THE MAHATMA GANDHI UNIVERSITY

UNDERGRADUATE PROGRAMMES

(HONOURS) SYLLABUS

MGU-UGP (Honours)

(2024 Admission Onwards)

Faculty: Science

BoS: Microbiology (Combined UG/PG)

Programme: Bachelor of Science (Honours) Microbiology

Mahatma Gandhi University
Priyadarshini Hills
Kottayam – 686560, Kerala, India

Contents

Preface

As the Chairperson of the Board of Studies for Microbiology (combined), it is my distinct pleasure to present the syllabus for the Four-year Undergraduate Program in Microbiology according to the New Education Policy adopted by Kerala State Higher Education and MG University. This syllabus preparation reflects our commitment to ensuring that our curriculum remains dynamic, relevant, and responsive to the evolving needs of the field and the aspirations of our students.

In today's rapidly changing world, the study of microbiology plays a vital role in addressing global challenges such as infectious diseases, environmental sustainability, and biotechnological innovation. With this in mind, the present syllabus seeks to provide students with a comprehensive understanding of microbiology's fundamental principles, advanced concepts, and practical applications.

Drawing upon the expertise of our esteemed BoS members, faculty members, industry professionals, and academic partners, this syllabus incorporates the latest advancements in microbiology research, technology, and industry practices. It emphasises hands-on learning experiences, laboratory-based training, and interdisciplinary approaches to problem-solving, thereby equipping our students with the skills and knowledge necessary to thrive in diverse professional settings.

Furthermore, this syllabus underscores our commitment to fostering holistic development and critical thinking among our students. It incorporates elements of experiential learning, project-based assessments, and opportunities for research and innovation, empowering students to explore their interests, pursue their passions, and contribute meaningfully to the field of microbiology and beyond.

I sincerely appreciate all members of the Board of Studies, faculty members, stakeholders, and students who have contributed their insights, expertise, and feedback throughout the process. The support and enthusiasm provided by MG University are highly appreciable, I take this opportunity to thank the Syndicate members and Office staff who worked day and night to make this a reality. Organising the 5-day residential workshop and providing a Master trainer for the same by the university authorities is highly appreciated, without which this syllabus would not have been successfully prepared. Special thanks to Dr. Jithasha Balan, Coordinator of the workshop, Dr. Mohan S for overall arrangements for the workshop at Sree Sankara College and the Principal and Management for granting permission and providing facilities to conduct the workshop at SS College. The financial support from the university is gratefully acknowledged.

I am confident that this syllabus will inspire and empower our students to embark on a transformative educational journey that prepares them to make meaningful contributions to society, advance scientific knowledge, and embrace lifelong learning in the dynamic field of microbiology.

Chairperson,
Combined UG/PG Board of Studies in Microbiology

Board of Studies & External Experts

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Smt. Arabhi P., Assistant Professor, Department of Zoology, Baselius College, Kottayam.

Smt. Minu M., Assistant Professor, Department of Zoology, S.N.M. College, Maliankara.

Dr. Ganga G., Assistant Professor, Department of Microbiology, Sree Ayyappa College, Eramallillara.

Dr. Vinod N.V., Assistant Professor, Department of Microbiology, St. Pius X College, Rajapuram, Kasargod.

Syllabus Index

Name of the Major: Microbiology

Semester: 1

Course Code	Title of the Course	*Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					**L	T	P	O
MG1DSCMBG100	Unseen World of Microbes	DSC A	4	5	3	0	2	0
MG1MDCMBG100	Fascinating World of Microbes	MDC	3	4	2	0	2	0

*DSC- Discipline Specific Course; MDC- Multi-disciplinary course
**L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others

Semester: 2

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCMBG100	Perspectives of Microbiology	DSC A	4	5	3	0	2	0
MG2MDCMBG100	Beneficial microbes in daily life	MDC	3	4	2	0	2	0

Semester: 3

Course Code	Title of the Course		*Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG3DSCMBG200	General Microbiology		DSC A	4	5	3	0	2	0
MG3DSCMBG201	Microbial Genetics		DSC A	4	5	3	0	2	0
MG3DSEMBG200	Bioinstrumentation and Techniques	Any One	DSE	4	4	4	0	0	0
MG3DSEMBG201	Extremophiles, Geo and Astromicrobiology			4	4	4	0	0	0
MG3DSEMBG202	Biodiversity and Human Wellbeing			4	4	4	0	0	0
MG3DSCMBG202	Techniques in Microbiology		DSC B	4	5	3	0	2	0
MG3MDCMBG200	Public Health and Emerging Microbial Disease		MDC	3	3	3	0	0	0
MG3VACMBG200	Microbial products		VAC	3	3	3	0	0	0

*DSE-Discipline Specific Elective; SEC- Skill Enhancement Courses; VAC – Value Added Course

Semester: 4

Course Code	Title of the Course		Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG4DSCMBG200	Environmental Microbiology		DSC A	4	5	3	0	2	0
MG4DSCMBG201	Food Microbiology		DSC A	4	5	3	0	2	0
MG4DSEMBG200	Industrial Microbiology	Any One	DSE	4	4	4	0	0	0
MG4DSEMBG201	Computational Biology and Bioinformatics			4	4	4	0	0	0
MG4DSEMBG202	Dairy Microbiology			4	4	4	0	0	0
MG4DSCMBG202	Applied Microbiology		DSC C	4	5	3	0	2	0
MG4SECMBG200	Solid Waste Management		SEC	3	3	3	0	0	0
MG4VACMBG200	Sanitation Microbiology		VAC	3	3	3	0	0	0
MG4INTMBG200	Internship		INT	2					

Semester: 5

Course Code	Title of the Course		Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG5DSCMBG300	Agricultural Microbiology		DSC	4	5	3	0	2	0
MG5DSCMBG301	Essentials of Immunology		DSC	4	5	3	0	2	0
MG5DSEMBG300	Medical Bacteriology 1	Any Three	DSE	4	4	4	0	0	0
MG5DSEMBG301	Medical Parasitology			4	4	4	0	0	0
MG5DSEMBG302	Food Safety and Management			4	4	4	0	0	0
MG5DSEMBG303	Emerging and Re-Emerging Infections			4	4	4	0	0	0
MG5SECMBG300	Entrepreneurship in Microbiology		SEC	3	3	3	0	0	0

Semester: 6

Course Code	Title of the Course		Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG6DSCMBG300	Medical Bacteriology -2		DSC	4	5	3	0	2	0
MG6DSCMBG301	Medical Mycology		DSC	4	5	3	0	2	0
MG6DSEMBG300	Medical Virology	Any Two	DSE	4	4	4	0	0	0
MG6DSEMBG301	Microbiome and health			4	4	4	0	0	0
MG6DSEMBG302	Microbial Prospecting			4	4	4	0	0	0
MG6DSEMBG303	Forensic DNA Analysis and Profiling			4	4	4	0	0	0
MG6SECMBG300	Diagnostic Microbiology		SEC	3	4	2	0	2	0
MG6VACMBG300	Good Manufacturing Practices		VAC	3	3	3	0	0	0

Semester: 7

Course Code	Title of the Course	*Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG7DCCMBG400	Advanced Immunology	DCC	4	5	3	0	2	0
MG7DCCMBG401	Molecular Microbiology and Genetic Engineering	DCC	4	4	4	0	0	0
MG7DCCMBG402	Microbial Process Technology	DCC	4	4	4	0	0	0
MG7DCEMBG400	Research Methodology and Biostatistics	DCE	4	4	4	0	0	0
MG7DCEMBG401	IPR and Bioethics in Microbiology	DCE	4	4	4	0	0	0
MG7DCEMBG402	AMR and One Health Approach	DCE	4	4	4	0	0	0

*DCC- Discipline Specific Capstone Course

Semester: 8

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG8DCCMBG400	Advanced Techniques in Microbiology	DCC	4	4	4	0	0	0
MG8DCCMBG401	Microbial Nanotechnology	DCC	4	4	4	0	0	0
MG8DCEMBG400	Microbial Quality Control and Testing	DCE	4	6	2	0	4	0
MG8DCEMBG401	Microbial Inoculants and Mushroom Cultivation	DCE	4	6	2	0	4	0
MG8DCEMBG402	Pharmaceutical Microbiology	DCE	4	5	3	0	2	0
MG8PRJMBG400	Project (Research / Honours)		12					

Appendix I

Name of the Minor : Food Microbiology

Syllabus Index

Semester: 1

Course Code	Title of the Course	*Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					** L	T	P	O
MG1DSCMBG101	Wonders of the Microbial World	DSC	4	5	3	-	2	-
MG1MDCMBG101	Microbiology in Everyday Life	MDC	3	4	2	-	2	-

*DSC- Discipline Specific Course; MDC- Multi-disciplinary course; DSE-Discipline Specific Elective; SEC-Skill Enhancement Courses; VAC – Value Added Course
**L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

Semester: 2

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCMBG101	Microbial Physiology and Food Microbiology	DSC	4	5	3	-	2	-
MG2MDCMBG101	Industrial and Entrepreneurial Microbiology	MDC	3	4	2	-	2	-

Semester: 3

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG3DSCMBG203	Foodborne Diseases, Food Sanitation and Food Safety	DSC	4	5	3	-	2	-
MG3MDCMBG201	Applied Microbiology	MDC	3	3	3	-	0	-
MG3VACMBG201	Sensory Evaluation of Foods	VAC	3	3	3	-	0	-

Semester: 4

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG4DSCMBG203	Foodborne Diseases, Food Sanitation and Food Safety	DSC	4	5	3	-	2	-
MG4SECMBG201	Fundamentals of Microbiological Analysis of Food and Water	SEC	3	3	3	-	0	-
MG4VACMBG201	Microbial Perspectives in Disaster Response and Forensic Investigations	VAC	3	3	3	-	0	-

Semester: 7

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG7DSEMBG400	Instrumentation and Advances in Food Analysis	DSE	4	4	4	-	0	-
MG7DSEMBG401	Food Biotechnology, Metabolic Engineering and Bioprocess Technology	DSE	4	4	4	-	0	-
MG7DSEMBG402	Nutraceutical Science	DSE	4	4	4	-	0	-

Appendix-II

Name of the Minor: **Medical Microbiology**

Semester: 1

Course Code	Title of the Course	*Type of the course	Credit	Hours/ week	Hour Distribution /week			
					** L	T	P	O
MG1DSCMBG102	Understanding microbial world	DSC	4	5		3	2	
MG1MDCMBG102	World of microbes	MDC	3	4		2	2	

*DSC- Discipline Specific Course; MDC- Multi-disciplinary course; DSE-Discipline Specific Elective; SEC-Skill Enhancement Courses; VAC – Value Added Course
**L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

Semester: 2

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCMBG102	Unveiling the applications of microbiology	DSC	4	5		3	2	
MG2MDCMBG102	Microbes in Daily Life	MDC	3	4		2	2	

Semester: 3

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG3DSCMBG204	Microbes of medical importance	DSC	4	5		3	2	
MG3MDCMBG202	Public Health Microbiology	MDC	3	3		3		
MG3VACMBG202	Microbial products in health industry	VAC	3	4		2	2	

Semester: 4

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG4DSCMBG204	Medical Microbiology: Clinical Perspective	DSC	4	5		3	2	
MG4SECMBG202	Biomedical and solid Waste management	SEC	3	4		2	2	
MG4VACMBG202	Sanitation microbiology	VAC	3	4		2	2	

Semester: 5

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG5SECMBG301	Bioentreprenuership development	SEC	3	4		2	2	

SEMESTER-I

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**UNSEEN WORLD OF MICROBES**					
Type of Course	**DSC A**					
Course Code	**MG1DSCMBG100**					
Course Level	**100 - 199**					
Course Summary	The course on the UNSEEN WORLD OF MICROBES provides a comprehensive knowledge of microbiology fundamentals like history, microbial diversity, scope and current trends of the subject. Students will gain hands-on experiments on the fundamentals of laboratory practices in handling microorganisms.					
Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Knowledge of plus two level basic science subjects.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the history and important personalities who contributed to the development of Microbiology and the Scope of Microbiology.	R	2
2	Understand different methods of Classification of Microorganisms and Current trends in Microbiology.	R	3,10
3	Understand the diversity of the microbial world and the Visualisation of microbes.	U	2
4	To identify the basic Laboratory Practices and to experiment with basic staining techniques for observation of bacteria and fungi.	A	1,5,8,10
5	Teacher-specific contents.		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Definition and history of microbiology. Spontaneous generation. Biogenesis versus abiogenesis. Contributions of Antony van Leeuwenhoek, Francesco Redi, Louis Pasteur, Robert Koch, Alexander Flamming, Joseph Lister and Edward Jenner	16	1
	1.2	Different fields of Microbiology -Medical and Public health microbiology, Immunology, Agricultural microbiology, Microbial ecology, food and dairy microbiology, Microbial genetics and molecular biology – role of a microbiologist		1
2	2.1	Levels of classification. Linnaeus' two-kingdom classification, Haeckel's three-kingdom concept. Carl Woese's three-domain classification. Whittaker's five kingdom classification	14	2
	2.2	Brief account on Current trends- Molecular medicine, Personalised medicine, Preventive medicine, Gene therapy, Antimicrobial peptides of microbial origin		2
3	3.1	Difference between prokaryotes and eukaryotes. Different groups of Microorganisms –Brief description of Bacteria, Viruses, Fungi, and Protozoa. Differentiate between archaebacteria and eubacteria—beneficial and harmful microbes	15	3
	3.2	Visualisation of microbes – Microbiological stains, Types of dyes based on chemical behaviour, smear preparation for staining, simple staining.		3
4	4.1	**Hands-on Training on** Introduction to laboratory practices. Preparation of smears for staining. Microscopy – simple staining, Negative staining, LPCB Staining of any fungus, Staining of yeast	30	4
5		**Teacher Specific Contents**		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td colspan="4">Total 25 Total 15*
* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td colspan="2">Total: 50 marks</td><td>Total</td><td>35**
** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
3. Ananthanarayanan and Paniker's (2020) Textbook of Microbiology 11th edition, Universities Press publishes.
4. Dr.C.B.Powar& H.F.Daginawala. General Microbiology (Vol-I), Himalaya Publishers.
5. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood and Chris Wolverton
6. Dubey R.C. and Maheswary A K., (2018) A textbook of Microbiology, S. Chand Publications
7. Aneja K.R. 2020 Experiments in Microbiology, Plant Pathology and Biotechnology sixth edition, New Age International Publications Private Limited

SUGGESTED READINGS

1. Daniel Lim, (1997), Microbiology Brown (William C.) Co, U.S.; 2nd edition.
2. Topley & Wilson's Microbiology and Microbial Infections (1998), 8 volumes, sixth edition, Hodder Arnold, London.

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**FASCINATING WORLD OF MICROBES**					
Type of Course	**MDC**					
Course Code	**MG1MDCMBG100**					
Course Level	**100 – 199**					
Course Summary	This course FASCINATING WORLD OF MICROBES aims to provide students with a comprehensive introduction to microbiology including its history, diversity, benefits and harmful effects.					
Semester	I	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Knowledge of 10th-level basic science subjects.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Remember** the historical aspects of microbiology by studying the various contributions of scientists in the development of microbiology and the diversity of microorganisms in our World.	R	2,6,10
2	Develop **an interest** in creating different beneficial products using microbes and the role of harmful microbes	I	1,2,4,6, 10
3	Understand different methods for observing bacteria.	U	2
4	Teacher specific Content		
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	History and development of microbiology, Biogenesis Vs abiogenesis, Contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming and Edward Jenner.	14	1
	1.2	Mention Whittaker's five-kingdom classification—types of microorganisms (bacteria, fungi, virus, protozoa): A brief description.		1
2	2.1	Beneficial Roles - The food industry (bread, pickles, vinegar), Pharmaceutical industry (Antibiotics, vaccines), Agriculture (biofertilisers (nitrogen & phosphate solubilisers; and biopesticide) and Normal flora of human beings	16	2
	2.2	Harmful Role : Bacterial diseases (E. coli, Salmonella, Mycobacterium), Viral diseases (Chicken pox, Nipha, Corona), Fungal diseases (Candida sp., Aspergillus sp., Tinea sp.), Food spoilage (milk, fish and meat)		2
3	3.1	1. Testing the quality of milk (MBRT, SPC) 2. Microscopic demonstration of Nitrogen fixing bacteria from root nodule –Rhizobium, Lactobacilli from curd.	30	3
4		Teacher specific Content		

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➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<tr><td>Seminar</td><td>2.5</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>2.5</td><td>Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>15</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="2">End Semester Evaluation (ESE)</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 1mark Any 10 out of 12</td><td>10 X 1 = 10</td><td>Experiments</td><td>25</td></tr>
</table>

	2 Credit Theory: 35 Marks Time: 1.5 Hours **1 Credit Practical: 17.5 Marks**	Part - B: 5 Marks Any 3 out of 6	3 X 5 = 15	Record	5
		Part- C: 10 Marks Any 1 out of 2	10 X 1 = 10	Viva voce	5
				Total	**35****
		Total:	**35 marks**	** Adjusted to 17.5 Marks for final calculation	

References

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
3. Ananthanarayanan and Paniker's (2020) Textbook of Microbiology 11th edition, Universities Press publishes.
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5. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood and Chris Wolverton
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SEMESTER-II

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Perspectives of Microbiology**					
Type of Course	**DSC A**					
Course Code	**MG2DSCMBG100**					
Course Level	**100 - 199**					
Course Summary	The course on Perspectives of Microbiology provides a comprehensive knowledge of the morphology, nutrition, reproduction, growth and cultivation of microorganisms.					
Semester	2	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Knowledge of plus two level basic science subjects					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Outline the morphology of bacteria, viruses and fungi.	U	2
2	Summarise the nutritional types, requirements and different culture media for bacterial cultivation.	U	3 10
3	Explain the reproduction, growth curve and enumeration of microbes.	U	2 10
4	Demonstrate the basal, differential and enriched media for the cultivation of bacteria. Cultivation of bacteria by streak plate method, agar slants and deeps	U	2
5	Teacher specific content		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Morphological diversity of microbes - Size, Shape and arrangement of bacterial cells.	15	1
	1.2	A brief study on the morphology of viruses- capsids, envelopes, genomes.		1
	1.3	General morphological characteristics of fungi and yeast.		1
2	2.1	Nutritional requirements – Physical factors and chemical - Macronutrients, micronutrients and growth factors. Temperature, pH, oxygen and pressure	18	2
	2.2	Nutritional Types – based on carbon, energy and electron source		2
	2.3	Classification based on (a) consistency-solid, liquid, semisolid (b) function- Simple media, Complex Media, Defined media Special media- Enriched, Enrichment, Selective, Differential, Indicator, Transport and Anaerobic media. (three examples for each media)		2
3	3.1	Multiplication in bacteria-binary fission, budding and fragmentation.	12	3
	3.2	Growth curve – phases of growth and their significance		3
	3.3	Enumeration of bacteria - Viable count- SPC, Total count-Direct Microscopic Count and turbidimetric method		3
4	4.1	1. Culture media preparation- Basal media – Peptone water, Nutrient broth, nutrient agar. Differential media- MacConkey agar. Enriched media- Blood agar, chocolate agar. 2. Dispensing media in test tubes and Petridish and Preparation of agar slants, agar deeps, and agar plates. 3. Demonstration of culture methods- Streak Plate method	30	4
5		Teacher specific content		

	Classroom Procedure (Mode of transaction)

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<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks Any 10 out of 12</td><td>10 X 2 = 20</td><td>Experiments</td><td>25</td></tr>
<tr><td>Part - B: 5 Marks Any 4 out of 6</td><td>4 X 5 = 20</td><td rowspan="2">Record</td><td rowspan="2">5</td></tr>
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References

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
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SUGGESTED READINGS

1. Daniel Lim, (1997), Microbiology Brown (William C.) Co, U.S.; 2nd edition.
2. Topley & Wilson's Microbiology and Microbial Infections (1998), 8 volumes, sixth edition, Hodder Arnold, London.

Mahatma Gandhi University
Kottayam

Programme					
Course Name	**BENEFICIAL MICROBES IN DAILY LIFE**				
Type of Course	**MDC**				
Course Code	**MG2MDCMBG100**				
Course Level	**100 - 199**				
Course Summary	The course on BENEFICIAL MICROBES IN DAILY LIFE would provide students with a holistic understanding of the diverse roles of beneficial microbes in various domains emphasising their positive impact on human health and the food industry.				
Semester	II	Credits		3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial / Practical	Others	
		2	0 / 1	0	60
Pre-requisites, if any	Knowledge of tenth-level basic science subjects.				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Understand** microbiology and its relevance in our daily lives.	U	2
2	**Analyse the Production of** different varieties of fermented foods at home and the best methods for food preservation.	An	1 3 6 10
3	**Apply** the technique in day-to-day life to meet living expenses.	A	1 2 6 8 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Microbiology in and around us: Microbial flora of air, water, soil and human	12	1
	1.2	Microbes in the food industry- Fermented Foods – Types, nutritional values and health benefits. Probiotics, prebiotics, synbiotics and nutraceuticals		1
2	2.1	Fermented food products: 1. Alcoholic-Wine, Beer and cider 2.Non-Alcoholic-Coffee ,tea & Dairy products, Curd, Butter	18	2
	2.2	Introduction to preservation, types of preservation, natural and artificial preservative agents.		2
	2.3	Methods of preservation: thermal process, drying and dehydration, cooking and freezing, food preservation by chemicals, minimal processing of fresh foods.		2
3	3.1	**HANDS-ON TRAINING:** 1. Mushroom cultivation (any one) 2. Cheese production 3. Wine production	30	3
4		Teacher specific content		

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<tr><td>Part -A: 2 marks Any 10 out of 12</td><td>10 X 1= 10</td><td>Experiments</td><td>25</td></tr>
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	(ESE) **2 Credit Theory: 35 Marks** **Time: 1.5 Hours** **1 Credit Practical: 17.5 Marks**				
		Part - B: 5 Marks Any 4 out of 6	3 X 5 = 15	Record	5
		Part – C: 10Marks Any 1 out of 2	1 X 10 = 10	Viva voce	5
		Total:	**35 marks**	**Total**	**35****
				** Adjusted to 17.5 Marks for final calculation	

References

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
2. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
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7. Aneja K.R. 2020 Experiments in Microbiology, Plant Pathology and Biotechnology sixth edition, New Age International publications Private Limited
8. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
9 Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India

SUGGESTED READINGS

1. Daniel Lim, (1997), Microbiology Brown (William C.) Co, U.S.; 2nd edition.
2. Topley & Wilson's Microbiology and Microbial Infections (1998), 8 volumes, sixth edition, Hodder Arnold, London.

