.	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participitation	
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	
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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO1				S		M	M	S			S			
CO2				S		M	M	S			S			
CO3				S		S	S	S			S			
CO4				S		M	S	S			S			
CO5				S		M	S	S			L			

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GE2B	Herbal Technology and Cosmetic Microbiology	Elective Course II (Choice 2)	Y	Y	-	-	3	4	25	75	100
Course Objectives											
CO1	Impart knowledge of Indian Medicinal Plants and their applications in microbiology.										
CO2	Promote the technical skills involved in preparation of different types of plant extracts.										
CO3	Explain methods to analyze the antimicrobial activity of medicinal plants.										
CO4	Acquire knowledge on cosmetic microbiology and role of microorganisms in cosmetics.										
CO5	Gain insight into pharmacopeial microbial assays and biosafety.										
UNIT	Details								No. of Hours	Course Objectives	
I	Herbs, Herbal medicine - Indian medicinal plants: Scope and Applications of Indian medicinal plants in treating bacterial, fungal and viral diseases. Basic principles involved in Ayurvedha, Sidha, Unani and Homeopathy.								12	CO1	
II	Collection and authentication of selected Indian medicinal plants: <i>Embllica officinalis</i> , <i>Withania somnifera</i> , <i>Phyllanthus amarus</i> , <i>Tinospora cordifolia</i> , <i>Andrographis paniculata</i> , <i>Piper longum</i> , <i>Ocimum sanctum</i> , <i>Azardirchata indica</i> , <i>Terminalia chebula</i> , <i>Allium sativum</i> . Preparation of extracts- Hot and cold methods. Preparation of stock solutions.								12	CO2	
III	Antimicrobial activity of selected Indian medicinal Plants: - In vitro determination of antibacterial and fungal activity of selected whole medicinal plants/ parts – well-diffusion methods. MIC - Macro and micro dilution techniques. Antiviral activity- cell lines- cytotoxicity, cytopathic and non-cytopathic effect.								12	CO3	
IV	History of Cosmetic Microbiology – Need for cosmetic microbiology, Scope of cosmetic microbiology, - Role of microbes in cosmetic preparation. Preservation of cosmetics. Antimicrobial properties of natural cosmetic products – Garlic, neem, turmeric, aloe vera and tulsi. Sanitary practices in cosmetic manufacturing - HACCP protocols in cosmetic microbiology.								12	CO4	
V	Cosmetic microbiology test methods - Antimicrobial preservative efficacy, microbial content testing and biological toxicological testing. Validation methods - bioburden and Pharmacopeial microbial assays. Preservatives of cosmetics - Global regulatory and toxicological aspect of cosmetic preservatives.								12	CO5	

		Total	60	
Course Outcomes				
Course Outcomes	On completion of this course, students will;			
CO1	Identify the applications of Indian medicinal plants in treating diseases.	PO1, PO5		
CO2	Identify and authenticate herbal plants.	PO6, PO7		
CO3	Evaluate the antimicrobial activity of medicinal plants.	PO4, PO6, PO9		
CO4	Describe the role of microorganisms and their metabolites in the preparation of cosmetics.	PO1, PO5, PO7		
CO5	Validate procedures and biosafety measures in the mass production of cosmetics.	PO6, PO7		
Text Books				
1.	Ayurvedic Formulary of India. (2011). Part 1, 2 & 3. Pharmacopoeia Commission for Indian Medicine and Homeopathy. ISBN-10:8190648977.			
2.	Panda H. (2004). Handbook on herbal medicines. Asia Pacific Business Press Inc. ISBN:8178330911.			
3.	Mehra P. S. (2019). A Textbook of Pharmaceutical Microbiology. Dreamtech Press. ISBN 13:9789389307344.			
4.	Geis P. A. (2020). Cosmetic microbiology: A Practical Approach. (3 rd Edition). CRC Press. ISBN:9780429113697.			
5.	Brannan D. K. (1997). Cosmetic microbiology: A Practical Handbook. CRC Press.ISBN-10:0849337135.			
References Books				
1.	Indian Herbal Pharmacopoeia (2002). Vol. I &II Indian Drug Manufacturers Association, Mumbai.			
2.	British Herbal Pharmacopoeia.(1990).Vol.I. British Herbal Medicine Association.ISBN: 0903032090.			
3.	Verpoorte R. and Mukherjee, P. K. (2010). GMP for Botanicals: Regulatory and Quality issues on Phytomedicines. In GMP for botanicals: regulatory and quality issues on phytomedicines. (2 nd edition). Saujanya Books, Delhi.ISBN-10:81-900788-5-2/8190078852. ISBN-13:978-81-900788-5-6/9788190078856.			
4.	Turner R. (2013). Screening methods in Pharmacology. Elsevier. ISBN:9781483264233.			
5.	Cupp M. J. (2010). Toxicology and Clinical Pharmacology of Herbal Products (pp. 85-93). M. J. Cupp. Humana Press.Totowa, NJ, USA. ISBN-10:1617371904.			
Web Resources				
1.	https://www.academia.edu/50236711/Modern_Extraction_Methods_for_Preparation_of_Bioactive_Plant_Extracts			
2.	https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl			
3.	https://pubmed.ncbi.nlm.nih.gov/17004305/			
4.	https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/microbiological-safety-and-cosmetics			
5.	https://pubmed.ncbi.nlm.nih.gov/15156038/			

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	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	
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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	M				S									
CO2						S	M							
CO3				S		S			M					
CO4	M				S		S							
CO5						M	S							