SEMESTER-III

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**GENERAL MICROBIOLOGY**					
Type of Course	**DSC A**					
Course Code	**MG3DSCMBG200**					
Course Level	**200 - 299**					
Course Summary & Justification	The course on 'General Microbiology' provides comprehensive knowledge on the fundamentals of microbiology like taxonomy, anatomy, identification and culturing of bacteria, and control of microorganisms. Students will gain hands-on experiments on the fundamentals of laboratory practices in handling microorganisms.					
Semester	III	Credits			4	Total Hours
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Completion of a minimum of two courses related to the microbiology subject					
Course Outcomes (CO)						

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Explain the concept of bacterial taxonomy and anatomy	U	1, 4
2	Demonstrate fundamental techniques used for the identification and culturing of aerobic and anaerobic bacteria.	U	2, 4,1
3	Apply the physical, chemical and chemotherapeutic methods used in the control of microorganisms.	A	2, 4,5, 10
	HANDS-ON TRAINING		
4	To understand the principles of staining techniques, hanging drop and culture techniques in bacteriology. To demonstrate staining techniques, hanging drop and culture techniques	U	2, 6
5	Teacher Specific Contents		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Bacterial Taxonomy & Anatomy**	21	
	1.1	Principles and methods of bacterial classification-phenetic, phylogenetic and intraspecies classification. Numerical taxonomy, A Brief Account of Bergey's Manual of Systematic Bacteriology		1
	1.2	Ultrastructure and functions of prokaryotic cell structures. Structures external to Cell wall- Extra polymeric substances – Capsule, slime layer and glycocalyx, flagella-ultra structure and arrangement, fimbriae and pili.		1
	1.3	Cell wall: Composition and detailed structure of Gram-positive cell wall-peptidoglycan, teichoic acid and Gram-negative cell wall- lipopolysaccharide (endotoxin), peptidoglycan.		1
	1.4	Structures internal to cell wall- Cell membrane, Bacterial nucleoid, plasmids, ribosomes, mesosomes, inclusion bodies. Endospore: Structure, types, stages of sporulation and germination.		1
2		**Bacteriological techniques- Staining and Culture methods**	12	
	2.1	**Staining Techniques:** Staining methods- principle and procedure of a) Differential staining -Grams and acid-fast staining b) Structural / Special staining - endospore, capsule, volutin granule, flagella staining.		2
	2.2	**Culture methods:** Pure Culture Techniques- Streak plate method, Spread plate method, Pour plate method, Lawn culture, Stab culture and Stroke culture Broth culture.		2
	2.3	Anaerobic culture methods – Production of vacuum, Absorption of oxygen, Anaerobic jar-candle jar and McIntosh jar, Gaspak method, use of reducing agents.		2
3		**Control of microorganisms**	12	
	3.1	**Physical methods**: Principles and applications- sunlight, drying, Heat:- dry heat-flaming, red heat, incineration, hot air sterilisation, moist heat-temperature below 100 degrees, temperature at 100 degrees and above 100 degrees. Filtration, Radiation- ionizing and nonionizing, Ultrasonic and sonic vibration.		3
	3.2	**Disinfection**. Disinfectants- mode of action and uses, Testing of disinfectants-phenol coefficient.		3

	3.3	Antibacterial antibiotics- mode of action and uses.		3
4		**Hands-on training.**	30	
	4.1	1**.** Principle and working of bright field microscope**.** **Staining techniques-** 2. Gram's stain. 3. Capsule stain- Maneval method. 4. Volutin granule -Albert's method. 5. Endospore staining.		4
	4.2.	**Culture methods** 6**. P**late (quadrant streak) 7. Spread plate, Pour plate. 8. Stab and Stroke culture. 9. Broth culture.		4
	4.3	**Motility test** 10. Hanging drop technique		4
5		Teacher Specific Contents		

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References

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5. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood, and Chris Woolverton (2017). Prescott's Microbiology. 12th Edition, Singapore: McGraw-Hill Education.
6. Gerard J. Tortora, Microbiology an introduction. (2015), 13th Edition, United Kingdom: Pearson.
7. James G Cappuccino and Natalie Sherman (2014) Microbiology laboratory manual, 11th Edition, United Kingdom: Pearson.
8. Mackie and McCartney, Microbiology: Principles and Explorations by Jacquelyn G. (1996), 15th Edition, India: Churchill Livingstone.
9. K.Rajeshwar.Reddy, Microbiology and Parasitology. Reddy, K. R. (2010). Microbiology and Parasitology: Question and Answer Review.5th Edition, India: Paras Medical Publisher.

SUGGESTED READINGS

1. Aneja K.R. 2020 Experiments in Microbiology, Plant Pathology and Biotechnology sixth edition, New Age International publications Private Limited
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3. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) microbiology**					
Course Name	**Microbial Genetics**					
Type of Course	**DSC A**					
Course Code	**MG3DSCMBG201**					
Course Level	**200 - 299**					
Course Summary	The course on 'Microbiology Genetics' provides a basic concept of the genomic organization of bacteria & experiments, genetic mechanisms and mutation. Students will gain hands-on experiments on the isolation of bacterial DNA.					
Semester	III		Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Completion of a minimum of two papers related to the microbiology subject					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand the basic concepts of genomic organization of bacteria & experiments	U	1 2
2	Distinguish the genetic exchange mechanisms in bacteria Analyse the molecular mechanism involved in bacterial gene expression	An	2 1
3	Identify the concepts of mutation and repair mechanisms in bacteria	An	1 2
	Hands-On Training		
4	Demonstrate the isolation of Bacterial DNA	U	2 6
4	To understand the bacterial mutagenesis with UV radiation	U	2 6
5	Teacher Specific Contents		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Experiments to prove DNA as the genetic material-** Griffith's experiment, Avery-MacLeod-McCarty experiment, and Hershey-Chase experiment.	12	1
	1.2	**Bacterial Chromosome-** structure, function, Organization **DNA replication in bacteria-** Mechanism		1
	1.3	**Extrachromosomal genetic material in bacteria**: **Their role in adaptation and survival: Plasmids-** R plasmid, F plasmid, Col Plasmid, Rolling circle replication-mechanism. **Mobile genetic elements and their significance:** transposons- IS elements, Composite. Transposition - Cut & Paste Mechanism.		1
2	2.1	**Genetic exchange- :** Experiments and Mechanism of transformation, transduction(Generalised, Specialised)	22	2
	2.2	Conjugation (F^+-F^- and Hfr-F^-), U-tube Experiment		2
	2.3	Transmission of drug resistance through horizontal gene transfer- Transposons, transformation and transduction		2
	2.4	. **Gene expression in prokaryotes** - Central Dogma, Transcription, Translation, Enzymes involved		2
	2.5	Control of Gene Expression in Prokaryotes – Induction, Repression, Positive Control, Negative Control – based on Lac operon Concept		2
3	3.1	**DNA damage**-Mutation - Spontaneous - base pair changes-deletion, addition, frameshift, tautomerism, **Induced mutation** -Mutagens:- Physical agents- X rays, Gamma rays, U V rays. Chemical agents- Base analogues, intercalating agents.	11	3
	3.2	Useful phenotypes of mutants (Auxotrophs, conditional, lethal, resistant). Ames test.		3
	3.3	**DNA repair in bacteria**- Photo reactivation and Excision Repair.		3
4		**HANDS-ON TRAINING**	30	
	4.1	To isolate bacterial DNA		4
	4.2	To determine the bacterial mutagenesis with UV radiation - Loss of Pigmentation - Reduced Viability - Changes in the cell wall nature		4
	4.3	To isolate Streptomycin resistant mutant in a Phototrophic bacterial Population.		4
5		**Teacher Specific Contents**		

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References:

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2. Dubey, R. C., and D. K. Maheshwari. *Practical Microbiology,* 5th Edition, S. Chand Publications, 2002.
3. Maloy, Stanley R., John E. Cronan, and David Michael Freifelder. "Microbial genetics." (1994). 2nd Edition, India: Jones and Bartlett.
4. Molineux, Ian J. "Phage and the Origins of Molecular Biology." (2008)
5. Rastogi, Veer Bala. *Fundamentals of Molecular Biology*. 2nd edition Ane Books Pvt Ltd, (2008)
6. Willey, Joanne M., Linda M. Sherwood, and Christopher J. Woolverton. *Prescott, Harley, and Klein's microbiology*.7th Edition, McGraw-Hill, 2008.

Suggested Reading:

1. Klug WS, Cummings MR, Spencer C, Paladino (2011). Concepts of Genetics, 10th Edition, Benjammin Cummings
2. Russell PJ (2009). *I* Genetics- A Molecular Approach. 3rd Edition, Benjamin Cummings.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**BIOINSTRUMENTATION AND TECHNIQUES**					
Type of Course	**DSE**					
Course Code	**MG3DSEMBG200**					
Course Level	**200 - 299**					
Course Summary	The course on 'Bioinstrumentation and Techniques' provides a basic concept of Principles, working and application of different microscopes, Centrifuge, Electrophoresis and Molecular Techniques.					
Semester	III		Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Completion of a minimum of two courses related to the microbiology subject					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Distinguish the Principle, working and application of Light, Dark, Phase contrast, fluorescent, Confocal microscope and Electron microscope	An	1,4,10
2	Understand the Principle and application of Differential centrifugation and Density gradient centrifugation.	U	1,4,10
3	Compare the Principle, application and types of Electrophoresis and Blotting techniques.	An	1,2,4,10
4	Understand Beer Lamberts Law, Principle, instrumentation and application of Colorimetry, Turbidometry, UV & Visible Spectrophotometry	U	1,4,10
5	Explain the Principle and application of PCR, Molecular markers - RFLP, RAPD, VNTR & DNA fingerprinting.	E	1,2,4,10

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Microscopic techniques** Microscopy- Principle, Instrumentation and Application – Introduction- Magnification, Resolution, and Numerical aperture.	20	1
	1.2	Principle, design, working, applications, advantages and disadvantages of Light, Dark, Phase contrast, fluorescent, Confocal microscope.		
	1.3	Electron Microscope – SEM and TEM. Chromatic Aberration.		
2	2.1	Principles, Instrumentation and application of Differential centrifugation, Density gradient centrifugation.	15	2
	2.2	**Electrophoretic Techniques** Basic Principle and application of Electrophoresis: AGE, PAGE, SDS PAGE. Two-dimensional electrophoresis		
	2.3	Blotting techniques: Southern, Northern, and Western hybridization		
3	3.1	**Spectrophotometric Techniques** Beer Lambert's Law. Basic principles and application of colourimetry and turbidometry.	15	3
	3.2	Spectrophotometry: Principles, working and application – UV, Visible Spectrophotometry.		
4	4.1	**Introduction to Molecular Techniques** PCR- Steps and application, Types – Nested PCR, Multiplex.	10	4
	4.2	Molecular markers - RFLP, RAPD, VNTR. DNA fingerprinting.		
5		Teacher Specific Content	0	

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4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="4">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks

Time: 2 Hours</td><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References

1. Boyer, R. (2000). *Modern experimental biochemistry*.3rd Edition, Pearson Education India.
2. Jogdand, S. N. (2009). *Gene biotechnology*. 4th Edition, Himalaya Publishing House.
3. Karp, G. (2009). *Cell and molecular biology: concepts and experiments*. 9th Edition, John Wiley & Sons.
4. Mohan P Arora *Biophysics,* 2nd Edition, Himalaya Publishing House
5. Pattambiraman (2015) *Practical Biochemistry*, 4th Edition, All Indian Publisher;
6. Singh, B. D. (2005). *Biotechnology*.12th Edition, Campus Books International.
7. Upadhyay, A., Upadhyay, K., & Nath, N. (1993). Biophysical chemistry principles and techniques. Himalaya Publishing House
8. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008). *Prescott, Harley, and Klein's microbiology*. 7th Edition, McGraw-Hill.
9. Wilson, K., & Walker, J. M. (Eds.). (2000). *Practical biochemistry: principles and techniques*. 5th Edition, Cambridge University Press.

Suggested reading:

1. Webster, J. G. (Ed.). (2003). *Bioinstrumentation*. John Wiley & Sons.
2. Singh, M. (2014). *Introduction to biomedical instrumentation*. PHI Learning Pvt. Ltd.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Extremophiles, Geo & Astromicrobiology**					
Type of Course	DSE					
Course Code	**MG3DSEMBG201**					
Course Level	**200 - 299**					
Course Summary & Justification	The course on 'Extremophiles, Geo & Astromicrobiology' provides a basic concept of extremophiles and their adaptations to extreme conditions. Students will get an idea of the challenges and opportunities of microbial life in space.					
Semester	III	Credits			4	Total Hours
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites	Basic knowledge of microbial diversity					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the concept of extremophiles and their adaptations to extreme conditions.	U	1,2
2	Explain the role of microorganisms in geochemical processes on Earth.	U	1,2
3	Analyze the challenges and opportunities of microbial life in space	An	1,2,3,9
4	Explain the applications of extremophiles in Biotechnology and human health	A	1,2,3,9,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1		**Introduction to Extreme Environments**	15	
	1.1	Introduction to extremophiles-Classification of extreme environments- Deep-sea hydrothermal vents, Acidic and alkaline environments, High-temperature environments, Low temperature-Polar environments. Permafrost microbiology		1
	1.2	Types of extremophiles-thermophiles, psychrophiles, halophiles, acidophiles, alkalophiles, methanogenic extremophiles.		1
	1.3	Microbial Adaptations to Extreme Conditions Molecular and physiological adaptations		1
2		**Geochemical Processes and Microbial Life**	15	
	2.1	Role of Extremophiles in geochemical cycles – C, S, P		2
	2.2	Role of microorganisms in mineral weathering, bio corrosion, bioleaching, biomining		2
	2.3	Microbial contributions to soil formation		2
3		**Space Exploration and Astrobiology**	15	
	3.1	Overview of astrobiology: Search for life beyond Earth, Exo microbiology. Brief account on space missions (Mars missions, Chandrayaan mission) and their astrobiological implications		3
	3.2	Microbial survival in space -Contamination concerns in space exploration Spacecraft sterilization techniques.		3
	3.3	Life Detection Techniques in Space: A Brief Account of Instruments for life detection, Challenges in detecting microbial life, bio-waste management in spacecraft or space stations.		3
4		**Extremophiles in Biotechnology & Human Health**	15	
	4.1	Industrial applications of extremophiles Enzymes from extremophiles		4
	4.2	Bioremediation using extremophiles		4
	4.3	Extremophiles and medicine. Microbial extremophiles in biopharmaceuticals. Therapeutic applications		4

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<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="12">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="7">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
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<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
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Time: 2 Hours</td><td colspan="2">Theory</td></tr>
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Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
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</table>

References

1. Annette Summers Engel, Daniel L. Hatten Dorf, and John M. Parks. Microbial Life of Cave Systems
2. Bell, E. M. (Ed.). (2012). *Life at extremes: environments, organisms and strategies for survival*. Cabi.
3. Ehrlich's Geomicrobiology. (2015). United Kingdom: CRC Press.
4. Francisco J. de Jesus Benevides Costa, FabianoJaresContesini, and Laura Montes de Oca Naranjo.
5. Gerard J. Tortora, Microbiology an introduction. (2015), 13th Edition, United Kingdom: Pearson.
6. Plaxco, K. W., Gross, M. (2011). Astrobiology: A Brief Introduction. 2nd Edition, United States: Johns Hopkins University Press.
7. Preston, L. J., & Dartnell, L. R. (2014). Planetary habitability: lessons learned from terrestrial analogues. *International Journal of Astrobiology*, *13*(1), 81-98.
8. Raddadi, N., Cherif, A., Daffonchio, D., Neifar, M., & Fava, F. (2015). Biotechnological applications of extremophiles, extremozymes and extrapolates. *Applied microbiology and biotechnology*, *99*, 7907-7913.
9. Ricardo Amils, Cynan Ellis-Evans, and Helmut Hinghofer-Szalkay. Amils, R., Ellis-Evans, C., Hinghofer-Szalkay, H. G. (2007). Life in Extreme Environments Germany: Physica-Verlag.
10. Schaechter, M., Ingraham, J. L., Neidhardt, F. C. (1997). Beginning, Microbiology. United Kingdom: Cogito.6. Planets and Life: The Emerging Science of Astrobiology by Woodruff T. Sullivan III.

11. Shu, W. S., & Huang, L. N. (2022). Microbial diversity in extreme environments. *Nature Reviews Microbiology*, *20*(4), 219-235.
12. Stetter, K. O. (1999). Extremophiles and their adaptation to hot environments. *FEBS letters*, *452*(1-2), 22-25.
13. Wiley. Extremophiles: Microbial Life in Extreme Environments. (1998). United Kingdom:

SUGGESTED READINGS

1. Kirby, B. M., Easton, S., Marla Tuffin, I., & Cowan, D. A. (2011). Bacterial diversity in polar habitats. *Polar microbiology: life in a deep freeze*, 1-31.
2. Rampelotto, P. H. (2013). Extremophiles and extreme environments. *Life*, *3*(3), 482-485.
3. Vishnivetskaya, T. A., Mironov, V. A., Abramov, A. A., Shcherbakova, V. A., & Rivkina, E. M. (2022). Biogeochemical Characteristics of Earth's Volcanic Permafrost: An Analog of Extraterrestrial Environments. *Astrobiology*, *22*(7), 812-828

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Biodiversity and Human Well-being**					
Type of Course	DSE					
Course Code	**MG3DSEMBG200**					
Course Level	**200 - 299**					
Course Summary & Justification	The course on 'Biodiversity and Human Well-being' provides basic concepts of biodiversity and its values.					
Semester	III	Credits			4	Total Hours
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites	Basic knowledge of Biodiversity					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand what is biodiversity and its values	U	2 3
2	Understand biodiversity in India and the world	U	3
3	To list the threats and methods of conservation of biodiversity	An	3 6
4	To relate biodiversity to health	A	9 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs.	CO No.
1		**An introduction to biodiversity**	15	1
	1.1	Biodiversity- definition; Types of biodiversity-species diversity, genetic diversity, ecological diversity.		1
	1.2	Biodiversity at global, national and local levels.		1
	1.3	Value of biodiversity: consumptive use, productive use, social; ethical; aesthetic and option values.		1
2		**Biodiversity in India and the World**	15	2
	2.1	India is a diverse nation, in the biogeographical classification of India.		2
	2.2	Hotspot in India, endemic & endangered species.		2
	2.3	IUCN objectives, IUCN in India, red list- categories, protected area categories- nature reserve, national park		2
3		**Threats and conservation of biodiversity**	15	3
	3.1	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflict.		3
	3.2	Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.		3
4		**Biodiversity and health**	15	4
	4.1	Freshwater, air quality, food security, nutritional impact, health research & traditional medicine, mental health		4
	4.2	Bioaccumulation, infectious diseases, climate change		4
5		Teacher Specific Contents		

<table>
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➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="10">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
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<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks

Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
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<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References

1. Anubha Kaushik, C. P Kaushik, Perspectives in Environmental Studies (Second Edition), New Age International (P) Limited Publishers.
2. Blaikie, P., & Jeanrenaud, S. (2013). Biodiversity and human welfare. In *Social change and conservation*. Routledge.Biodiversity and human health, Dr Bharat Paul.
3. Dobson A.P (1996), Conservation and Biodiversity, Scientific American Library, New York.
4. Erach Bharucha, Textbook of Environmental Studies for undergraduate courses (second edition), University Grants Commission.
5. Groombridge, B., & Jenkins, M. D. (2000). *Global Biodiversity: Earth's living resources in the 21st century*. World Conservation Press.IUCN (2004), Red list of threatened species- a global species assessment, IUCN Gland, Switzerland.
6. Kevin J Gaston, John I Spicer, Biodiversity: An Introduction (Second edition), Blackwell Publishing.
7. K.G Chandrasekharan Nair, Dipa S Krishnan, Yohannan Varghese, Systematic approach to Environmental management and human rights, Chand Publications (B Com Vth Sem- M G University).
8. Loreau M, Inchausti P, Biodiversity and ecosystem functioning: synthesis and perspectives, Oxford University Press, Oxford (2002).