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
22MBP GE2C	Essentials of Laboratory Management and Biosafety	Elective Course II (Choice 3)	Y	Y	-	-	3	4	25	75	100
Course Objectives											
CO1	To utilize containment principles to ensure biosafety.										
CO2	To enrich the student role and responsibilities of laboratory hazards and their control.										
CO3	To know the importance of first aid technique for various common lab accidents.										
CO4	To acquire knowledge of biosafety level, risk assessment and maintain proper hygiene in the laboratory.										
CO5	To discuss the biosafety regulations and guidelines and implementation of safety programs.										
UNIT	Details								No. of Hours	Course Objectives	
I	Introduction to the laboratory and laboratory hazards - General laboratory facilities – Occupational safety- Lab accidents - Fires, chemical burns, slips and falls, Animal bites. Cuts from broken glass. Toxic fume inhalation. General laboratory rules, Good laboratory practice (GLP). Laboratory plan.								12	CO1	
II	Common hazards in laboratory: Chemical hazards- Safe handling of chemicals and gases, hazard labels and symbols. Material safety datasheet (MSDS), Chemical handling - Fume hood, Storage of chemicals. Chemical Waste Disposal Guideline. Physical hazards - Physical agent data sheets (PADS), Electric hazards- Electrical shock, Electrical explosions, Electrical burns. Safe work practices. Potential ignition sources in the lab. Stages of Fire. Fire Extinguishers. Fire Response.								12	CO2	
III	Prevention and First aid for laboratory accidents. Personal protective equipment (PPE), Proper attire (Eye/Face Protection, laboratory coats, gloves, respirators. Disposal/Removal of PPE. Emergency equipment safety - Showers/ Eye Washes. Laboratory security and emergency response. First aid for - Injuries caused by broken glass, Acid/Alkali splashes on the skin, swallowing acid/alkali, burns caused by heat, electric shock.								12	CO3	
IV	Biosafety - Historical background. Blood borne pathogens (BBP) and laboratory - acquired infections. Introduction to biological safety cabinets. Primary containment for biohazards. Biosafety levels of specific microorganisms.								12	CO4	

	Recommended biosafety. Levels for infectious agents and infected animals. Risk groups with examples - Risk assessment. Safety levels. Case studies - Safe working, hand hygiene. Laboratory instruments, packing, sending, transport, import and export of biological agents. Hygiene, disinfection, decontamination, sterilization.		
V	Biosafety regulations and guidelines. Centers for disease control and prevention and the National institutes of health. Occupational safety and health administration. Recombinant DNA advisory committee(RDAC), Institutional biosafety committee(IBSC), Review committee on genetic manipulation(RCGM), Genetic engineering approval committee (GEAC). Implementation of biosafety guidelines.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Employ skills on laboratory safety and avoid laboratory accidents.	PO1, PO2, PO3, PO7, PO11	
CO2	Prevent laboratory hazards by practicing safety strategies.	PO2, PO5, PO7, PO11	
CO3	Practice various first aid procedures during common laboratory accidents.	PO1, PO2, PO3, PO5, PO10, PO11	
CO4	Ensure biosafety strategies in laboratory.	PO2, PO3, PO4, PO7, PO10, PO11	
CO5	Recognize the importance of biosafety guidelines.	PO3, PO4, PO5, PO7, PO10, PO11	
Text Books			
1.	Sateesh M. K. (2013). Bioethics and Biosafety, IK International Pvt Ltd. ISBN : 8190675702.		
2.	Muthuraj M. and Usharani B. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN 10: 1645878856		
3.	Biosafety in Microbiological and Biomedical Laboratories - U.S. Health Department and Human Services. (2016). (5 th Edition). Lulu.com.		
4.	Kanai. L. Mukherjee. (Medical Laboratory Technology(4 th Edition). CBS Publishers.		
5.	Ramakrishnan (2012). Manual of Medical Laboratory Techniques. JP brothers.		
References Books			
1.	World Health Organization, Biosafety programme management. (2010). (4 th Edition). WHO Publications.		
2.	Rashid N. (2013). Manual of Laboratory Safety (Chemical, Radioactive, and Biosafety with Biocides) (1 st Edition).		
3	Dayuan X. (2015). Biosafety and Regulation for Genetically Modified Organisms, Alpha Science International Ltd, ISBN-10 : 1842657917		
4.	Ochei J. Kolhatkar(2000). A. (Medical Laboratory Science – Theory and Practice. ISBN; 13:978-0074632239.		

5.	Lynne S. Garcia. Clinical Laboratory Management (2 nd Edition). ASM Press	
Web Resources		
1.	https://www.cdc.gov/labs/pdf/CDC-BiosafetymicrobiologicalBiomedicalLaboratories-2009-P.pdf	
2.	https://ucanapplym.s3.ap-south-1.amazonaws.com/RGU/notifications/E_learning/Online_study/PG-SEM-IV-Biosafety%20regulation.pdf	
3.	https://consteril.com/biosafety-levels-difference/	
4.	https://www.cdc.gov/labs/pdf/CDC-BiosafetymicrobiologicalBiomedicalLaboratories-2009-P.pdf	
5.	https://www.who.int/publications/i/item/9789240011311	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Tests	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	
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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
CO1	S	S	S				S				S			
CO2		S			S		S				S			
CO3	S	S	S		S					S	S			
CO4		S	S	M			S			S	S			
CO5			S	S	S		S			S	S			