Suggested Reading:

1. Hosetti, B. B. (2002). *Glimpses of biodiversity*. Daya Books.
2. Krishnamurthy, K. V. (2018). *An advanced textbook on biodiversity: Principles and practice*. Oxford and IBH Publishing.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**TECHNIQUES IN MICROBIOLOGY**					
Type of Course	**DSC B**					
Course Code	**MG3DSCMBG202**					
Course Level	**200 - 299**					
Course Summary	This course aims to give a basic idea of microbiology lab safety rules, techniques for isolating microorganisms and how to view a microorganism.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge of Instruments					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Outline the** aseptic techniques in microbiology lab	**U**	**1, 2,10**
2	**Classify** the different types of microbial culture media	**U**	**1, 2, 6, 10**
3	**Analyze** the different techniques for isolation and preservation of microorganisms	**A**	**1, 2, 6, 10**
4	**Apply** the techniques and instruments involved in the study of microorganisms	**Ap**	**1, 2, 6,10**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Microbiology Lab Practices and Control of Microorganisms**	12	
	1.1	General microbiology lab practices and safety rules		1
	1.2	Sterilization techniques used in microbiology (Principle and methods) Physical methods -Moist heat, Dry heat, Filters in microbiology, Pasteurization, Tyndallisation, Radiation		1
	1.3	Chemical methods, Aldehydes, Phenols, Halogens, Surface active agents, Metallic salt, Ethylene oxide.		1
2		**Different types of Culture media in microbiology (with examples)**	8	
	2.1	Components of media, Simple media, Synthetic media, Defined media, Complex Media, Selective media, Differential media Indicator media, Enriched media, Enrichment media, Transport media, Sugar media,		2
		Anaerobic media- Thioglycollate, anaerobic chamber, Robertson's media, microaerophilic.		
3		**Culture Methods and Preservation of Microorganisms**	15	
	3.1	Sample collection (soil, water, air)-Serial dilution, Spread plate, Pour plate, Streak plate, Study of colony characters		3
	3.2	Methods of maintenance and preservation of microbial cultures in the lab- Short-term method(Periodic transfer of fresh inoculums, Preservation using glycerol, Storage by drying method, Refrigeration)		3
	3.3	Long-term method (Mineral oil /liquid paraffin, Liquid nitrogen storage, Lyophilisation, Cryopreservation.		3
4		**Staining Techniques & Microscopy**	10	
	4.1	Staining- Simple staining, Differential staining, Negative staining, special staining, Wet mount technique		4
	4.2	**A brief study:** Light microscopy (Compound microscope, Phase contrast microscope, Fluorescent microscope) Electron microscopy (SEM and TEM)		4
	4.3	**HANDS-ON TRAINING:** Principle and operation:-Autoclave, Hot air oven, Laminar Airflow, Filtration- Membrane filter.		
		Study the parts of a microscope		
		Isolation of Bacteria: - Culture media preparation, serial dilution, streak plate, spread plate, pour plate.		

		Colony characteristic study (macroscopic)	30	
		Staining of bacteria:-Simple staining, differential staining –Gram staining, spore staining		
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning ➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning Laboratory instructions, Demonstration of methods & Hands-on experiments				
Assessment Types	**Mode of Assessment**				
	Continuous Comprehensive Assessment (CCA) **3 Credit Theory: 25 Marks** **1 Credit Practical: 7.5 Marks**	**Theory**		**Practical**	
		Component	Mark	Component	Marks
		Test/Quiz	10	Test/Quiz	5
		Seminar	10	Lab involvement	2.5
		Assignment	5	*Activity (related to teacher-specific content)	7.5
		Total	**25**	**Total**	**15***
		* Adjusted to 7.5 Marks for final calculation			
	End Semester Evaluation (ESE) **3 Credit Theory: 50 Marks** **Time: 2 Hours** **1 Credit Practical: 17.5 Marks**	**Theory**		**Practical**	
		Part -A: 2 marks Any 10 out of 12	10 X 2 = 20	Experiments	25
		Part - B: 5 Marks Any 4 out of 6	4 X 5 = 20	Record	5
		Part – C: 10Marks Any 1 out of 2	1 X 10 = 10	Viva voce	5
		Total:	**50 marks**	**Total**	**35****
				** Adjusted to 17.5 Marks for final calculation	

References

1. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
2. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
6. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.

7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education

Suggested Reading:

1. Burrows, W. (1954). Textbook of microbiology. *Textbook of microbiology.* (16th Edit).
2. Collins, C. H., & Lyne, P. M. (1970). Microbiological methods. *Microbiological methods,* (3rd. Edition).

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**PUBLIC HEALTH AND EMERGING MICROBIAL DISEASE**					
Type of Course	**MDC**					
Course Code	**MG3MDCMBG200**					
Course Level	200 - 299					
Course Summary	This course will review a series of current issues and controversies in the prevention and control of infectious diseases both from scientific and policy perspectives. It will also serve as a forum for students to debate the merits of these issues and controversies.					
Semester	**III**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Basic knowledge of infections.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PO No
1	**Understand** the importance of public health and hazards related to health.	**U**	**2,10**
2	**Identify** some food and water-borne diseases	**A**	**1, 2, 6,10**
3	**Solve the** situation when airborne infection happens in life.	**Ap**	**1,2,4, 6,10**
	Differentiate various vector-borne infections**.**	A	**1,2,6,8,10**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Definition, scope, concept and importance of public health, Roles of microbiologists in public health, Concept of health and disease.	10	**1**
	1.2	Basic concept of pollution (air, water, noise, radiation and waste pollution) and public health hazards in the community.		**1**
2	2.1	Introduction on sources of food and water-borne infections: Foodborne diseases, Transmission of pathogens and control measures.	15	**2**
	2.2	Waterborne diseases (Viral, bacterial, protozoa), Transmission of waterborne diseases and control of waterborne diseases. Water pollution and sanitation-Brief study		**2**
3	3.1	Introduction**:** Air and its composition, Sources of microbial air pollution & control**,** Microbial Indicator of air pollution.	20	**3**
	3.2	Airborne diseases: Transmission of pathogens, Respiratory infection (Viral, bacterial, fungal), Sources of infection, characters of organisms and control of Viruses (Nipha, Zika, SARS) Bacteria (Pneumonia, Meningitis, tuberculosis.		**3**
	3.3	Definition of vectors, the transmission of disease by vectors, vector-borne diseases and control measures. Mosquito, aquatic snail, lice, sand flies, tsetse fly, ticks, black flies		4
4		Teacher Specific Contents		

	Mode of Assessment
	Classroom Procedure (Mode of transaction)

<table>
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<tr><td>Part -A: 2 marks
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Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td></tr>
<tr><td>Total:</td><td>50 marks</td></tr>
</table>

REFERENCES:

1. Ananthanarayanan and Paniker's (2020) Textbook of Microbiology 12th edition, Universities Press publishes.
2. C.B.Powar&H.F.Daginawala.General Microbiology (Vol-I), Himalaya Publishers.
3. Daniel Lim, (1997), Microbiology Brown (William C.) Co, U.S.; 2nd edition.
4. William C Frazier, Food Microbiology.
5. Edelman,kudzma Mandle ,Health Promotion Throughout the life span
6. Jacquelin g Black, Microbiology Principles and Explorations.
7. K.Dass, Public Health and Hygiene 2021, Notion Press publishers
8. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
9. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood and Chris Wolverton
10. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

Suggested Reading:

1. Krasner, R. I., & Shors, T. (2014). *The microbial challenge: a public health perspective*. Jones & Bartlett Publishers.
2. Lederberg, J., Hamburg, M. A., & Smolinski, M. S. (Eds.). (2003). *Microbial threats to health: emergence, detection, and response*. National Academies Press.

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Microbial products**					
Type of Course	**VAC**					
Course Code	**MG3VACMBG200**					
Course Level	**200 - 299**					
Course Summary	This course provides the concepts of microbiology and its applications in pharma, food, agriculture, beverages and nutraceutical industries					
Semester	III	Credits			3	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Prerequisites, if any	Basic Knowledge of the application of Microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	To understand various Fermented food and food ingredients as the Fermentation Products	U	1,3,9,10
2	To understand the Microbes beneficial in health care	U	1.2.3.4.8. 10
3	To analyse the newer technologies and applications for microbes in human food	An	2,4,6,8,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Fermented food and food ingredients as the Fermentation Products**	20	
	1.1	General concepts of value addition – Nutritional profile of microbes Fermented milk – Acidophilus milk, Yoghurt, Kefir		1
	1.2	Fermented vegetables – Kanji. Gundruk, Soy sauce Fermented fruit drinks – Banana beer, Mango wine, Fruit vinegar: Amla Cider, Guava Cider		1
	1.3	Food Ingredients as the Fermentation Products and their application - Enzymes – protease, Amylase, Cellulase, Hemicellulase, Antimicrobials - Nisin, Lysozyme, Vitamins – B 2, B12, K, Sweeteners, Stabilizers.		1
2		**Microbes in Health**	17	
	2.1	**Cosmeceuticals** - Definition, Role of microbes in the cosmetic industry, major pigments and their applications in cosmetics. New advancements with microbes in cosmetic and skin care products.		2
	2.2	**Skinceuticals** – Normal flora of skin- bacteria, fungi and their role. Skin conditions requiring SkinCeuticals, Skin prebiotics and skin probiotics and their effect. Benefits of skinceuticals.		2
	2.3	**Neutraceuticals:** Synbiotics, prebiotics, probiotics, Health benefits, Challenges for probiotic formulations.		2
3		**Newer technologies and applications for microbes in human food**	8	
	3.1	Microbes as a protein source in human food Animal meat alternatives		3
	3.2	Other animal product alternatives - dairy and eggs.		3
	3.3	Obstacles and future developments in the path to adopting widespread use of Microbial foods.		3
4		Teacher Specific Content		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks</td><td colspan="3">Theory</td></tr>
<tr><td>Component</td><td colspan="2">Mark</td></tr>
<tr><td>Test/Quiz</td><td colspan="2">10</td></tr>
<tr><td>Seminar</td><td colspan="2">5</td></tr>
<tr><td>Assignment</td><td colspan="2">5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td colspan="2">5</td></tr>
<tr><td>Total</td><td colspan="2">25</td></tr>
<tr><td rowspan="4">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours</td><td colspan="3">Theory</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td colspan="2">10 X 2 = 20</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td colspan="2">4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td colspan="2">1 X 10 = 10</td></tr>
<tr><td>Total:</td><td colspan="2">50 marks</td></tr>
</table>

References:

1. Marco M.L., Heeney D., Binda S., Cifelli C.J., Cotter P.D., Foligné B., Gänzle M., Kort R., Pasin G., Pihlanto A., et al. Health benefits of fermented foods: Microbiota and beyond. *Curr. Opin. Biotechnol.* 2017;44:94–102. Doi 10.1016/j.copbio.2016.11.010.
2. Park K.Y., Jeong J.K., Lee Y.E., Daily J.W., 3rd Health benefits of kimchi (Korean fermented vegetables) as a probiotic food. *J. Med. Food.* 2014; 17:6–20. Doi: 10.1089/jmf.2013.3083.
3. Pedersen, C.S., (1979), *Microbiology of Food Fermentations*, AVI Publishers, USA
4. Stanton, R.W., (1985), *Food Fermentation in the Tropics*, in "Microbiology of Fermented Foods", edited by Wood, B.J.B., Elsevier Applied Science Publishers, UK.

Suggested Reading:

1. Espín, J. C., García-Conesa, M. T., & Tomás-Barberán, F. A. (2007). Nutraceuticals: facts and fiction. *Photochemistry*, *68*(22-24), 2986-3008.
2. Lockwood, B., & Rapport, L. (2007). *Nutraceuticals* (pp. 1-18). London: Pharmaceutical Press.
3. Souyoul, S. A., Saussy, K. P., & Lupo, M. P. (2018). Nutraceuticals: a review. *Dermatology and Therapy*, *8*, 5-16.

SEMESTER-IV

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**ENVIRONMENTAL MICROBIOLOGY**					
Type of Course	**DSC A**					
Course Code	**MG4DSCMBG200**					
Course Level	**200 - 299**					
Course Summary	The course will provide knowledge for conserving the environment and resolving environmental-related issues.					
Semester	IV	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	**1**	**0**	**75**
Pre-requisites, if any	Basic knowledge of soil and aquatic ecosystems.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To understand the contaminants in air and air sampling techniques	U	1,2, 10
2	To Remember the various aquatic ecosystems and familiarize the various organisms	An	1,2,10
3	To recognize the various pollutants in the environment using microorganisms	An	1, 2, 10
4	Hands-on Training	S	2, 6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	AEROBIOLOGY- Microbial contamination of air- Sources of contamination-Microbial indicators of pollution. Enumeration of bacteria in air, Air sampling devices	15	1
	1.2	Microbial indicators of pollution		
	1.3	Enumeration of bacteria in air, Air sampling devices		
2	2.1	Aquatic Microbiology: Microbiology of aquatic environment-fresh water (ponds, lakes, streams) marine(estuaries, mangroves, deep sea)	15	2
	2.2	Marine microflora and biofouling, Biofilm development		
	2.3	Water pollution and water-borne pathogens.- Bacteriological examination of water-indicator organisms Purification and disinfection of water. Microbiology of sewage – Wastewater treatment- BOD, COD		
3	3.1	Recycling of liquid and solid waste- Composting, Biogas Bioremediation –ex-situ and in-situ methods, Phytoremediation	15	3
	3.2	Microbial degradation of petroleum and petroleum products,		
	3.3	Pesticide degradation, microbial-enhanced oil recovery		
4	4.1	HANDS-ON TRAINING • MPN- Presumptive, Confirmative, Confirmed tests • Perform BOD/ DO • SPC from soil, water and air • Membrane filtration • Compost Preparation Screening of petroleum degradation by microbes	30	4
5		Teacher Specific Contents		

		Classroom Procedure (Mode of transaction)

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="4">➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
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<tr><td rowspan="11">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Total</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td colspan="2">Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
<tr><td colspan="3"></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References:

1. Atlas RM & Bartha R (1998) *Microbial ecology: fundamentals and applications* (Benjamin/Cummings, Menlo Park, Calif.; Harlow) 4th ed.
2. Campbell RE (1983) *Microbial ecology* (Blackwell Scientific Publications, Oxford; Boston) 2nded
3. Maier RM, Pepper IL, & Gerba CP (2009) Environmental Microbiology (Elsevier Academic Press)
4. Mitchell R(1974) *Introduction to environmental microbiology*(Prentice-Hall, Englewood Cliffs, N.J.,)
5. Nybakken JW & Bertness MD (2005) Marine biology: an ecological approach (Pearson/Benjamin
6. Prescott LM, Harley JP, & Klein DA (2005) Microbiology (McGraw-Hill, Boston; London) 6thed Cummings)
7. Rheinheimer G (1991) *Aquatic microbiology* (John Wiley and Sons) 4thed

Suggested Reading:

1. Cunliffe, M., Upstill-Goddard, R. C., & Murrell, J. C. (2011). Microbiology of aquatic surface microlayers. *FEMS microbiology reviews*, *35*(2), 233-246.
2. Hurst, C. J., Crawford, R. L., Garland, J. L., & Lipson, D. A. (Eds.). (2007). *Manual of environmental microbiology*. American Society for Microbiology Press.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**
Course Name	**FOOD MICROBIOLOGY**
Type of Course	**DSC A**
Course Code	**MG3DSCMBG201**
Course Level	**200 - 299**
Course Summary	This course provides knowledge of the significance and activities of microorganisms in food, the risk of contaminants and preventing outbreaks of food-borne diseases. Students learn various hands-on training on isolation, detection and identification of microorganisms in food.

Semester	IV	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	1	0	75
Prerequisites, if any	Basic knowledge of microorganisms associated with food.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PO No
1	To understand the type of microorganisms involved in food microbiology	An	1.4
2	To understand the methods of examination and preservation in the food industry	U	1,2,10
3	To understand the major fermented food products	U	3,4,6
4	To Analyse the food-borne illness and food safety management.	An	2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Incidence and types of organism & Qualitative techniques for examination and preservation of food**		
	1.1	Beneficial types of microorganisms – Microbes in the food industry- Molds, yeast and bacteria	15	1
	1.2	Significance and activities of microorganisms in food. Role of intrinsic and extrinsic factors on growth and survival of microorganisms.		
	1.3	Contamination and spoilage – Vegetables and fruits, Meat and meat products, Milk and milk products, Fish and seafood spoilage of canned food		
	1.4	Microbial examination of food and milk Principles and preservation of food – High temperature, Low temperature, Drying, Food additives		
2		**Importance of microbes in the food industry**		
	2.1	Fermented food products- Bread, Vinegar, Alcoholic beverages- Beer, Wine	15	2
	2.2	Oriental fermented foods -Shoyu, Miso, Tempeh Fermented vegetables- Sauerkraut, Pickles		
	2.3	Milk and milk products – Butter and cheese Probiotics, Neutraceuticals, SCP, Edible mushrooms.		
3		**Foodborne illnesses and Food Safety management**		
	3.1	Foodborne illnesses: foodborne infection, intoxications and poisoning: Salmonellosis, Botulism Rotavirus Norovirus	15	3
	3.2	*E.coli toxins*, Aflatoxin, Scromboid fish poisoning		
	3.3	Foodborne parasites –Trichinosis, Seafood toxicants- Ciguatera poisoning,		
	3.4	HACCP-Definition and principle (Outline)		
4		**Hands-on Training**	30	4
	4.1	Study of microbial contaminants in food products, Fruits, Fish and Meat		
	4.2	Milk Analysis –MBRT		
	4.3	Isolation of Lactobacillus from curd		
	4.4	Enumeration and isolation of microorganisms from water		
5		Teacher Specific Contents		

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<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
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<tr><td></td><td></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References:

1. Cappuccino, J. G., Sherman, N. (2014). Microbiology: A Laboratory Manual. United Kingdom: Pearson.
2. Frazier, W.C,1978, Food Microbiology, Mc Graw Hill
3. Jay, J. M., Loessner, M. J., Golden, D. A., Golden, D. A. (2005). Modern Food Microbiology. India: Springer US
4. R C Dubey, D.K Maheswari, S Chand Practical Microbiology. (2002). India: S. Chand Limited.
5. Samuel C Prescott (2002), Industrial Microbiology Agrobios (India),

Suggested Reading:

1. Adams, M. R., & Moss, M. O. (2000). *Food microbiology*. Royal society of chemistry.
2. Jay, J. M., Loessner, M. J., & Golden, D. A. (2008). *Modern food microbiology*. Springer Science & Business Media.
3. Matthews, K. R., Kniel, K. E., & Montville, T. J. (2017). *Food microbiology: an introduction*. John Wiley & Sons

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**INDUSTRIAL MICROBIOLOGY**					
Type of Course	**DSE**					
Course Code	**MG4DSEMBG200**					
Course Level	**200 - 299**					
Course Summary	This course provides knowledge on concepts in the processes, instruments, quality etc. being used in industries to produce products using microorganisms					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Prerequisites, if any	Basic knowledge of different fermentation processes and application of microorganisms.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basic concepts of industrial Microbiology & Explain the different stages of a fermentation process.	A	1,2
2	Differentiate different Fermentation processes & different parts of a fermenter and their functions	An	1,2,4
3	List the various stages of down streaming & Summarize different methods of Immobilisation.	An	1,2
4	Explain the production of different industrially important products	E	1,2,4,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction & Development Of Industrial Fermentation Process**	18	1
	1.1	Scope of Industrial Microbiology		
	1.2	Historical perspective		
	1.3	Industrially important Microorganisms and their products		
	1.4	Industrial strains– characteristics		
	1.5	Isolation techniques- primary and secondary screening techniques. Preservation of industrial strains.		
	1.6	Fermentation media formulation and modification		
2		**Fermentation**	17	2
	2.1	Fermentation Types- batch, continuous, dual or multiple, Fed-batch, solid- state and submerged fermentation.		
	2.2	Design and Parts of a fermenter- Basic Functions of a fermenter and parts		
	2.3	Principles of Industrial Sterilization-Sterilization of Equipment, Sterilization of production media, Sterilization of air		
3		**Down Streaming and Immobilization Methods**	15	3
	3.1	**Product recovery and purification**.		
		Solid Liquid Separation Cell disruption Concentration techniques Purification methods Formulation methods		
	3.2	**Immobilization methods-** Adsorption; covalent linkages, membrane entrapment. Advantages and disadvantages of each method. Applications of immobilized enzymes		
4		**Industrial products from microorganisms**	10	4
	4.1	Antibiotics-Penicillin Organic acids- citric acid Amino acids- glutamic acid Enzymes- amylase		
5		Teacher Specific Contents		

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<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="7">Continuous Comprehensive Assessment (CCA)
4 Credit Theory:
30 Marks</td><td colspan="3">Theory</td></tr>
<tr><td colspan="2">Component</td><td>Mark</td></tr>
<tr><td colspan="2">Test/Quiz</td><td>10</td></tr>
<tr><td colspan="2">Seminar</td><td>5</td></tr>
<tr><td colspan="2">Assignment</td><td>5</td></tr>
<tr><td colspan="2">Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td colspan="2">Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory:
70 Marks
Time: 2 Hours</td><td colspan="3">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References:

1. Patel, A. H. (2012). *Industrial Microbiology*. Trinity Press.
2. Prescott, Samuel Cate, and Cecil Gordon Dunn. "Industrial microbiology." (1949).
3. Rodgers, P. J. "Principles of fermentation technology: By Peter F. Stanbury and Allan Whitaker Pergamon Press, Oxford, 1984
4. Schwartz, W. "LE Casida Jr., Industrial Microbiology. (1969):.

SUGGESTED READINGS

1. Atlas, Ronald M., ed. *Manual of industrial microbiology and biotechnology*. American society for microbiology, 1999.
2. Benda, I., and G. Reed. "Prescott and Dunn's Industrial Microbiology." (1982)

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**COMPUTATIONAL BIOLOGY AND BIOINFORMATICS**					
Type of Course	DSE					
Course Code	**MG4DSEMBG201**					
Course Level	**200 - 299**					
Course Summary	This course provides a basic knowledge and awareness of the basic principles, and concepts of biology, computer science and mathematics. Students learn existing software effectively to extract information from large databases.					
Semester	**IV**	**Credits**			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4	**0**	**0**	0	**60**
Prerequisites, if any	Basic knowledge in Computer science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand Computational Biology, Bioinformatics, DNA and Protein sequencing along with Protein Structure and functions	U	1,2
2	Explain Data Mining & Web Mining	E	1,2
3	Explain Python	E	1,2
4	Apply Bioinformatics & Computational Approaches for Drug Design	A	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Computational Biology, Bioinformatics, DNA and Protein sequencing**	15	1
	1.1	Nature and scope of Computational Biology and Bioinformatics, Basic algorithms in Computational Biology.		
	1.2	Introduction to DNA and Protein sequencing, Human Genome Project, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, Gene Bank, DDBJ; Secondary nucleotide sequence databases.		
	1.3	Protein structure and function, Protein Primary structure, Amino acid residues, Secondary, Tertiary, Quaternary Structure of Protein.		
	1.4	Protein sequence databases- SwissProt/ TrEMBL, PIR, Sequence motif databases -Pfam, PROSITE, Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Sequence, structure and function relationship.		
2		**Data Mining & Web Mining**	15	2
	2.1	Introduction to Data Mining: Basics of data mining, Related concepts, KDD Process, Data mining techniques: statistical methods, similarity measures and decision trees.		
	2.2	Classification - Overview and Techniques: regression, Bayesian classification, distance-based and decision tree-based algorithm.		
	2.3	Clustering - Overview and Techniques: hierarchical algorithm, partitional algorithms- k means clustering. Association rules - support and confidence, APRIORI algorithm.		
	2.4	Web Mining: Introduction, Web Content Mining, Web Structure Mining, Web Usage Mining, Introduction to PHP, Introduction to MySQL, integration of PHP with database, introduction to XML, introduction to LAMP, examples for small database management project.		
3		**Study of Python**	15	3
	3.1	Introduction to Python: Pros & cons		
	3.2	A Brief History of Python, Python Versions, Installing Python, Environment Variables		
	3.3	Executing Python from the Command Line, Editing Python Files, Dynamic Types, Python Reserved Words, Naming Conventions, Basic Python Syntax- String Values, String Operations		
4		**Drug Design**	15	4
	4.1	Computational approaches in Drug Design: Applications of bioinformatics in target identification & validation, binding site prediction.		
	4.2	Lead compound identification: Structure-based & ligand-based approaches; Molecular docking- algorithms and scoring functions.		
	4.3	Virtual screening- combinatorial chemistry and ligand databases		
5		Teacher Specific Contents		
		Classroom Procedure (Mode of transaction)		

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<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
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<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
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Any 10 out of 12</td><td>10 X 2= 20</td></tr>
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Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References:

1. Aggarwal, C. C. (2015). Data Mining: The Textbook. Germany: Springer International Publishing.
2. Blass, B. E. (2015). Basic principles of drug discovery and development. Elsevier.
3. Computational Biology: A Practical Introduction to Biodata Processing and Analysis with Linux, MySQL, and R" by Röbbe Wünschiers.
4. Kumar, V. (2016). Introduction to Data Mining. India: Pearson India.
5. Computational Medicinal Chemistry for Drug Discovery. (2003). United States: Taylor & Francis..
6. Matthes, E. (2023). Python crash course: A hands-on, project-based introduction to programming. no starch press.
7. Scime, A. (2005). Web Mining: Applications and Techniques. United Kingdom: Idea Group Pub.
8. Waterman, M. S. (2018). Introduction to Computational Biology: Maps, Sequences and Genomes. United Kingdom: CRC Press.
9. Zelle, J. M. (2004). Python programming: an introduction to computer science. Franklin, Beedle & Associates, Inc..

Suggested reading:

1. Encyclopedia of Bioinformatics and Computational Biology: ABC of Bioinformatics. (2018). Netherlands: Elsevier Science.
2. Tramontano, A. (2018). Introduction to Bioinformatics. United Kingdom: CRC Press.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**DAIRY MICROBIOLOGY**					
Type of Course	**DSE**					
Course Code	**MG4DSEMBG202**					
Course Level	**200 - 299**					
Course Summary	This course provides knowledge on the micro-environment of different indigenous dairy products and the public health significance, and quality assurance of various dairy products.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Awareness of the Diary industry.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basics of dairy microbiology	U	1,2
2	Analyze various dairy operations and dairy products	An	1,2,10
3	Apply the role of various microorganisms on fermented milk products and milk-borne diseases	A	1,2,10
4	Analyze the Quality assurance of Dairy products	An	1,2,10
5	Teacher Specific Contents		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Introduction to dairy microbiology-** Definition, Scope and importance, Characteristic properties of milk-composition, physical and chemical properties. Microorganisms in milk-Bacteria, Moulds, Yeast Starter cultures: *Streptococcus thermophillus, Lactobacillus bulgaricus*	15	1
	1.2	**Preservation of milk:** Pasteurization-LTST& HTST, UHT, Homogenization		1
	1.3	**Spoilage of milk:** Sources of contamination-milch animals, utensils and equipment, water, milking environment, Types of spoilage: Red milk, Blue milk, Yellow milk		1
2	2.1	**Dairy processing operations**, Storage, transportation and distribution of milk, Sanitation of dairy	15	2
	2.2	**Brief account on Dairy products: -**Fluid milk products, Concentrated and dried milk products, condensed milk, evaporated milk, whole and skimmed milk powder		2
3	3.1	**Microbiology of fermented products:** Fermentation-Souring, Lactic acid fermentation, proteolysis Products-Acidophilus milk, buttermilk, Kefir,	15	3
	3.2	**Cultured milk products:** Whipped cream, Ice-cream, Cheese, Yogurt, Butter		3
	3.3	**Milk Borne diseases:** *Mastitis, Listeria, Clostridium, Salmonella,* Mycotoxins in milk and its prevention		3
4	4.1	**Quality assurance**: Microbiological quality standards of milk, Food safety and safety of dairy products, control of hazards	15	4
	4.2	**HANDS-ON TRAINING** ● Quality Checking of various milk products available in the market- Curd, Ice cream, Butter ● Quality checking of milk samples from various companies. ● Isolation and staining of lactobacillus sp. from milk products ● Fermentative production of Curd ● Microbiological examination of milk**:** MBRT, ● To perform Phosphatase test		4
5		Teacher Specific Contents		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="8">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory:
30 Marks</td><td colspan="3">Theory</td></tr>
<tr><td>Component</td><td colspan="2">Mark</td></tr>
<tr><td>Test/Quiz</td><td colspan="2">10</td></tr>
<tr><td>Seminar</td><td colspan="2">5</td></tr>
<tr><td>Assignment</td><td colspan="2">5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td colspan="2">10</td></tr>
<tr><td>Total</td><td colspan="2">30</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
4 Credit Theory:
70 Marks
Time: 2.00 Hours</td><td colspan="3">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td colspan="2">5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td colspan="2">10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td colspan="2">5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td colspan="2">1 X 15 = 15</td></tr>
<tr><td>Total:</td><td colspan="2">70 marks</td></tr>
<tr><td></td><td colspan="3"></td></tr>
</table>

References:

1. Eckles, C. H. (1951). Milk and Milk Products. United Kingdom: McGraw-Hill.
2. Jay, J.M, (2005). Modern Food Microbiology 4th Edition, Van Nostra and Rainhokdd Co.
3. Prajapati Textbook of *Dairy Microbiology*, Publisher-Indian Council Of Agricultural Research,
4. Robinson R K, (1990).Dairy Microbiology: The microbiology of milk. (1981). United Kingdom: Applied Science Publishers.

Suggested Reading:

1. Srivastava, M. (2002). *Handbook of milk microbiology*. Daya Books.

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Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**APPLIED MICROBIOLOGY**					
Type of Course	**DSC C**					
Course Code	**MG4DSCMBG202**					
Course Level	**200 - 299**					
Course Summary & Justification	This course provides knowledge about the application of microbes in several fields of microbiology.					
Semester	IV	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge of microbes and microbial products.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the Role of microbes in the food industry and food products and illness.	U	2,3,6,10
2	Applications of microorganisms in soil	A	6,10
3	Explain the type of organisms in the aquatic field and diseases. Analyse the water quality and water purification.	An	2,3,6,10
4	Analyse the air quality and sanitation & Understand the airborne diseases	U	1,6,10
5	Hands-on training	A	1,2,6,10

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**FOOD MICROBIOLOGY**	13	1
	1.1	Role of microbes in the food industry Fermentation: Milk products, Vinegar, Wine, Beer, Bread		
	1.2	Production of edible mushrooms- Agaricus, Volvariella. Oriental fermented Food products-Miso, temph. Single-cell protein (algae -spirulina, Chlorella, baker's yeast, bacteria, fungi) Probiotics.		
	1.3	Microbiological examination of milk. Spoilage – milk, meat Foodborne illness		
2		**SOIL MICROBIOLOGY**	12	2
	2.1	Soil microorganisms & interactions. Nitrogen fixation (Symbiotic and non-symbiotic Nitrogen fixation), phosphate solubilization.		
	2.2	Biofertilizers - Rhizobium, phosphate solubilizing organs		
	2.3	Biopesticide, Bioinsecticide		
3		**AQUATIC MICROBIOLOGY**	14	3
	3.1	The aquatic environment and distribution of microorganisms in the aquatic environment. Aquatic Ecosystem- freshwater (ponds, lakes, streams) marine (estuaries, mangroves, deep sea).Water zonations- upwelling. Benthic microorganisms		
	3.2	Waterborne diseases		
		Water quality analysis		
	3.3	Microbial assessment of water quality		
	3.4	Water purification		
4		**AEROMICROBIOLOGY**	6	4
	4.1	Definition, Microbiological assessment of air quality and Sanitation.		
	4.2	Air borne diseases		
	4.3	**HANDS-ON TRAINING** MPN(Water,Milk) SPC (raw and spoiled food, milk, soil), MBRT Serial dilution and plating of rhizosphere and non-rhizosphere soil Isolation of Rhizobium, Air exposure plates	30	4
5		Teacher Specific Contents		

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➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2.0 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks Any 1 out of 2</td><td>1 X 10 = 10</td><td rowspan="2">Viva voce</td><td rowspan="2">5</td></tr>
<tr><td>Total:</td><td>50 marks</td></tr>
<tr><td></td><td></td><td>Total</td><td>35**</td></tr>
<tr><td colspan="4">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References:

1. Adams, Martin R., and Maurice O. Moss. *Food microbiology*. Royal society of chemistry, 2000.
2. Bhagyaraj, D. J., and G. Rangaswami. *Agricultural microbiology*. PHI Learning Pvt. Ltd., 2007.
3. Daniel, Joseph C. "Environmental Aspects of Microbiology." (1996).
4. Frazier, William C., and Dennis C. Westhoff. "Food microbiology 4th ed." *International Edition McGraw Hill, Singapore* (1998): 440-441.
5. Jr Michael J Pelczar, Noel R Krieg, Ecs Chan,Microbiology Michael J. Pelczar, Jr., Roger D. Reid Tata McGraw-Hill,1993:ISBN: 9786509333283
6. Microbial Ecology: Fundamentals and Applications 4th Edition (English, Paperback, Ronald M Atlas, Bartha :ISBN: 9788131713846,
7. N.Arumugam, A M., L M N., V Kumaresan, A M Selvaraj Textbook of Microbiology by Kumaresan Edition: 2014: ISBN: 9789386519085, 9386519089
8. Subba, Rao. *Soil microbiology*. Oxford and IBH Publishing, 2017.
9. V Kumaresan, Text Book of Biotechnology Saras Publication, Edition: Sixth Format: Paperback: ISBN: 9789384826109

10. Willey, Joanne M., Linda M. Sherwood, and Christopher J. Woolverton. *Prescott's microbiology*. McGraw-Hill, 2014.

Suggested Reading:

1. Glazer, A. N., & Nikaido, H. (2007). *Microbial biotechnology: fundamentals of applied microbiology*. Cambridge University Press.
2. Patterson, M. F. (2005). Microbiology of pressure-treated foods. *Journal of Applied Microbiology*, *98*(6), 1400-1409.

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Programme						
Course Name	**Solid Waste Management**					
Type of Course	**SEC**					
Course Code	**MG4SECMBG200**					
Course Level	**200 - 299**					
Course Summary	This course provides the technical, legal and economic points by learning of design principles related to general solid waste management.					
Semester	IV	**Credits**			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Prerequisites, if any	Basic knowledge of solid waste management.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline Solid Waste Management & Disposal Methods for Solid Waste	U	1,2,6,10
2	Explain the Bioprocessing of organic wastes	E	1,2,3,6,10
3	Compare different methods of Composting by Demonstration	E	1,2,3,6,10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Solid Waste Management**	12	1
	1.1	Waste management by Refuse, Reuse, Recycle, and Reduce		
	1.2	Generation of solid waste - Sources		
	1.3	Types of solid wastes, Sampling and onsite handling.		
	1.4	Disposal methods for solid waste- Open dumping, Sanitary dumping, Landfilling, Incineration, Biogas, Pyrolysis.		
2		**Bioprocessing of organic wastes- Anaerobic digestion, Vermicomposting, Composting,**	18	2
	2.1	Anaerobic digestion- Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis.		
	2.2	Products of anaerobic digestion - biogas, digestate and slurry.		
	2.3	Vermicomposting- methods. Earthworm species used in vermicomposting & Factors affecting vermicomposting		
	2.4	Types of composting: anaerobic and aerobic composting.		
	2.5	Methods of composting. Advantages and disadvantages of composting.		
	2.6	Endproduct- Compost. Parameters for good compost.		
3	3.1	**Practical content** Demonstration of Garden Waste & Kitchen Waste Composting – Different Techniques – Bin Composting, Pit Composting, Tube Composting, In-Vessel Composting, Open Pile	15	3
4		Teacher Specific Contents		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning ➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning Laboratory instructions, Demonstration of methods & Hands-on experiments

Assessment Types

Mode of Assessment

Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks

Theory	
Component	Mark
Test/Quiz	10
Seminar	5
Assignment	5
Activity (Related to teacher-specific content)	5
Total	**25**

	End Semester Evaluation (ESE) 3 Credit Theory: 50 Marks Time: 2.0 Hours	**Theory**	
		Part -A: 2 marks Any 10 out of 12	10 X 2 = 20
		Part - B: 5 Marks Any 4 out of 6	4 X 5 = 20
		Part – C: 10Marks Any 1 out of 2	1 X 10 = 10
		Total:	**50 marks**

References

1. Alexander M. "Introduction to soil microbiology".Wiley, New York; London. 2nd ed. 1977
2. Atlas, R. M., & Bartha, R. "Microbial ecology: Fundamentals and applications". 6th ed Menlo Park, Calif: Benjamin/Cummings 1998.
3. Bhide A.D and Sundaresan B.B, "Solid waste management – collection, processing and Disposal", Mudrashilpa Offset Printers 2001.
4. Dubey, R.C. and Maheswari, D.K." A Textbook of microbiology". S. Chand & Company Ltd. New Delhi. 2005.
5. Hagerty, D. Joseph, Joseph L. Pavoni, and John E. Heer. "Solid waste management." Van Nostrand Reinhold, (1973).
6. Mitchell R. "Introduction to environmental microbiology". Prentice-Hall, Englewood Cliffs, N.J. 1974.
7. Shukla S. K. & Srivastava P. R. In: Waste Management and Control. Commonwealth Publishers, New Delhi 1992.

SUGGESTED READINGS

1. Manual on Solid Waste Management, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000.
2. Vesilind, P.A. and Rimer, A.E., "Unit Operations in Resource Recovery Engineering", Prentice Hall, Inc., 1981

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Kottayam

Programme						
Course Name	**SANITATION MICROBIOLOGY**					
Type of Course	VAC					
Course Code	**MG4VACMBG200**					
Course Level	**200 - 299**					
Course Summary	This course provides information on sanitation and safety precautions in industrial, food processing, animal housing, hospitals and laboratories.					
Semester	IV	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Prerequisites, if any	Basic knowledge of beneficial microorganisms.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Basic concepts of Sanitation and disinfection.	U	1,2
2	To analyse methods of air sampling and quantification of air microflora	An	1,2,6,10
3	To explain the microbiology of sewage treatment and wastewater treatment and waterborne diseases.	E	1,2,6,10
4	To implement solid waste disposal, sanitary landfill, composting, methanogenesis and biogas production	A	1,2,4,6,10
5	Teacher Specific Contents		

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**General concept of sanitation and disinfection**. Sanitation and Safety precautions in animal houses, industrial fermentation units, food processing units, hospitals and laboratories.	15	1
2		**Aero microbiology**	15	2
	2.1	Airborne diseases(common cold Influenza, Chickenpox, Mumps, Measles, Whooping cough (pertussis), Tuberculosis (TB), Diphtheria, Covid 19) and preventive measures.		
	2.2	Methods of sampling air- settling under gravity, Centrifugal action, filtration impingement and electrostatic forces.		
	2.3	Air sanitation – techniques and applications.		
3		**Water microbiology**	15	3
	3.1	Microbiology of municipal sewage and sewage treatment.		
	3.2	Detailed study of Wastewater treatment, Primary, Secondary and Tertiary treatments with special reference to aerobic and anaerobic methods.		
	3.3	Waterborne diseases (Cholera, diarrhoea, Hepatitis A, Typhoid, Polio, Leptospirosis, Cryptosporidiasis, Otitis media) and preventive measures.		
	3.4	Solid waste disposal-sanitary landfills, composting – types of composting, vermicompost. Disposal of animal and agricultural waste. Methanogenesis and biogas production		
4		Teacher Specific Contents		

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<tr><td rowspan="8">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory:
25 Marks</td><td colspan="3">Theory</td></tr>
<tr><td>Component</td><td colspan="2">Mark</td></tr>
<tr><td>Test/Quiz</td><td colspan="2">10</td></tr>
<tr><td>Seminar</td><td colspan="2">5</td></tr>
<tr><td>Assignment</td><td colspan="2">5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td colspan="2">5</td></tr>
<tr><td>Total</td><td colspan="2">25</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory:
50 Marks

Time: 2.0 Hours</td><td colspan="3">Theory</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td colspan="2">10 X 2 = 20</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td colspan="2">4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td colspan="2">1 X 10 = 10</td></tr>
<tr><td>Total:</td><td colspan="2">50 marks</td></tr>
</table>

References:

1. Brock. (1996). Biology Microorganisms Vol 2. United States: Prentice Hall Books.Environmental aspects of microbiology-Joseph C. Danie
2. Cheesbrough, M. (1984). Medical Laboratory Manual for Tropical Countries. United Kingdom: Tropical Health Technology.
3. McKane, L., Kandel, J. (1996). Microbiology: Essentials and Applications. United Kingdom: McGraw-Hill.Environmental Microbiology Vijay Ramesh
4. Salle, A. J. (1973). Fundamental Principles of Bacteriology. India: McGraw-Hill.Microbiology- Prescott, M.J., Harley J P., and Klein, D.A

Suggested reading:

1. Omarova, A. O., Belyayev, I. A., Akhmetova, S. B., Zh, Y. N., & Kharin, A. D. (2021). CHALLENGES OF MICROBIOLOGICAL SAFETY OF WATER SUPPLY, SANITATION AND HYGIENE. LITERATURE REVIEW. *Наука и здравоохранение*, (4), 46-57.
2. Spencer, J. F., & de Spencer, A. L. R. (Eds.). (2008). *Public health microbiology: methods and protocols* (Vol. 268). Springer Science & Business Media.

SEMESTER-V

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Programme	**BSc (Hons) Microbiology**					
Course Name	**AGRICULTURAL MICROBIOLOGY**					
Type of Course	DSC					
Course Code	**MG5DSCMBG300**					
Course Level	**300 - 399**					
Course Summary & Justification	This course will enable students to understand the beneficial role & applications of microorganisms in agriculture and comprehend plant diseases caused by microorganisms and their control measures					
Semester	**V**	Credits			**4**	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	**1**	**0**	**75**
Pre-requisites	Prior knowledge of the diversity of microbes and environmental microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand soil microbes & their interactions among themselves & plants	U	1.2
2	Compile knowledge on retting, silage, tobacco & curing role of microbes in biogeochemical cycles	C	1,2
3	Develop knowledge on natural defence mechanisms in plants, Plant pathogenesis, control measures and the role of biopesticides and biofertilizers	A	1,2,3,6,10
4	Develop knowledge on the isolation and enumeration of soil microbes, nitrogen-fixing bacteria and plant pathogens	A	1,2,3,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1	1.1	**Soil microbes & their interactions**	15	1
		Soil microflora		
	1.2	A brief account of microbial interactions (symbiosis)- commensalism, synergism, mutualism, amensalism, parasitism, predation.		
	1.3	Plant-microbe interactions- Mycorrhiza- ecto, endo & ectendomycccorhiza.		
2	2.1	**Soil microbes & their roles**	15	2
		Rhizosphere & phyllosphere microflora & its importance PGPR, siderophore. Endophytic microflora.		
	2.2	Microbiology of silage, tobacco curing. Role of microbes in retting		
	2.3	Biogeochemical cycles		
3	3.1	**Plant pathogens**	15	3
		Microbial diseases of plants- pathogens, transmission & control measures. Common **bacterial**- crown gall disease, potato scab, soft rot disease, citrus canker, **fungal**- club root disease, wart disease, ergot of cereals & **viral**- TMV, bunchy top of banana, tomato spotted wilt, sugar cane mosaic- diseases		
	3.2	Natural defence mechanism in plants- structural & biochemical		
	3.3	**Biopesticides & biofertilizers** Biopesticides- bacterial, viral & fungal pesticides. Biological control of plant diseases. Integrated pest management Production of biofertilizers- Rhizobium		
4	4.1	**Lab experiments** Isolation & enumeration of soil microbes	30	4
	4.2	Calculation of R:S ratio		
	4.3	Isolation of nitrogen-fixing bacteria		
	4.4	Isolation of bacterial plant pathogen		
5		Teacher specific content		

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Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
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<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
<tr><td colspan="2"></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

REFERENCES

1. Bagyaraj, D. J. (2011). *Microbial biotechnology for sustainable agriculture, horticulture & forestry*. New India Publishing Agency.
2. Soil Microorganisms & plant growth- N S Subba Rao Rao, N. S. S. (1995). *Soil microorganisms and plant growth* (No. Ed. 3). Science Publishers, Inc..
3. Campbell, R. (1985). *Plant microbiology*. Edward Arnold Ltd.Microbiology – Prescott M J
4. Diseases of crop plants in India- G Rangaswamy Rangaswami, G. (1962). Bacterial plant diseases in India. *Bacterial plant diseases in India.*
5. Experiments in Microbiology, plant pathology and biotechnology – K R Aneja Aneja, K. R. (2007). *Experiments in microbiology, plant pathology and biotechnology*. New Age International.
6. Microbiology laboratory manual- Cappuccino, Sherman, Pearson Education James, C., & Natalie, S. (2014). Microbiology. A laboratory manual

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) microbiology**					
Course Name	**ESSENTIALS OF IMMUNOLOGY**					
Type of Course	DSC					
Course Code	**MG5DSCMBG301**					
Course Level	**300 - 399**					
Course Summary	This course will enable students to understand the innate and adaptive immune response, study structure, functions of the immune system and strategies to develop vaccines, identify and treat infectious diseases genetic defects					
Semester	**5**	**Credits**			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	**1**	0	**75**
Prerequisites, if any	Basic concepts & techniques of microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Acquire a fundamental understanding of the Immune System, History, Types of Immunity Cells& Organs	U	1,2
2	Illustrate the structure and functions of components involved in the immune response – Ag, Ab, Monoclonal Antibody Complement System, Ag – Ab Reactions	U	1,2
3	Explain the basic mechanisms of immune response – HMI & CMI & Analyse the role of immune response in health and disease - Autoimmunity Hypersensitivity	An	1,2,6,10
4	Explain the laboratory techniques in Immunology - Widal Test, RPR Test, Blood Grouping, Immunodiffusion and ELISA	E	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Fundamental Understanding of the Immune System.** History of Immunology	10	1
	1.2	Infection and types of infections		
	1.3	Types of Immunity- innate immunity and Acquired immunity		
	1.4	Study of the cells and organs of the immune system		
2		**Structure and functions of components involved in the immune response**	12	2
	2.1	Antigens- types, properties, Haptens, Adjuvants		
	2.2	Immunoglobulins- Structure, types and properties.		
		Monoclonal antibodies – Hybridoma Technology, Applications		
	2.3	Complement- functions of complement components and Complement activation pathways,		
	2.4	Antigen-Antibody Reactions – Precipitation Reaction, Agglutination Reaction, Complement Fixation Test, ELISA.		
3	3.1	**Basic mechanisms of immune responses.** Primary and Secondary Immune Response	11	3
	3.2	Humoral Immune response- B cells, plasma cells and antibody secretion.		
	3.3	Cell-mediated immune response – Cells involved and their mechanism– T Cells, NK Cells, ADCC.		
	3.4	**Role of immune response in health and disease** Autoimmunity Hypersensitivity reactions – Type I, II, II & IV.	12	
4		**Hands-on Training on** Blood Grouping, ASO, Widal Test (Qualitative and Quantitative), RPR Test (Qualitative and Quantitative), ELISA (Demonstration)	30	4
5		**Teacher specific contents**		

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<tr><td>Teaching and Learning Approach</td><td colspan="4">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="13">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td colspan="2">Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
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References

1. Kindt, Thomas J., Richard A. Goldsby, Barbara A. Osborne, and Janis Kuby. *Kuby immunology*. Macmillan, 2007.
2. Ananthanarayan, R. *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan, 2006.
3. Delves, Peter J., Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt. *Roitt's essential immunology*. John Wiley & Sons, 2017.
4. Latha, Madhavee P. *A Textbook of Immunology*. S. Chand Publishing, 2012.
5. Kannan I.*Immunology.* MJP Publishers, Chennai, 2021

SUGGESTED READINGS

6. Rao, C. V. *Immunology: A textbook*. Alpha Science Int'l Ltd., 2005.

Mahatma Gandhi University
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Programme	**BSc (Hons) Microbiology**					
Course Name	**MEDICAL BACTERIOLOGY I**					
Type of Course	**DSE**					
Course Code	**MG5DSEMBG300**					
Course Level	**300 - 399**					
Course Summary	The course Medical Bacteriology I provides a descriptive study of the systematic identification, Pathogenesis and prophylaxis of common bacterial pathogens					
Semester	**V**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	**0**	**0**	**0**	**60**
Prerequisites, if any	Knowledge of Bacterial taxonomy and anatomy					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	To understand the systematic identification of bacteria using morphology, cultural Characteristics and biochemical reactions.	A	1,10
2	To explain the pathogenesis, laboratory diagnosis and treatment of medically important Gram-positive and Gram-negative cocci	A	1,2,10
3	To explain the pathogenesis, laboratory diagnosis and treatment of medically important Gram-positive bacilli	A	1,2,10
4	To explain the pathogenesis, laboratory diagnosis and treatment of medically important Gram-negative bacilli	An	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Identification of Bacteria** Systematic study of Bacteria Morphology, Colony characteristics	10	
	1.2	**Biochemical reactions** Carbohydrate fermentations, IMViC, TSI, H_2S production, Urease, Nitrate reduction, Catalase and Oxidase		1
2	2.1	**Detailed study of Morphology, Cultural characteristics, Biochemical reactions, Epidemiology, Pathogenesis, Laboratory diagnosis, Prophylaxis and Treatment of** **GRAM-POSITIVE COCCI** *Staphylococcus aureus,* *Streptococcus pyogenes, Streptococcus pneumoniae*	20	2
	2.2	**GRAM-NEGATIVE COCCI** *Neisseria meningitides, N.gonorrhoeae*		
3	3.1	**GRAM POSITIVE BACILLI** *Clostridium perfringens, Clostridium tetani,*	15	
	3.2	*Clostridium botulinum.*		
	3.3	*Corynebacterium diphtheriae* *Bacillus anthracis*		3
4	4.1	**GRAM NEGATIVE BACILLI - Enterobacteriaceae I** *Coliforms – Escherichia coli, Klebsiella,* *Proteus mirabilis,*	15	4
	4.2	**Enterobacteriaceae II** - *Shigella dysentriae*		
	4.3	**Enterobacteriaceae III** - *Salmonella typhi &* *Salmonella paratyphi*		
	4.4	*Vibrio cholerae,* *Pseudomonas*		
4		Teacher specific contents		

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<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References

1. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
2. Mackie, T. J., McCartney, J. E., & Collee, J. G. (1989). Mackie & McCartney practical medical microbiology. *(No Title)*.
3. Atlas, R. M. (1988). Microbiology: fundamentals and applications.
4. Greenwood, D. (Ed.). (2012). *Medical Microbiology, With STUDENT CONSULT online access, 18: Medical Microbiology*. Elsevier Health Sciences.
5. Wilson, G. S., Topley, W. W. C., & Miles, A. (1984). *Principles of Bacteriology*. Edward Arnold.
6. Cappuccino, J. G., & Welsh, C. T. (2017). *Microbiology: a laboratory manual*. Pearson Higher Ed.

Suggested Readings

1. Janda, J. M., & Abbott, S. L. (2002). Bacterial identification for publication: when is enough enough? *Journal of Clinical Microbiology*, *40*(6), 1887-1891.
2. Cowan, S. T., & Steel, K. J. (1965). Manual for the identification of medical bacteria. *Manual for the identification of medical bacteria.*

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Kottayam

Programme	**BSc (Hons) microbiology**					
Course Name	**MEDICAL PARASITOLOGY**					
Type of Course	**DSE**					
Course Code	**MG5DSEMBG301**					
Course Level	**300 - 399**					
Course Summary & Justification	The course Medical Parasitology provides a comprehensive study of the taxonomy, anatomy, pathogenesis, diagnosis and prophylaxis of major human parasites					
Semester	**V**	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical		
		4	**0**	**0**	**0**	**60**
Pre-requisites	Knowledge of basic concepts of infection					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand general concepts of parasitology and Identify the laboratory techniques in parasitology	U	1,9,10
2	Explain Pathogenic mechanisms, disease transmissions, their life cycles and Lab Diagnosis of the mentioned protozoans	A	1,2,6,10
3	Point out the classification, life cycle, Transmission, pathogenicity and Lab diagnosis of mentioned helminths.	An	1,2,6,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1	1.1	**General concepts in parasitology** **Parasitology – Introduction to Parasitology –** Protozoology and helminthology, Classification – Host-parasite relationship.	18	1
	1.2	**Laboratory techniques in parasitology** Blood –Thick and thin smear. Faeces –Examination for ova and cyst.		
2	2.1	**Clinical characterisation of protozoans** **Protozoology: Pathogenic mechanisms, Disease transmissions, their life cycles and Lab Diagnosis of the following** *Entamoeba histolytica, Giardia lamblia, Trichomonas vaginalis, Leishmania donovani, Plasmodium vivax, Plasmodium falciparum, Balantidium coli, Toxoplasmagondii, Cryptosporidium parvum and Naegleria fowleri*	22	2
	2.2	**Clinical Characterisation of Helminths** **Helminthology: Classification** **Cestodes –** *Taenia solium, T. saginata, T.echinococcus* **Trematodes** –*Schistosoma haematobium, Fasciola hepatica*	10	2
3.	3.1	**Clinical Characterisation of Helminths** **Helminthology: Classification** **Nematodes –** *Ascaris, Anchylostoma, Trichuris,* **- their life cycle, Transmission, pathogenicity and Lab Diagnosis**	**10**	3
	3.2	*Enterobius and Wuchereria***- their life cycle, Transmission, pathogenicity and Lab Diagnosis**		
4		Teacher specific contents		

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<tr><td>Activity (Related to teacher-specific content)</td><td colspan="2">10</td></tr>
<tr><td>Total</td><td colspan="2">30</td></tr>
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</table>

References

1. Olson, L. J. (1971). Parasitology (Protozoology and Helminthology).
2. Paniker, C. K. J. (2002). Textbook of medical parasitology. Jaypee Brothers. *New Delhi, India*, *6*, 89-96.
3. Parija, S. C. (2008). Textbook of Medical Parasitology, Protozoology & Helminthology. *Revista do Instituto de Medicina Tropical de São Paulo*, *50*, 282-282.

Suggested Readings

1. Hennessy, D. R. (1997). Physiology, pharmacology and parasitology. *International Journal for Parasitology*, *27*(2), 145-152.
2. Foster, W. D. (1965). A history of parasitology. *A history of parasitology.*

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Kottayam

Programme	**BSc (Hons)Mmicrobiology**					
Course Name	**FOOD SAFETY AND MANAGEMENT**					
Type of Course	**DSE**					
Course Code	**MG5DSEMBG302**					
Course Level	**300 - 399**					
Course Summary & Justification	This course allows the students to understand food safety programs and standards maintained in food industries					
Semester	5	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites	Basic Concepts of Food Microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Explain the terminology and concepts of food safety	U	1,2,7,10
2	Describe current food safety regulations in India	A	1,2
3	Evaluate the relevance of international food safety norms	E	2
4	Appraise the requisites for implementation and maintenance of HACCP in the food industry	S	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1	1.1	**Concepts in Food Safety** Food safety, Food Quality assurance & Quality compliance, Food standards, Microbiological criteria, Traceability and Recalls	15	1
	1.2	Introduction to Hazards in food: Physical hazards, Biological hazards, and Chemical hazards Safety of Ready to Eat food (RTE)		
	1.3	Safe handling of food and good Hygiene Practices. **Importance of accredited food testing laboratories like the National Accreditation Board for Testing and Calibration of Laboratories (NABL)**		
2	2.1	**Food Safety Regulations in India** Highlights of Food Safety and Standards Act of 2006 & Food Safety Regulations, 2011	15	2
	2.2	Establishment of the Food Safety and Standards Authority of India (FSSAI); Functions of FSSAI - Brief account of *FSSAI* manual		
	2.4	Role of National Food Quality Regulatory bodies: Agricultural and Processed Food Export Development Authority (APFEDA), Marine Product Export Development Authority(MPEDA), Export Inspection Council and Export Inspection Agency (EIA)		
3	3.1	**International food safety regulations** Brief account on ISO Food Safety Management System: ISO22000	10	3
	3.2	FAO-WHO norms: *Codex alimentarius*		
	3.3	Highlights of US-FDA regulations and European Union (EU) regulations Introduction to Bacteriological Analytical Manual (BAM)		
4	4.1	**Quality Management system -** **Hazard Analysis Critical Control Points (HACCP)** Introduction to HACCP; 'Farm-to-Table' concept; Advantages of implementing HACCP management system	20	4
	4.2	Pre requisites for implementation of HACCP 1. Assemble HACCP team 2. Describe the product 3. Identify the intended use 4. Construct flow diagram 5. On-site confirmation of flow diagram		
	4.3	Seven Principles of HACCP 1. Conduct a hazard analysis 2. Determine the Critical Control Points (CCPs) 3. Establish critical limit(s).		

		4. Establish a system to monitor control of the CCP. 5. Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. 6. Establish procedures for verification to confirm that the HACCP system is working effectively. 7. Establish documentation concerning all procedures and records appropriate to these principles and their application.		
	4.4	Implementation and Maintenance of the HACCP program An example of HACCP process flow diagram - for the production of poultry meat		4
5		Teacher specific contents		

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References

1. Andres Vasconcellos J. 2005. Quality Assurance for the Food Industry - A practical approach. CRC press.
2. Ronald H. Schmidt, Gary E. Rodrick 2005 Food Safety Handbook Wiley Publishers ISBN:9780471432272
3. https://foodsafety.kerala.gov.in/acts-rules-and-regulations/
4. https://www.fssai.gov.in/upload/uploadfiles/files/Chapter2.pdf

5. https://www.iso.org/iso-22000-food-safety-management.html
6. https://www.fao.org/3/cc6246en/cc6246en.pdf
7. Hazard analysis and critical control point principles and application guidelines. Adopted August 14, 1997. National Advisory Committee on Microbiological Criteria for Foods. J Food Prot. 1998 Sep;61(9):1246-59.

SUGGESTED READINGS

7. Hal King 2013 Food Safety Management: Implementing a Food Safety Program in a Food Retail Business (Food Microbiology and Food Safety) Springer-Verlag New York Inc.
8. https://www.fssai.gov.in/cms/about-fssai.php
9. https://www.fao.org/3/Y1579E/y1579e03.htm
10. https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php
11. https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines

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Programme	**BSc (Hons) Microbiology**					
Course Name	**EMERGING AND RE-EMERGING DISEASES**					
Type of Course	**DSE**					
Course Code	**MG5DSEMBG303**					
Course Level	**300 - 399**					
Course Summary	The course Emerging and re-emerging Diseases provides a comprehensive study on causes of evolving diseases and control of epidemics/ pandemics					
Semester	5	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	**60**
Prerequisites, if any	Basic Knowledge of the epidemiology of infectious diseases					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand the historical perspectives and basic concepts of Emerging and Re-emerging diseases	U	1,4
2	Explain the concepts of epidemiology and assess the Strategies for combating emerging and re-emerging diseases and challenges encountered	A	1,6,10
3	Analyse the etiology, transmission and prevention of major viral, and bacterial diseases	An	1,2,10
4	Analyse the etiology, transmission and prevention of major fungal and parasitic diseases	An	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Historical perspectives** Major epidemics and pandemics such as the bubonic plague, yellow fever, cholera, typhus, Coronavirus and Influenza	15	1
	1.2	Introduction to Emerging infectious diseases (EIDs) and re-emerging infectious diseases (REIDs). Classification of Emerging and reemerging disease. Neglected tropical diseases (NTDs)		
	1.3	Bioterrorism – agents and detection methods		
2	2.1	**Epidemiology** Epidemiological Triad of disease, Factors that precipitate the occurrence and transmission of EIDs and REITs – microbial adaptation and change, ecological changes, human demographics and behaviour, technology and health care, human susceptibility to infection, social/political/economic & lifestyle factors	15	2
	2.2	Role of Antimicrobial resistance in the evolution of emerging and re-emerging disease		
	2.3	**Combating emerging infections** Challenges in disease management. Global collaboration and International initiatives. GOARN Surveillance and Response, Applied research, Infrastructure and training, Prevention and Control of EIDs and REIDs.		
3	3.1	**Major diseases, etiological agents, transmission and prevention** Viral diseases – Influenza, Ebola, SARS, MERS & COVID 19, KFD & Nipah virus disease	15	3
	3.2	Bacterial diseases – Lyme disease, Melioidosis, Buruli ulcer, Legionnaire's disease		
	3.3	Bacteria diseases: TB, Bubonic plague		
4	4.1	**Major diseases, etiological agents, transmission and prevention** Fungal - Mucormycosis, Candidiasis, Cryptosporidiosis, Sporotrichosis, Emergomycosis	15h	4
	4.2	Major diseases, etiological agents, transmission and prevention of Parasitic diseases: Malaria, Leishmaniasis,		
	4.3	Parasitic diseases: Chagas disease, Ascariasis		
5		Teacher specific contents		

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➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
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<tr><td rowspan="11">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory:
30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory:
70 Marks
Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

REFERENCES

1. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
2. Bailey, W. E., & Scott, E. G. (1962). Diagnostic microbiology. *Diagnostic microbiology.*
3. Beltz, L. A. (2011). *Emerging infectious diseases: a guide to diseases, causative agents, and surveillance* (Vol. 10). John Wiley & Sons.
4. Dutta, T. K., Parija, S. C., & Dutta, J. K. (2012). *Emerging and Re-Emerging Infectious Diseases*. JP Medical Ltd.
5. Feldmann, H., Czub, M., Jones, S., Dick, D., Garbutt, M., Grolla, A., & Artsob, H. (2002). Emerging and reemerging infectious diseases. *Medical microbiology & immunology*, *191*, 63-74.
6. Kayingo, G. (Ed.). (2023). *Emerging and Re-Emerging Infectious Diseases, An Issue of Physician Assistant Clinics, E-Book* (Vol. 8, No. 3). Elsevier Health Sciences.
7. Lashley, F. R., & Durham, J. D. (Eds.). (2007). *Emerging infectious diseases: trends and issues*. Springer Publishing Company.
8. Snowden, F. M. (2008). Emerging and reemerging diseases: a historical perspective. *Immunological Reviews*, *225*(1), 9-26.

SUGGESTED READINGS

1. Zuber, K., Davis, J. S., & Kayingo, G. Emerging and Re-Emerging Infectious Diseases.
2. SA Tabish - International Journal of Health Sciences, 2009 - pubmed.ncbi.nlm.nih.gov
3. Tabish, S. A. (2009). Recent trends in emerging infectious diseases. *International journal of health sciences*, *3*(2).

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**ENTREPRENEURSHIP IN MICROBIOLOGY**					
Type of Course	**SEC**					
Course Code	**MG5SECMBG300**					
Course Level	**300 - 399**					
Course Summary	The course Entrepreneurship in Microbiology provides foundations for developing entrepreneurship skills, ventures and innovations in the field of Microbiology					
Semester	V	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Knowledge of the applications & scope of Microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline the concept of entrepreneurship. Idea generation, Feasibility Study, opportunity assessment and Business Plan	U	1,3
2	Analyse the role of Entrepreneurs In problem-solving, technology in Entrepreneurship and an idea about the difference between startups and MSMEs and different agencies supporting entrepreneurship.	An	1,2,10
3	Assess entrepreneurial ventures in the field of Microbiology	E	1,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1	1.1	**Entrepreneurship: Concept and Functions** Why Entrepreneurship for You, Myths about Entrepreneurship, Advantages and Limitations of Entrepreneurship An Entrepreneur: Types of Entrepreneurs, Competencies and Characteristics, Entrepreneurial Values, Attitudes and Motivation, Intrapreneur: Meaning and Importance	20	1
	1.2	Entrepreneurship Journey Idea generation, Feasibility Study and opportunity assessment, Business Plan: meaning, purpose and elements, Execution of Business Plan.Design thinking.		
2	2.1	**Entrepreneurship as Innovation and Problem Solving** Entrepreneurs as problem solvers, Innovations and Entrepreneurial Ventures – Global and Indian, Role of Technology – E-commerce and Social Media, Social Entrepreneurship - Concept	20	2
	2.2	Difference between startups and MSMEs.NISP (NATIONAL INNOVATION AND STARTUP POLICY), Brief Insight into National Innovation Foundation (NIF), MoES Innovation Council (MIC), Kerala start-up mission, IEDC.		
3	3.1	Conduct a case study of any entrepreneurial venture in the field of Microbiology in your nearby area **OR** Interaction with a successful entrepreneur.	5	3
4		Teacher specific contents		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>5</td></tr>
<tr><td>Total</td><td>25</td></tr>
<tr><td rowspan="4">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks

Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td></tr>
<tr><td>Total:</td><td>50 marks</td></tr>
</table>

References

Mohanty, Sangram Keshari. *Fundamentals of entrepreneurship*. PHI Learning Pvt. Ltd., 2005.
Kumar, S. Anil. *Entrepreneurship development*. New Age International, 2008.

SEMESTER-VI

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) microbiology**					
Course Name	**MEDICAL BACTERIOLOGY- II**					
Type of Course	**DSC**					
Course Code	**MG6DSCMBG300**					
Course Level	**300 - 399**					
Course Summary & Justification	The course Medical Bacteriology II provides a descriptive study of the systematic identification, Pathogenesis and prophylaxis of bacterial pathogens					
Semester	**VI**	**Credits**			**4**	**Total Hours**
Course details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		3	**0**	**1**	**0**	**75**
Pre-requisites	Knowledge of Bacterial taxonomy and anatomy					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Distinguish the characteristics of *Mycobacterium sps.*	An	1,2,10
2	Distinguish Gram-negative, non-sporing, Coccobacilli & Spirochetes	An	1,2,10
3	Differentiate the obligate intracellular, gram-negative, nonmotile bacteria & Identify the characteristics of a Mollicute	An	1,2,10
4	Identify major pathogens based on Morphology, cultural characteristics and Biochemical reactions	An	1,2,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1		**Detailed study of Morphology, Cultural characteristics, Biochemical, Pathogenicity, Epidemiology, laboratory diagnosis, prophylaxis and treatment of the following bacteria**	15	1
	1.1	*Mycobacterium tuberculosis*		
	1.2	*Mycobacterium leprae*		
	1.3	Atypical Mycobacterium		
2		**Detailed study of Morphology, Cultural characteristics, Biochemical, Pathogenicity, Epidemiology, laboratory diagnosis, prophylaxis and treatment of the following bacteria**	20	2
	2.1	Haemophilus, Bordetella		
	2.2	Brucella, Yersinia		
	2.3	Spirochetes – Treponema, Leptospira		
3		**Detailed study of Morphology, Cultural characteristics, Biochemical, Pathogenicity, Epidemiology, laboratory diagnosis, prophylaxis and treatment of the following bacteria**		
	3.1	Rickettsiaceae- Genus Rickettsia	10	3
	3.2	*Chlamydiae pneumonia* and *C. trachomatis*		
	3.3	*Mycoplasma pneumoniae*		
4	4.1	**Hands-on Training:** Systematic study of bacteria Morphology-Staining	30	4
	4.2	Colony characteristics- NA, MA, BA and other selective media		
	4.3	Biochemical Reactions of Bacteria Sugar Fermentation, TSI, Mannitol motility, IMViC, H_2S Production, Urease, Catalase, Oxidase, Nitrate Reduction		
	4.4	Identification of Bacteria: Staphylococcus, *E.coli*, Klebsiella, Proteus, Pseudomonas		
5		Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="4">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<tr><td rowspan="11">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td colspan="2">Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="5">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td colspan="2" rowspan="4">End Semester Examination for 50 marks</td><td>Experiments</td><td>25</td></tr>
<tr><td>Record</td><td>5</td></tr>
<tr><td>Viva voce</td><td>5</td></tr>
<tr><td>Total</td><td>35**</td></tr>
<tr><td colspan="5">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References:

1. Ananthanarayan and Paniker's Textbook of Microbiology R. Ananthanarayan, C.K. JayaramPanikar
2. Practical Medical Microbiology by Mackie and McCartney– 13th edition, Churchill Livingstone.
3. Microbiology, Fundamentals and Applications by Ronald M.Atias (1989). IIedition. Maxwell Macmillan International editions. 44 Syllabus for B.Sc.Microbiology Programme w.e.f. 2017 Admission
4. Medical Microbiology by David Greenwood, Richard C.B.Stack and John Forrest Peutherer (1992). 14thedition. ELBS with Churchill Livingstone.
5. Principles of Bacteriology, Virology and Immunity by Topley / Wilson (1990). VIII editions, Vol.III Bacterial Diseases, Edward Arnold, London.

Suggested Readings

1. Janda, J. M., & Abbott, S. L. (2002). Bacterial identification for publication: when is enough enough? *Journal of Clinical Microbiology*, *40*(6), 1887-1891.
2. Cowan, S. T., & Steel, K. J. (1965). Manual for the identification of medical bacteria. *Manual for the identification of medical bacteria.*

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MEDICAL MYCOLOGY**					
Type of Course	**DSC**					
Course Code	**MG6DSCMBG301**					
Course Level	**300 - 399**					
Course Summary	This course provides a detailed study of fungal taxonomy, anatomy, etiology, epidemiology and control of fungi in infections					
Semester	**VI**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	**1**	**0**	**75**
Pre-requisites, if any	Knowledge of the epidemiology of infectious diseases					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To understand the general characteristics of fungi - reproduction, classification, isolation & cultivation of fungi and the mode of action and uses of antifungal agents.	U	1,2,8
2	Analyse in detail the etiological agents, clinical manifestations, laboratory diagnosis, and treatment of superficial mycoses and cutaneous mycoses	An	1,6,10
3	Analyse in detail the etiological agents, clinical manifestations, laboratory diagnosis, and treatment of subcutaneous mycoses and systemic mycoses	An	1,6,10
4	Identify common fungal contaminants & pathogens by staining, isolation and culture techniques	An	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

MODULE	UNITS	Course description	Hrs	CO No.
1	1.1	**Introduction to mycology**. General characteristics of fungi – yeast and mould, Cell structure, vegetative structure (yeast and mould). Growth and nutrition in fungi. (yeast and mould). Fungal dimorphism. Economic importance of fungi	25	1
	1.2	**Reproduction in fungi** – asexual and sexual (yeast and mould). Classification of fungi principles and approaches. Mycotoxins and Mycetismus. Antifungal agents – mechanism of action and uses.		
	1.3	**Isolation and identification of fungi.** Cultivation of fungi – culture media and cultural characters Routine mycological techniques- Germ tube test, hair perforation test, hair bait technique, slide culture technique, LPCB mount. Staining methods used in mycology- wet mount and differential stain.		
2.	2.1	**Fungal diseases** Etiological agent, clinical manifestations, laboratory diagnosis and treatment. Superficial mycoses – Pityriasis versicolor, Piedra.	10	2
	2.2	Cutaneous mycoses- Dermatophytoses.		
3	3.1	**Fungal diseases** Etiological agent, clinical manifestations, laboratory diagnosis and treatment. **Subcutaneous mycoses** - Mycetoma, Rhinosporidiosis, Sporotrichosis	10	3
	3.2	**Systemic mycoses** - Histoplasmosis, Blastomycosis. Opportunistic mycoses-Aspergillosis, Candidiasis.		
4		**Hands-on training** 1. Cultivation of fungi- preparation of SDA and PDA. 2. Study of colony characters of yeast and mould. 3. Microscopic morphology of molds-*Penicillium, Aspergillus, Mucor, Rhizopus, Fusarium* by LPCB mount examination. 4. Gram staining of yeast 5. Examination of Germ tube-*Candida albicans*	30	4
5		Teacher specific contents		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="4">Classroom Procedure (Mode of transaction)
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<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
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<tr><td>Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time:2 hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
<tr><td></td><td></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References.

1. Chander, J. (2017). *Textbook of medical mycology*. JP Medical Ltd.
2. Alexopoulos, C. J., & Beneke, E. S. (1952). Laboratory manual for Introductory mycology. *Laboratory manual for Introductory mycology.*
3. Sinha, A. K. (1962). *Botany for degree students fungi*. S. Chand Publishing.
4. Neil, K. (1998). Topley and Wilson, Microbiology and Microbial Infections.
5. Rippon, J. W. (1982). *Medical mycology; the pathogenic fungi and the pathogenic actinomycetes*. Eastbourne, UK; WB Saunders Company.
6. Conant, N. F., Smith, D. T., Baker, R. D., & Callaway, J. L. (1971). Manual of clinical mycology. *Manual of clinical mycology.*, (Ed. 3).
7. Dubey, R. C., & Maheshwari, D. K. (2002). *Practical Microbiology, 4/e*. S. Chand Publishing.
8. Cappuccino, J. C., & Sherman, N. (1992). Microbiology: A laboratory manual (pp. 125-179). *New York*.
9. Sharma, K. (2007). *Manual of Microbiology*. Ane Books Pvt Ltd.
10. Aneja, K. R. (2007). *Experiments in microbiology, plant pathology and biotechnology*. New Age International.

Suggested Reading

Wickes, B. L., & Wiederhold, N. P. (2018). Molecular diagnostics in medical mycology. *Nature communications*, *9*(1), 5135.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MEDICAL VIROLOGY**					
Type of Course	**DSE**					
Course Code	**MG6DSEMBG300**					
Course Level	**300 - 399**					
Course Summary	This course aims to provide students an in-depth knowledge and understanding of viruses, the diseases they cause and how they cause them. They also learn how to diagnose, control and prevent infections in individuals and communities. Also, get aware of emerging viral diseases.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic concepts of infection					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the basics of Virology and apply the knowledge for the prevention of emerging and reemerging viral diseases	**U**	**1,2,10**
2	List out different types of Animal DNA viruses	**An**	**1,2,6,10**
3	Analyze the different types of Animal RNA viruses:	**An**	**1,2,6,10**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction and general properties of animal viruses. Replication of animal viruses Bacteriophage structure and replication,	18	1
	1.2	Diagnosis of viral diseases Prophylaxis		
	1.3	**Emerging** and **re-emerging** viruses- Influenza, SARS, Nipah, Coronavirus (Covid-19)-Epidemiology, Symptoms, Prevention, Prophylaxis.		
2	2.1	Characters and pathogenic significance of **Animal DNA viruses:** Poxvirus & Adenovirus.	17	2
	2.2	Herpesvirus – HSV1 & 2, Varicellazoster, CMV, EBV		
3	3.1	Characters and pathogenic significance of **Animal RNA viruses:** Picornavirus - Poliovirus Rhabdovirus Myxovirus – Influenza virus, Mumps & Measles	25	3
	3.2	Arbovirus - Togavirus and Flavivirus		
	3.3	HIV & Hepatitis virus		
4		Teacher specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning ➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning Laboratory instructions, Demonstration of methods & Hands-on experiments		
Assessment Types	**Mode of Assessment**		
	Continuous Comprehensive Assessment (CCA) **4 Credit Theory: 30 Marks**	**Theory**	
		Component	Mark
		Test/Quiz	10
		Seminar	5
		Assignment	5
		Activity (Related to teacher-specific content)	10
		Total	**30**
	End Semester Evaluation	**Theory**	
		Part -A: 1 marks Answer All 5 Questions	5 X 1 = 5
		Part -B: 2 marks	

	(ESE) **4 Credit Theory:** **70 Marks** **Time: 2 Hours**	Any 10 out of 12	10 X 2= 20
		Part - C: 6 Marks Any 5 out of 7	5 X 6 = 30
		Part – D: 15 Marks Any 1 out of 2	1 X 15 = 15
		Total:	**70 marks**

REFERENCES:

1. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
2. Belshe, R. B. (1984). Textbook of human virology. *(No Title)*.
3. Dimmock, N. J., & Primrose, S. B. (1987). Introduction to Modern Virology Oxford.
4. Fenner, F. R. A. N. K. (1995). Classical studies of virus evolution. *Molecular basis of virus evolution. Cambridge Univ. Press, Cambridge, UK*, 13-30.
5. Oxford, J. S., Collier, L. H., & Kellam, P. (2016). *Human virology*. Oxford University Press.
6. Zuckerman, A. J. (2009). *Principles and practice of clinical virology*. John Wiley & Sons.
7. Wilson, S. G. S., & Miles, S. A. (1975). *Principles of bacteriology, virology and immunity*. Edward Arnold.

SUGGESTED READINGS:

1. Emerging Human Viral Diseases, Volume I Respiratory and Haemorrhagic fever-Prudhvi lal bhukya, Suhas T.Mhaske, subash c.Sonkar 2023ISBN : 978-981-99-2819-4
2. Patel M, Goel AD, Bhardwaj P, et al. Emerging and re-emerging viral infections in India. Journal of Preventive Medicine and Hygiene. 2021 Sep;62(3):E628-E634. DOI: 10.15167/2421-4248/jpmh2021.62.3.1899. PMID: 34909490; PMCID: PMC8639133.
3. Bankar N J, Tidake A A, Bandre G R, et al. (October 08, 2022) Emerging and Re-Emerging Viral Infections: An Indian Perspective. Cureus 14(10): e30062. doi:10.7759/cureus.30062
4. Reeta S. Mani • V. Ravi • Anita Desai • S.N. Madhusudana Emerging Viral Infections in India Proc. Natl. Acad. Sci. Sect B. Biol. Sci. (January–March 2012) 82(1):5–21 DOI 10.1007/s40011-011-0001-1

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) microbiology**					
Course Name	**MICROBIOME AND HEALTH**					
Type of Course	**DSE**					
Course Code	**MG6DSEMBG301**					
Course Level	**300 - 399**					
Course Summary & Justification	This course outlines the significance of microbiomes, its applications and benefits in improving human health					
Semester	VI	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites	Knowledge of beneficial microbes					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No
1	Demonstrate the normal microbial flora & Explain the role of the microbiome in disease	U	1, 2
2	Identifying the beneficial effects of microbiome	An	1, 2, 6
3	Applying the microbiome to human health and nutrition	A	1,2,10,3,8

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Unit	Course description	Hrs	CO No.
1	1.1	**Normal flora** The human microbiome – introduction, the composition of human microbiota, functions. Physiological changes during life span.	25	1
	1.2	**Microbiome in Disease** Nutrition, diet and genes		
	1.3	Brief description of human microbiome in disease – Malnourished and obese, cancer, auto-immune disease		

		[Inflammatory Bowel Diseases (IBD)], neurodegenerative disease (Alzheimer's and Parkinson's disease).		
2	2.1	**Merits of microbiome** Beneficial microorganisms. Lactic acid bacteria (GRAS) – characteristics, homo and heterolactic acid fermentation;	15	2
	2.2	Lactobacillus, Bifidobacterium, Streptococcus and their beneficial effects.		
	2.3	Gut-brain axis		
3	3.1	**Applications** Application of the microbiome in food - Probiotics, prebiotics, and symbiotics.	20	3
	3.2	Medical therapy - brief description of Microbial therapies - Fecal microbiota transplantation (FMT) - Treatment for neurodegenerative diseases (Alzheimer's disease) - Cancer treatment (colon cancer)		
4		Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory:
30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory:
70 Marks
Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References

1. Prasad, G. (2007). Normal microbial flora of the human body and host-parasite relationship.
2. Davis CP. Normal Flora. In: Baron S, editor. Medical Microbiology. 4th ed. Galveston (TX): University of Texas Medical Branch at Galveston; 1996. Chapter 6. PMID: 21413249.
3. Masood, M. I., Qadir, M. I., Shirazi, J. H., & Khan, I. U. (2011). Beneficial effects of lactic acid bacteria on human beings. *Critical reviews in microbiology*, *37*(1), 91-98.
4. Bettelheim, K. A. (2000). The Natural History and Ecology of Commensal Human Floras. *Persistent Bacterial Infections*, 101-114.
5. Gomaa, E. Z. (2020). Human gut microbiota/microbiome in health and diseases: a review. *Antonie Van Leeuwenhoek*, *113*(12), 2019-2040.
6. Young, V. B. (2017). The role of the microbiome in human health and disease: an introduction for clinicians. *Bmj*, *356*.

Suggested Readings

1. Diwan, A. D., & Harke, S. N. (2021). Bank on Microbiome to Keep the Body Healthy. *Journal of Nutrition & Food Sciences*, *2*(2), 1-5.
2. Ogunrinola, G. A., Oyewale, J. O., Oshamika, O. O., & Olasehinde, G. I. (2020). The human microbiome and its impacts on health. *International journal of microbiology*, *2020*.
3. Candela, M., Biagi, E., Brigidi, P., O'Toole, P. W., & De Vos, W. M. (2014). Maintenance of a healthy trajectory of the intestinal microbiome during ageing: a dietary approach. *Mechanisms of ageing and development*, *136*, 70-75.
4. Mohajeri, M. H., Brummer, R. J., Rastall, R. A., Weersma, R. K., Harmsen, H. J., Faas, M., & Eggersdorfer, M. (2018). The role of the microbiome for human health: from basic science to clinical applications. *European journal of nutrition*, *57*, 1-14.
5. Kim, B. S., Jeon, Y. S., & Chun, J. (2013). Current status and future promise of the human microbiome. *Pediatric gastroenterology, hepatology & nutrition*, *16*(2), 71-79.
6. Foo, J. L., Ling, H., Lee, Y. S., & Chang, M. W. (2017). Microbiome engineering: Current applications and its future. *Biotechnology journal*, *12*(3), 1600099.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MICROBIAL PROSPECTING**					
Type of Course	**DSE**					
Course Code	**MG6DSEMBG302**					
Course Level	**300 - 399**					
Course Summary	This course will allow students to understand the importance of microbial products over chemically synthesized products and future strategies and innovative areas of research – ethical, biosafety and legal aspects of production.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Should have an awareness of the applications and prospects of microbes					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand the importance of microbial products over chemically synthesized products.	**U**	**1,6**
2	Apply the biochemical and physiological basis of pigment, and flavor compound	**A**	**1,2,10**
3	Analyze bacterial and fungal pigments, genetic engineering in pigments, flavour, its ethical, biosafety and legal aspects of production	**An**	**1,2,6,10**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Scope of the subject**. Scope of the subject. Importance of microbial products over chemically synthesized products .ill effects of chemicals	15	1
	1.2	overall view of microbes involved in pigment, flavour production		
2	2.1	**Isolation and Extraction** Biochemical and physiological basis of pigment and, flavour production .compound synthesis and biocatalysis. Culture-dependent and culture-independent methods to identify the organisms	25	2
	2.2	Techniques used to identify novel potential organisms		
	2.3	**Microbial pigments and their application** Microbial pigments: Bacterial pigments – prodigiosin, violacein and deoxy violacein .fungal pigment- monastic. bacterial and algal carotenoids – astaxanthin		
	2.4	isolation and biological properties – catalysis – its applications and importance		
3	3.1	**Genetic engineering in pigment and flavour production** Genetic engineering in pigment and flavour production	20	3
	3.2	Mass multiplication – upscaling – product recovery – purification of pigments, and flavour compounds		
	3.3	Future strategies and innovative areas of research – ethical, biosafety and legal aspects of production.		
4		Teacher Specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="7">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks

Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td></td><td>Total:</td><td>70 marks</td></tr>
</table>

REFERENCE

1. Margalith P.Z. (1992) Pigment Microbiology, Chapman and Hall.
2. Berger R.G. (Ed.) (2007) Flavours and Fragrances: Chemistry, Bioprocessing and Sustainability, Springer-Verlag

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**FORENSIC DNA ANALYSIS AND PROFILING**					
Type of Course	**DSE**					
Course Code	**MG6DSEMBG303**					
Course Level	**300 - 399**					
Course Summary	This course provides a comprehensive study of the principles, methods & applications of forensic DNA analysis					
Semester	VI	**Credits**			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4	**0**	**0**	0	**60**
Prerequisites, if any	Basic concepts of molecular biology and techniques					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand the principles, and methods of forensic DNA analysis, and its applications in criminal investigations.	U	1,2,6
2	Explain DNA mixture analysis, statistical methods for interpretation, and the challenges associated with complex mixtures as well as emerging trends in DNA analysis	E	1,2,8
3	Analyze Forensic DNA profiling and its application in criminal and civil investigations	An	1,2,6,8
4	Evaluate case studies and practical applications of forensic DNA Analysis	E	1,2,6,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Introduction to Forensic DNA Analysis:** Overview of forensic biology and DNA profiling-historical developments in DNA analysis, legal and ethical aspects of DNA evidence.	**15**	**1**
	1.2	Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.		
	1.3	Collection and preservation of hair samples. Morphological and microscopic examination of human and animal hair.		
	1.4	DNA extraction and quantification: DNA extraction methods from various sample types-quantitative PCR (qPCR) for DNA quantification-quality control measures in DNA extraction.		
2	2.1	**DNA Analysis, Interpretation and Emerging trends in forensic DNA analysis** Short Tandem Repeat (STR) analysis: Introduction to STR markers-capillary electrophoresis for STR analysis-allele calling and interpretation.	15	**2**
	2.2	Advanced DNA profiling techniques: Mitochondrial DNA analysis- Y chromosomal DNA analysis- SNP genotyping for ancestry determination.		
	2.3	Complex DNA mixtures and challenges-statistical methods for mixture interpretation-case studies.		
	2.4	Emerging trends in forensic DNA analysis: Next-generation sequencing (NGS) in forensics-DNA phenotyping and predicting physical traits-ethical considerations in emerging technologies.		
	2.5	DNA database and CODIS (Combined DNA Index System): CODIS and its role in forensic investigations-national and international DNA databases-legal issues and privacy concerns.		
3	3.1	**Forensic DNA profiling and its application in criminal and civil investigations.** Generation and assessment of DNA profiles, Statistical interpretation of DNA profiles, evaluation and presentation of DNA evidence.	15	**3**
	3.2	Lineage markers DNA databanks and their utility in various criminal investigations.		
4	4.1	Forensic DNA evidence in court: expert witness testimony-presentation of DNA evidence in court-cross-examination and challenges	15	4
		Case studies and practical applications: a review of real-life forensic cases-ethical dilemmas in DNA analysis-group discussion and analysis.		
5		Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="14">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="7">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2 hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References:

1. Brown, T; Gene cloning and DNA analysis: An Introduction, 5th ed. Blackwellpublishing, London, 2006.
2. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
3. Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.
4. Primorac, D.&Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.
5. Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed., CRC Press, New York, 2001.
6. Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**DIAGNOSTIC MICROBIOLOGY**					
Type of Course	**SEC**					
Course Code	**MG6SECMBG300**					
Course Level	**300 - 399**					
Course Summary & Justification	This course will provide a descriptive study of the etiology & epidemiology of different types of infections and practical concepts of diagnosis and treatment					
Semester	VI	Credits			**3**	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	**0**	**1**	**0**	**60**
Pre-requisites	Prior knowledge of infectious microorganisms, pathogenesis and control measures					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No
1	To Apply the microbiology laboratory safety mechanisms.	A	2,6,8,10
2	To choose the appropriate methods of specimen, collection, transport and processing.	A	2,6,9,10
3	To apply techniques in diagnostic microbiology.	A	2,10
4	To understand the principles of sanitation, waste segregation and its disposal.	U	2,6
5	To demonstrate the pathogenicity and antibiotic sensitivity of microorganisms	A	4,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transactions (Units)

MODULE	UNIT	Course description	Hrs	CO No.
1	1.1	**Microbiology Laboratory Safety** General safety principles in microbiology laboratory (WHO safe codes). Universal precautions for blood and body fluids, PPE. Biological safety cabinets, bio-safety levels, and classification of biological agents based on hazards. Laboratory-associated infections, Nosocomial infections.	15	1
	1.2	**Collection, Transport and Examination of specimens** General guidelines for collection and transport of specimens (including mailing of biohazardous materials) and its disinfection and disposal. Scheme for collection, transport and microbiological examination of Sputum, CSF, blood, urine, stool, wound aspirates, urogenital specimens, throat swabs, nasal swabs and oral swabs.		
2	3.1	**Techniques in Diagnostics.** Antimicrobial susceptibility tests- MIC, MBC. Disc diffusion- Kirby Bauer test, Stokes method, Epsilometer test. Dilution test- Broth dilution and Agar dilution. Antibiotic assay in body fluids.	15	2
	3.2	Applications of serological and molecular techniques in diagnostic microbiology- agglutination, precipitation, immunofluorescence, ELISA, PCR, Automation in Clinical Microbiology.		
3	3.1	**Hands-on training** Aseptic practices in clinical labs- Surface disinfection, hand sanitation, Management of safety cabinets.	30	3
	3.2	Isolation of normal flora from oral, skin specimens.		
	3.3	Isolation of pathogens/microorganisms from clinical specimens-urine, pus swab, sputum, throat swab. (should include the processing of specimens)(any two desired)		
	3.4	Antimicrobial susceptibility tests diffusion- Kirby Bauer test.		
4		Teacher specific contents		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="4">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
2 Credit Theory: 15 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>2.5</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>2.5</td><td>Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>15</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">*Adjusted to 7.5 for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
2 Credit Theory: 35 Marks
Time: 1.5 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 1= 10</td><td rowspan="2">Experiments</td><td rowspan="2">25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>3 X 5 = 15</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>35 marks</td><td>Total</td><td>35**</td></tr>
<tr><td colspan="3"></td><td>**Adjusted to 7.5 for final calculation</td></tr>
</table>

References

1. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries. Cambridge University Press.2nd ed.
2. Mackie, T.J., McCartney, J.E., and Collee, J.G. (1989). Mackie & McCartney practical medical microbiology. Churchill Livingstone, 13th ed
3. Black, J.G. (1999). Microbiology: principles and explorations. Prentice Hall International, London. 4th ed. 10. Kindt, T.J., Goldsby, R.A., Osborne, B.A., and Kuby, J. (2006).
4. Forbes, B.A., Sahm, D.F., Weissfeld, A.S., and Bailey, W.R.D.m. (2007). Bailey & Scott's diagnostic microbiology. Elsevier, Mosby, London. 12the
5. Ananthanarayan, R., and Paniker, C.K.J. (2006). Textbook of microbiology (Orient Blackswan) 7th ed.
6. Cappuccino, J.G., and Sherman, N. (2008). Microbiology: A Laboratory Manual (Pearson/Benjamin Cummings. 9thed.
7. Prescott LM, Harley JP & Klein DA (2005) Microbiology (McGraw-Hill, Boston; London) 6th ed.
8. Topley, W.W.C., Wilson, G.S., Parker, T., and Collier, L.H. (1990). Topley and Wilson's Principles of Bacteriology, Virology and Immunology (Edward Arnold)

Suggested readings

1. Blair, J.E.e., Lennette, E.H.e., and Truant, J.P.e. (1970). Manual of clinical microbiology. American Society for Microbiology, Bethesda, Md.
2. Lennette, E.H., Balows, A., Hausler, W.J., and Shadomy, H.J. (1985). Manual of clinical microbiology. American Society for Microbiology, Washington, D.C. 4thed.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**GOOD MANUFACTURING PRACTICES**					
Type of Course	VAC					
Course Code	**MG6VACMBG300**					
Course Level	**300 - 399**					
Course Summary	The course Good Manufacturing Practices outlines the concepts, regulations, standards and processing of Microbial products					
Semester	**VI**	Credits			**3**	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	0	0	45
Pre-requisites, if any	Basic knowledge of concepts of sterilization, asepsis and containment in industrial processes					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	To understand the concept of GMP	U	1,4,3
2	To list out the GMP regulations and standards	U	1,3,4,6,10
3	To understand the components of GMP	U	4,8,10
4	To illustrate the processing of GMP	U	3,4,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Introduction to GMP** History and Definition of GMP, Requirements of GMP, Principles related to GMP, GMP documentation, basic procedures in GMP. Key elements of GMP, Importance of GMP Categories of GMP. Applications of GMP	15	1
	1.2	**GMP regulation and standards** US FDA Regulations, Cgmp, W H O Regulations. China – National Medical Products Administration(NMPA), European Medicines Agency (EMA) Regulations, FSSAI, ISO, BIS, NABL, GMP, AUDIT, HACCP, Comparison with other Quality standards.		
2	2.1	**Components of GMP** Premises - Buildings, Facilities, Equipment, Utilities. Personnel –Training, -Research & Development, Production & Process controls- Quality Control, Quality Assurance, Distribution control Engineering and Maintenance, etc.	15	2
	2.2	Workflow of Warehouse Management, Receipt and Handling of Raw Materials and Good Distribution Practices		
3	3.1	**Processing of GMP** Packing Materials, labelling, Solvents, Hazardous Material, Miscellaneous Materials, Intermediates and Finished Products, Dispensing., GMP practices in bacterial Upstream process, and downstream,	15	3
	3.2	Process Filling of various dosage forms, Packing and Dispatch of Finished Products		
4		Teacher specific contents		

<table>
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<tr><td rowspan="11">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory:
25 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>5</td></tr>
<tr><td>Total</td><td>25</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory:
50 Marks
Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td></tr>
<tr><td>Total:</td><td>50 marks</td></tr>
</table>

References

1. https://www.pharmaknowledgecentre.com/wp-content/uploads/2018/07/Good-Manufacturing-Practice- min.pdf
2. Quality system & control for pharmaceutics by published John Wiley & sons Ltd p. 57-69.
3. Quality Assurance of Pharmaceuticals – A Compendium of guidelines & related material vol-2 GMP & inspection, published by Pharma Book Syndicate, Page.No.- 6-83
4. www.Scribd.com/doc/5554035/The- Ten -Principles-of- GMP
5. www.fda.gov/cosmetics/guidancecomplianceregulatoryinformation/good

SEMESTER-VII

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**ADVANCED IMMUNOLOGY**					
Type of Course	**DCC**					
Course Code	**MG7DCCMBG400**					
Course Level	**400 - 499**					
Course Summary	The course is intended for honours degree students to comprehend the molecular events leading to humoral and cell-mediated immunity of the body. This course will give an account of MHC and cytokines. Completion of this course will equip students a practical skills to serological tests including immune diffusion assays.					
Semester	VII	**Credits**			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	**1**	0	**75**
Prerequisites, if any	Preferred to complete a fundamental course in immunology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the role of Cytokines and MHC in the immune response	A	1,2
2	Explain the steps involved in T cell and B cell maturation, activation and proliferation. Explain the Generation of Antibody diversity	A	1,2
3	Analyse the role of the immune system in health and disease Explain Advanced Immunological Techniques	An	1,2
4	Perceive practical skills in immunological techniques, data interpretation and troubleshooting common challenges encountered during the performance of Serological tests.	E	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Role of Cytokines and MHC in Immune Response**	**12**	
	1.1	Cytokines- properties, Mode of action-autocrine, paracrine and endocrine action, Functions of cytokines		1
	1.2	MHC-Class I & Class1I molecules -structure and functions, MHC restriction		1
	1.3	Steps in Antigen processing and presentation		1
2		**Details of Cell-mediated Immune Response & Details of Humoral immune response**	**20**	2
	2.1	T cell maturation in the thymus, Thymic selection- Positive and negative selection, Structure of TCR		2
	2.2	T helper cell activation-formation of tri-molecular complex, Signal transduction, Immunological synapse; T cell differentiation-Generation of effector and memory cells		2
	2.3	B cell maturation in bone marrow B cell activation- Thymus-dependent activation and Thymus-independent activation.		2
	2.4	B cell differentiation- Formation of plasma cells, memory cells and antibody production. Generation of Antibody Diversity.		2
3		**Immune system in health and diseases**	**13**	
	3.1	Immune response to infectious diseases - viral, bacterial, protozoan, and helminths		3
	3.2	Immunological Tolerance-Central and peripheral		3
	3.3	Tumour immunology, Transplantation immunology		3
	3.4	Vaccines-types and uses		3
	3.5	Advanced immunological techniques and applications of different types of ELISA, RIA, HLA typing, Western blotting, immunomagnetic precipitation, and flow cytometry		3
4		**Hands-on Training on** Identification of various immune cells by Leishman staining, Differential count and Total Count, Hemagglutination, CRP, Radial Immunodiffusion (RID), Ouchterlony Double Immunodiffusion (ODD), Sandwich ELISA	**30**	4
5		**Teacher specific content**		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<tr><td rowspan="11">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks Any 10 out of 12</td><td>10 X 2 = 20</td><td>Experiments</td><td>25</td></tr>
<tr><td>Part - B: 5 Marks Any 4 out of 6</td><td>4 X 5 = 20</td><td>Record</td><td>5</td></tr>
<tr><td>Part – C: 10Marks Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
<tr><td></td><td></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References

1. Kindt, T. J., Richard A. G., Barbara A. O., and Kuby J. (2007). *Kuby immunology*. Macmillan.
2. Ananthanarayan, R. (2006) *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
3. Delves, Peter J., Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt. (2017) *Roitt's essential immunology*. John Wiley & Sons.
4. Latha, Madhavee P. *A (2012) Textbook of Immunology*. S. Chand Publishing.
5. Kannan I(2021).*Immunology.* MJP Publishers, Chennai.

SUGGESTED READINGS

1. Rao, C. Vaman.(2005) *Immunology: A textbook*. Alpha Science Int'l Ltd.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MOLECULAR MICROBIOLOGY AND GENETIC ENGINEERING**					
Type of Course	**DCC**					
Course Code	**MG7DCCMBG401**					
Course Level	**400 - 499**					
Course Summary	The course provides comprehensive knowledge of molecular methods of microbial identification, typing and gene manipulation.					
Semester	**VII**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	**60**
Prerequisites, if any	Basic knowledge of molecular biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the concepts and methods of Molecular Identification of bacteria, fungi and algae and applications of metagenomics	A	1,2,4,10
2	Analyse the tools and techniques used in genetic engineering	An	1,2,10
3	Determine the physical, chemical and biological gene transfer methods	A	1,2
4	Assess the applications of rDNA technology	E	3,7,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Molecular Taxonomy** Introduction to Molecular Identification- Signature sequences - 16S rRNA sequence, and Fungal ITS sequencing, COX or COI sequence.	4	1
	1.2	Molecular typing methods: Pulsed Field Gel Electrophoresis, PCR-based microbial typing, Genotyping by Variable Number Tandem Repeats, Multilocus Sequence Typing, DNA sequencing - Sangers dideoxy sequencing.	8	
	1.3	Unculturable bacteria and Metagenomics.	3	
2	2.1	**Tools and techniques for genetic Engineering** History of rDNA Technology, Cohen and Boyer Patents, Isolation of genetic material. Modification of genetic material for the preparation of r DNA- Enzymes for in vitro modification of nucleic acids– Kinases, Phosphatases, Exonucleases, Restriction Endonucleases, Ligases and Terminal Transferases. Types and properties of restriction enzymes.	5	2
	2.2	Modification of Ends - Adapters, Linkers, Homopolymer Tailing.	3	
	2.3	**Cloning Vectors**- Plasmids and their desirable properties, E coli-based vectors pBR322, pUC19. Bacteriophages λ EMBL. Ti plasmids Brief explanation on Cosmids, Phasmid, Shuttle vectors, YAC, BAC, Artificial chromosome	7	
3	3.1	**Transformation of host cells** Artificial transformation and transfection of Bacteria Gene transfer methods – Agrobacterium-mediated, Microinjection & electroporation, Gene transfer by Chemical method - PEG mediated, Liposomes, biolistic method	5	3
	3.2	Markers in prokaryotes. Selection of recombinants. Blue-white screening, screening for Antibiotic resistance.	5	
	3.3	Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening.	5	
4	4.1	**Applications of recombinant DNA technology** Production and purification of recombinant proteins - insulin and somatostatin. Metabolite engineering.	5	

	4.2	GMOs – Golden rice, BT Cotton, Corn Genetically modified bacteria – Superbug	5	4
	4.3	Gene therapy. Gene Silencing through RNA interference and antisense therapy.	5	
5		Teacher specific content		

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<tr><td rowspan="7">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory:
30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory:
70 Marks
Time: 2 hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
<tr><td>Part -B: 2 marks
Any 10 out of 12</td><td>10 X 2= 20</td></tr>
<tr><td>Part - C: 6 Marks
Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
<tr><td>Part – D: 15 Marks
Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><td>Total:</td><td>70 marks</td></tr>
</table>

References

1. Madigan, M. T., & Martinko, J. M. (2006). Brock Biology of Microorganisms, 628 Pearson Prentice Hall: Upper Saddle River.
2. Macleod, D. (2006). Gene Cloning and DNA Analysis, TA Brown. Blackwell Publishing. 2006. 408 pages. ISBN 1405111216. Price£ 29.95.(paperback). *Genetics Research*, *88*(1), 77-77.
3. Primrose, S. B., & Twyman, R. (2006). *Principles of gene manipulation and genomics*. John Wiley & Sons.
4. Dale, J. W., Von Schantz, M., & Plant, N. (2011). From genes to genomes: concepts and applications of DNA technology.
5. Singh, B. D., Singh, B. D., & Singh, B. D. (2005). *Biotechnology*. Campus Books International.
6. Jogdand, S. N. (2009). *Gene biotechnology*. Himalaya Publishing House.

Suggested Reading

1.. Higuchi, R., Gyllensten, U., & Persing, D. H. (2011). Next-generation DNA sequencing and microbiology. *Molecular Microbiology: Diagnostic Principles and Practice*, 299-312.
2.. Sambrook, J., & Russell, D. W. (2001) Molecular cloning: A laboratory manual

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Microbial Process Technology**					
Type of Course	**DCC**					
Course Code	**MG7DCCMBG402**					
Course Level	**400 - 499**					
Course Summary & Justification	This course equips students with the knowledge of principles of Microbial process Technology, working knowledge on different types of bioreactors, downstream processing and major industrial bioprocess.					
Semester	VII	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites	Completion of 300-level courses in microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No
1	Explain the principles of fermentation technology	A	1,2
2	Distinguish different types of Bioreactors	An	1,2,6
3	Explain different methods of strain improvement.	E	1.2.6
4	Identify the various steps involved in the production of different metabolites.	An	1,2,6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Principles of bioprocess	15	1
	1.2	Importance of fermentation technology In Food and Pharmaceutical industries		
	1.3	Chronological developments in the field of Bioprocess Technology.		
2	2.1	Stirred Tank Bioreactor		2
	2.2	Types Of Bioreactors-: Airlift, Continuous Stirred tank Bioreactor, Tower Fermenter, Packed Column bioreactor, Fluidized bed bioreactor		
	2.3	Bioprocess monitoring and Control - PH, temperature, Foam, medium components on product synthesis. (Offline, online, inline)		
3	3.1	Strain improvement Techniques- Classical methods and Molecular approaches: Selection of Natural variants Mutagenesis and selection of induced mutants	15	3
	3.2	Recombination Methods- Protoplast fusion, Para sexual cycle in fungi		
	3.3	Recombinant DNA technology for strain improvement		
	3.4	Improvement of characters other than product yield		
4	4.1	Downstream processing and Purification and assay of Primary metabolites and Secondary metabolites in microbial processes and assay of fermentation products(physical, chemical, biological)	15	4
	4.2	Organic acid-citric acid; Alcohol- Ethanol		
	4.3	Aminoacids- Lysine, Glutamic acid; Antibiotics- Penicillin, Streptomycin		
	4.5	Visit to fermentation unit		
5		Teacher specific content		

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<tr><td rowspan="11">Assessment Types</td><td colspan="4">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="3">Theory</td></tr>
<tr><td colspan="2">Component</td><td>Mark</td></tr>
<tr><td colspan="2">Test/Quiz</td><td>10</td></tr>
<tr><td colspan="2">Seminar</td><td>5</td></tr>
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<tr><td colspan="2">Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td colspan="2">Total</td><td>30</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2 Hours</td><td colspan="2">Theory</td><td></td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td colspan="2">5 X 1 = 5</td></tr>
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</table>

References

1. Schwartz, W. . (1969) "LE Casida Jr., Industrial Microbiology
2. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. (2013) *Principles of fermentation technology*. Elsevier,
3. Patel, Arvind H. (2012) *Industrial Microbiology*. Trinity Press,
4. Prescott, S.C. and Dunn, C.G., (1983), Industrial Microbiology, Reed G. (Ed.). AVI Tech books.
5.

Suggested Reading

1. Crueger W. and Crueger A. (2005) Biotechnology: A textbook of Industrial Microbiology second edition, Panima Publishing corporation

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Research Methodology and Biostatistics**					
Type of Course	DCE					
Course Code	**MG7DCEMBG400**					
Course Level	**400 - 499**					
Course Summary	The course provides a comprehensive knowledge of research methodology and statistical analysis of data					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	No					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain types of research, research methods and research design	A	1
2	Explain and interpret the steps in research from sampling to reporting	An	1,2
3	Evaluate the role of statistics in research	E	1,2
4	Explain different software packages that help in research	A	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Essentials of Research Methodology** Meaning- Objectives-motivation-Significance of research, types of research, Research methods and methodology, Research and Scientific Method, Criteria of Good research, Problems of researcher	15	1
	1.2	Selection of the problem: Criteria for selection of problem and evaluating problems, Statement of problem formulation and definition		
	1.3	Research design: Meaning, need for research design, Features and important concepts relating to research design, Different research design, Basic principles of experimental design.		
	1.4	Survey of literature: Different methods of literature survey, sources of information, internet, search engines, websites, recording surveying information		
	1.5	Hypothesis: Nature and types of hypothesis		
2		**Proficient Research Practices – Sampling to Reporting**	15	2
	2.1	Sample and Sampling: Sample - meaning, types. Sampling - Unit of sampling, population: techniques, characteristics of good samples, Sampling errors and ways to reduce them.		
	2.2	Collection and analysis and interpretation of data: Procedure of data collection, analysis and interpretation of data.		
	2.3	Research report: Features of the report, format of research report, references pattern.		
3		**Statistics for Data Analysis in Research**	15	3
	3.1	Data collection and representation.		
	3.2	Measures of Central Tendencies – Mean, Median and Mode		
	3.3	Measures of Dispersion - Range, Mean deviation, Standard Deviation and Co-efficient of Variation.		
4		**Probability and Statistical Inference**	15	4
	4.1	Probability distributions - Binomial, Poisson and Normal		
	4.2	Testing of Hypothesis: Null and Alternative Hypothesis – Two types of error – Level of significance. Test based on student t-test, Chi-Square, ANOVA.		
	4.3	Software packages – EXCEL, SPSS		
5		Teacher specific Content		

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</table>

References

1. Gupta S P, Statistical methods, Sultan Chandh, New Delhi
2. Gurumani N, Research methodology for Biological Sciences, MJP Publishers Chennai
3. Holmes Debbie Moody Peter Dine Diana, Research methods for the biosciences.Oxford, Newyork.
4. Jayaraman K, Handbook on statistical analysis in forestry research. Kerala Forest Research Institute Peechi.
5. Kothari C R, Research methodology: methods and techniques, Wiswa Prakashan New Delhi
6. Biostatistics for medical, nursing and pharmacy students.a.indrayan and L. Satyanarayana.
7. Statistics for Biologists.Campbell. R

SUGGESTED READINGS

1. Fundamentals of Biostatistics. Bernard Rosner

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**IPR and Bioethics in Microbiology**					
Type of Course	**DCE**					
Course Code	**MG7DCEMBG401**					
Course Level	**400 - 499**					
Course Summary	Upon completion of this course, students will have a comprehensive knowledge of IPR, patenting and ethical and legal implications					
Semester	**VII**	**Credits**			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	**60**
Prerequisites, if any	No					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline of the significance of Intellectual Property Rights and its types	U	1,2,6
2	Explain the Laws of IPR, Agencies involved and Databases of Patents	A	1,2,8
3	Importance of Intellectual Property Rights in Microbiology	E	1,2,10
4	Evaluate the ethical and legal implications of Microbiology	E	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Overview of Intellectual Property Rights**	**15**	**1**
	1.1	Introduction to Intellectual Property Rights (IPR), Importance of protecting scientific discoveries		**1**
	1.2	Qualification for a Patent – Novel, Commercial & Non-obvious		**1**
	1.3	Types of IPR: Copyright, Trademarks, Patents, Trade Secrets, Industrial Designs, Geographical Indications, Traditional Knowledge, Plant Variety Rights, Database Rights		**1**
2		**Production and Characterization of nanoparticles**	**10**	**2**
	2.1	Indian Patent Act 1970; Recent Amendments; Patent application-forms, guidelines, Process of filing of a patent application, Rights of patent holder. Basmati rice patent issue: a case study		**2**
	2.2	Agencies involved in patenting: Indian -CGPDTM, IPO, NBA and International- WIPO, EPO, USPTO		**2**
	2.3	Patent databases: Indian Databases -Indian Patent Office (IPO) Database, National Biodiversity Authority (NBA) Database. International Databases- WIPO database, USPTO, European Patent Office (EPO) database.		**2**
3		**Intellectual Property Rights for Microbiology**	**15**	**3**
	3.1	Copyright principles and application to microbiological works access and copyright issues in scientific publications, Ethical considerations in using copyrighted materials		**3**
	3.2	Trademarks in microbiology- Protection of microbial strains and products, Patenting of microbes- Patent protection to GMO, Access and benefit-sharing in microbial resources,- International agreement- Ex: Nagoya Protocol, International Microorganism Deposit system of WIPO		**3**
	3.3	Emerging issues in IPR and Microbiology -Gene editing technologies (CRISPR), Nanotechnology in microbiology, Microbiome-related IPR challenges Patent infringements and litigations in Microbiology		**3**
4		**Bioethics**	**20**	**4**
	4.1	Introduction to Bioethics- Ethical and legal implications of Microbiology, Examples for historical cases of ethical issues in microbiology research		**4**
	4.2	Ethics in conduct of Research- Scientific integrity and misconduct, Authorship and publication ethics, Data management and sharing, Access to microbial resources and benefits sharing, collaboration, Balancing competing interests		**4**
	4.3	Ethical challenges and issues in studying pathogens- Dual-use research of concern (DURC) with examples, Bio-weapons and Bio-terrorism with examples, Ethical considerations in environmental monitoring, Impact of microbial activities on the environment- Biohazard risks		**4**

	4.4	Vaccines- Vaccine preparation & trials. Antiviral Drug- phases of drug trials, Biosecurity, Animal testing and alternatives Genetically modified Organisms- Biosafety and environmental safety concerns, GMO in India, Labelling of GM foods.		**4**
	4.5	Regulatory bodies in India and GEAC, ICMR, DBT, and Institutional Ethics Committees (IECs).		**4**
5		**Teacher specific content**		

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4 Credit Theory:
30 Marks</td><td colspan="2">Theory</td></tr>
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70 Marks
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References:

1. Intellectual Property: A Very Short Introduction by Siva Vaidhyanathan
2. Intellectual Property Rights in Biotechnology Worldwide by Heinz Goddar and Manja Sachet
3. Intellectual Property Laws, P. Narayanan, Eastern Law House.2001
4. Intellectual Property Laws, Meenu Paul, Allahabad Law Agency.2009
5. Bioethics: Principles, Issues, and Cases by Lewis Vaughn
6. Biotechnology, John E. Smith, 3rdEd.Cambridge University Press.

Suggested Reading

7. https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_113_1_The_Patents_Act_1970_-_Updated_till_23_June_2017.pdf
8. http://www.w3.org/IPR/
9. http://www.wipo.int/portal/index.html.en
10. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
11. https://ipindia.gov.in/
12. https://www.wipo.int/portal/en/index.html
13. https://www.cbd.int/abs/infokit/revised/web/factsheet-nagoya-en.pdf
14. https://testbook.com/ias-preparation/indian-patent-act

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**AMR AND ONE HEALTH APPROACH**					
Type of Course	**DCE**					
Course Code	**MG7DCEMBG402**					
Course Level	**400 - 499**					
Course Summary & Justification	Upon completion of this course, students will acquire knowledge of anti-microbial resistance,					
Semester	VII	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	**0**	**0**	**0**	**60**
Pre-requisites	**No**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	explain the key concepts of AMR.	A	2,6
2	Analyse the mechanisms of development of AMR.	An	1,6,10
3	Evaluate the resistance patterns of AMR organisms.	E	2,6
4	To apply the concepts of one health approach.	A	2,7,8,10
5	To apply the surveillance and preventive strategies in AMR.	A	2,7,8

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction

Module	Units	Course description	Hrs	CO No.
1		**Introduction to AMR**	**15**	**1**
	1.1	Antimicrobial agents- definition and types- Antibiotics, Antifungal, Antiviral and Antiprotozoal drugs.	3	1
	1.2	Antimicrobial resistance- definition, MDR, XDR, PDR.	2	1

	1.3	Reasons for AMR- indiscriminate use, use in poultry and agriculture, self-medication, industrial pollution, untreated disposal of sewage water bodies.	4	1
	1.4	Effects of AMR. Hospital as a hub of AMR. AMR in the environment and spread of AMR.	3	1
	1.5	Brief of antibiotic-resistant genes (ARGs). Brief of biofilm and AMR, Brief of Quorum sensing.	3	1
2		**Mechanisms of AMR.**	**15**	**2**
	2.1	Causes of antimicrobial resistance- natural resistance, Acquired resistance- selective pressure, mutation and gene transfer (brief account).	3	2
	2.2	Mechanisms of antimicrobial resistance- Altered target sites- (modified Penicillin-binding proteins), Production of antibiotic inactivating enzymes (beta-lactamases), Altered membrane permeability (disruption of membrane), Efflux pumps. (ABC transporters)	12	2
3		**AMR organisms**	**14**	**3**
	3.1	Methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-resistant Enterococci (VRE), Multi-drug Resistant Tuberculosis (MDR-TB), ESBL-producing Enterobacteriaceae, Carbapenam resistant Pseudomonas, ESKAPE pathogens. Quinine-resistant malaria, Drug-resistant candida, Anti-retroviral resistance.	14	3
4		**One Health Approach & Prevention of AMR**	**16**	
	4.1	Introduction to one health approach. Integration of human, animal and environmental health. Global health Vs. One health,	4	4
	4.2	Applications of One Health approach- prevention of AMR, emerging infectious diseases, food safety and zoonotic infections. A brief account of National One Health Mission.	4	4
	4.3	Antibiotic policy, surveillance in health care centres. Brief of environmental monitoring of AMR, Alternate treatment options- phage therapy, plant extracts.	4	5
	4.4	Brief of Global Action Plan on Antimicrobial Resistance (GAP), Brief of National Action Plan on Antimicrobial Resistance (2017-21). Kerala Antibiotic Resistance Strategic Action Plan (KARSAP)	4	5
5		Teacher specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning ➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning Laboratory instructions, Demonstration of methods & Hands-on experiments	
	Mode of Assessment	
	Theory	
	Component	Mark

Assessment Types	**Continuous Comprehensive Assessment (CCA)** **4 Credit Theory: 30 Marks**	Test/Quiz	10
		Seminar	5
		Assignment	5
		Activity (Related to teacher-specific content)	10
		Total	**30**
	End Semester Evaluation (ESE) **4 Credit Theory: 70 Marks** **Time: 2 Hours**	**Theory**	
		Part -A: 1 marks Answer All 5 Questions	5 X 1 = 5
		Part -B: 2 marks Any 10 out of 12	10 X 2= 20
		Part - C: 6 Marks Any 5 out of 7	5 X 6 = 30
		Part – D: 15 Marks Any 1 out of 2	1 X 15 = 15
		Total:	**70 marks**

References

1. Kon, K., Rai, M. (2016). Antibiotic Resistance: Mechanisms and New Antimicrobial Approaches. Netherlands: Elsevier Science.
2. Antibiotic Resistance: Mechanisms and Antimicrobial Approaches. (2022). United States: States Academic Press.
3. Prescott LM, Harley JP, & Klein DA (2005) Microbiology (McGraw-Hill, Boston; London) 6th ed.
4. One Health: People, Animals, and the Environment. (2014). United Kingdom: Wiley.
5. WHO Guidelines on Use of Medically Important Antimicrobials in Food-producing Animals. (2017). Philippines: World Health Organization.
6. Black, J. G., Black, L. J. (2018). Microbiology: Principles and Explorations. United Kingdom: Wiley.
7. Tortora, G. J., Funke, B. R., Case, C. L. (2010). Microbiology. United Kingdom: Pearson Benjamin Cummings.

SUGGESTED READINGS

1. https://ncdc.mohfw.gov.in/index1.php?lang=1&level=1&sublinkid=105&lid=56
2. https://main.mohfw.gov.in/sites/default/files/3203490350abpolicy%20%281%29.pdf
3. https://main.icmr.nic.in/sites/default/files/upload_documents/AMR_Annual_Report_2021.pdf

SEMESTER-VIII

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Advanced Techniques in Microbiology**					
Type of Course	**DCC**					
Course Code	**MG8DCCMBG400**					
Course Level	**400 - 499**					
Course Summary	An advanced course on molecular methods of identification, detection and characterization of metabolites					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Prerequisites, if any	Knowledge of microbial genetics, molecular biology and bioinformatics.					

COURSE OUTCOMES (CO)
Content for Classroom transaction

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Apply the advanced methods of bacterial Identification and next-generation sequencing	**A**	2,9,10
2	Execute the Molecular markers for the identification of bacteria	**A**	1,8
3	Explain the Microbial Metabolites and their activities	**A**	2,6
4	Compare separation methods of metabolites from Bacteria	**An**	2,10
5	Evaluate characteristics of Biomolecules	**E**	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction

Module	Unit	Course description	Hrs	CO No.
1		**Methods & Techniques for Identification of Bacteria**	**20**	**CO1**
	1.1	Molecular Characterization of Bacteria – DNA Isolation, PCR-Types & Application,	4	1
	1.2	Bacterial Molecular Markers- SSR, ISSR, AFLP. Micro RNA, Si RNA, CRISPR-CAS9.system, Fluorescence In –Situ Hybridization (FISH).	5	1
	1.3	Ribotyping and Matrix-assisted Laser desorption/ionization-time of flight-mass spectroscopy, (MALDI-TOF).	4	1
	1.4	Principles, Applications and differences of Proteomics & Genomics, Micro Array, Metagenomics,	4	2
	1.5	Automation & Rapid identification techniques. Pyrosequencing, Next Generation Sequencing.	3	2
2		**Assay of Microbial Metabolites**	**12**	**3**
	2.1	Bioactive Compounds –Bacterial enzymes- Amylase, Cellulase, Bacterial Pigments – Carotenoids, Pyocyanin, Biopeptides –Bacteriocins, Bacterial Biosurfactants Antibiotics- from Actinomycetes –*Streptomyces* sp & Fungus-*Penicillium* sp.	6	3
	2.2	Biological Activities of Microbial metabolites-Antibacterial Antifungal, Anticancerous (Cell cytotoxicity), Antioxidant Activities (DPPH Method).	6	3
3		**Separation and purification of Biomolecules**	**14**	**4**
	3.1	Separation of Biomolecules – Extraction methods-Precipitation method, Solvent extraction, Principle, and applications of Paper and Thin layer Chromatography	4	4
	3.2	Purification Methods - HPTLC, Ion –Exchange, Liquid chromatography, HPLC, GC-MS, LC-MS and Fast Protein Liquid Chromatography (FPLC), Flow cytometry.	10	4
4		**Characterization Methods of Biomolecules**	**14**	5
	4.1	Principle and applications of Field Emission Scanning Microscopy(FESEM), Scanning Electron Microscopy-Energy Dispersive X-ray spectroscopy (SEM-EDAX), Fourier Transform Infra-Red (FTIR) and Fluorescence spectroscopy.	10	5
	4.2	Characterization Methods of Macromolecules - X-ray crystallography, Nuclear magnetic resonance spectroscopy (NMR).	4	5
5		Teacher specific Content		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="12">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
<tr><td>Test/Quiz</td><td>10</td></tr>
<tr><td>Seminar</td><td>5</td></tr>
<tr><td>Assignment</td><td>5</td></tr>
<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2 Hours</td><td colspan="2">Theory</td></tr>
<tr><td>Part -A: 1 marks
Answer All 5 Questions</td><td>5 X 1 = 5</td></tr>
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Any 10 out of 12</td><td>10 X 2= 20</td></tr>
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Any 5 out of 7</td><td>5 X 6 = 30</td></tr>
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Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
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</table>

References

1. TA Brown. Gene Cloning and DNA Analysis An Introduction 7ED (PB 2016).Wiley Blackwell.
2. Sandy B. Primrose, Richard Twyman.Principles of Gene Manipulation and Genomics, 7th Edition.ISBN: 978-1-405-13544-3 January 2006 Wiley-Blackwell.
3. Sue Carson, Heather B. Miller, Melissa C. Srougi, D. Scott Witherow.Molecular Biology Techniques.A Classroom Laboratory Manual.4th Edition - March 5, 2019.

4.Tortora, G. J., Funke, B. R., Case, C. L. (2010). Microbiology. UnitedKingdom: Pearson. Benjamin Cummings.

5. Prescott LM, Harley JP, & Klein DA (2005) Microbiology (McGraw-Hill, Boston; London) 6th ed.

Suggested reading

1. James D. Watson, A. Baker Tania P. Bell Stephen. , Gann Alexander, Levine Michael, Losick Richard Molecular Biology Of The Gene. 2017.
2. Michael R. Green, Joseph Sambrook, Sambrook Molecular cloning: a laboratory manual.4th ed.Publisher: Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., ©2014.

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MICROBIAL NANOTECHNOLOGY**					
Type of Course	**DCC**					
Course Code	**MG8DCCMBG401**					
Course Level	**400 - 499**					
Course Summary	This advanced course prepares students with knowledge of the significance, applications and ethical and safety considerations of the subject of Nano-microbiology. This course provides a know-how on the production and characterization of nanoparticles.					
Semester	VIII	**Credits**			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	**60**
Prerequisites, if any	Knowledge of microbiology and instrumentation					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline of the scope and significance of Microbial Nanotechnology	U	1,2
2	Explain the production and characterization techniques of nanoparticles	A	1,2,3
3	Importance of Microbial Nanotechnology in various fields	E	1,2,3
4	Evaluate the Biosafety aspects and concerns of nanoparticles	E	1,2,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Microbial Nanotechnology**	**15**	**1**
	1.1	Definition and scope of nanotechnology, Historical development, Significance in various fields, including microbiology		**1**
	1.2	Properties of nanomaterials- Size-dependent, Optical, Mechanical, Electrical and Electronic, Magnetic, Chemical Reactivity, Thermal Properties, Biocompatibility, Self-Assembly		
	1.3	Microbial interactions with nanomaterials- Antimicrobial, Biocompatibility, toxicity, Effect on biofilm formation, environmental bioremediation		**1**
2		**Production and Characterization of nanoparticles**	**15**	**2**
	2.1	Nanoparticles Synthesis methods: Classification- Mechanical, Physical, Chemical and Biological methods; Bottom-Up Synthesis and Top-Down Synthesis with a few examples		**2**
	2.2	A Brief Account of Mechanical methods-Milling Physical methods are Vapour Deposition, Sputtering, Laser Ablation, and Laser Pyrolysis Chemical methods- Sol-gel, Chemical Vapour Deposition, Colloidal Method, Spray Pyrolysis		**2**
	2.3	Biological methods- Concept of Green synthesis, Nanoparticle production using Microbes (Bacteria, Fungi, Yeast), Plants (stem, leaves, latex, seeds).		**2**
	2.4	Characterization techniques used in Nanobiotechnology: Optical Microscopy, Atomic Force, Microscopy SEM, FTIR, X-ray Diffraction		**2**
3		**Applications of Microbial Nanotechnology**	**20**	**3**
	3.1	Treatment: Effective Drug Delivery, Targeted therapy- Cancer Treatment, Photothermal Therapy for selectively killing cancer cells Diagnostics: Biosensors in the early diagnosis of diseases. Biomedical Imaging: Diagnostic Imaging for early detection of diseases -Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) Positron Emission Tomography (PET), and Fluorescence Imaging		**3**
	3.2	Food: Detection of contaminants and pathogens in food products, Nanocomposites for Food Packaging Crop Improvement: Enhancing nutrient delivery to plants. Environmental Monitoring and Remediation: Nanosensors for detecting pollutants, toxins, and pathogens; Lab on a chip concept; Nanomaterials for Remediation: Nanoparticles for removal of pollutants through processes like adsorption and catalysis. Water Purification: Nanomembranes for water purification		**3**
	3.3	Genetic Engineering: Nanoparticles for Gene Delivery in Gene Therapy.		**3**
4		**Nanotoxicology and Biosafety**	**10**	**4**

	4.1	A brief account of biosafety concerns about nanoparticles; attributes contributing to nanomaterial toxicology		**4**
	4.2	Epidemiological evidence –entry routes into the human body- Lungs, Intestinal tract, Skin, Eyes, interaction with biological membranes, Neurotoxicity, the toxicity of nanoparticles in food, risks of using Nanocomposites for Food Packaging		**4**
	4.3	Environmental implications of nanomaterials –Fate and Health threats		**4**
5		Teacher specific content		

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Any 1 out of 2 | 1 X 15 = 15
Total: | 70 marks</td></tr>
</table>

References:

1. Nanomaterials Thomas Varghese, K.M. Balakrishna. (2011) Nanotechnology: An Introduction to Synthesis, Properties and Applications. Atlantis Distributors and Publishers
2. Yury Gogotsi, 2006. Nanomaterials – Handbook. CRC Press, Taylor & Francis Group.
3. Edelstein A S and Cammarata R C, (2012). Nanomaterials: Synthesis, Properties and Applications Taylor and Francis
4. Christof M. Niemeyer, ChadA. Mirkin, (2004). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley VCH
5. Abhay Raj, Ratnakar Tiwari, 2019. Microbial Nanoparticles: Promises and Challenges for Human Health. Springer

6. Torben Lund Skovhus, Virgílio Cruz-Morales, Evgeny Katz, (2021). Microbial Nanotechnology: Applications in Environmental and Health Risk Assessment. Wiley
7. Vipin Chandra Kalia, Pratyoosh Shukla, (2018). Microbial Nanotechnology: Bioprospecting and Environmental Applications Academic Press
8. Saxena, G., Bhargava, R. (2020). Green Synthesis of Nanoparticles and Their Applications in Water and Wastewater Treatment. Chapter In: (eds) Bioremediation of Industrial Waste for Environmental Safety. Springer, https://doi.org/10.1007/978-981-13-1891-7_16
9. Hoda Jafarizadeh-Malmiri, Zahra Sayyar, Navideh Anarjan, Aydin Berenjian, (2019). Nanobiotechnology in Food: Concepts, Applications and Perspectives ISBN 978-3-030-05846-3 (eBook) https://doi.org/10.1007/978-3-030-05846-3 Springer Nature Switzerland
10. Jo Anne Shatkin, (2008). Nanotechnology: Health and Environmental Risks by CRC Press
11. Matthew Hull, Diana Bowman, William Andrew, 2014. Nanotechnology Environmental Health and Safety: Risks, Regulation, and Management. Elsevier
12. P.P. Simeonova, N. Opopol, M.I. Luster, (2007). Nanotechnology - Toxicological Issues and Environmental Safety, Springer
13. Thomas J. Webster, (2008). Safety of Nanoparticles: From Manufacturing to Medical Applications by Springer

Suggested Readings:

14. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications Second Edition (2nd ed.). CRC Press. (2017) https://doi.org/10.4324/9781315374581
15. Pravin Raj Solanki, Sneha Saha, Pankaj Kumar Choudhury, (2019). Microbial Nanotechnology: Present and Future. CRC Press,
16. Vijai Kumar Gupta, Maria Tuohy, Anthonia O'Donovan, Mohtashim Lohani,(2020). Microbial Nanobionics: Manipulation of Microbes for Nanodrug Delivery, Nanobiosensing, and Nanobionics. Wiley

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MICROBIAL QUALITY CONTROL AND TESTING**					
Type of Course	**DCE**					
Course Code	**MG8DCEMBG400**					
Course Level	**400 - 499**					
Course Summary	Course prepares students with theoretical and practical knowledge of the working of a quality control, and safety laboratory.					
Semester	VIII	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		2	0	2		90
Prerequisites, if any	Basic knowledge of food safety, quality control, and quality assurance					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the significance of quality control, quality assurance and food safety	A	1,2,10
2	Analyse different methods of quality assurance and quality compliance	An	3,5,6,8
3	Apply skills in food safety and quality control labs	A	1,2
4	Evaluate schemes of regulations in food quality control	E	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		INTRODUCTION TO MICROBIOLOGICAL QUALITY CONTROL AND ESSENTIAL PRACTICES IN LAB	15	1
	1.1	Quality Assurance (QA), Quality Control(QC), SOP and importance of quality control.Historical perspective and evolution of quality control standards.		1
	1.2	Laboratory-associated infections, Good Manufacturing Practices (GMP), Good Hygiene Practices(GHP), Good Veterinary Practices(GVP). HACCP guidelines in different food products, Risk assessment.		1
	1.3	Good Laboratory Practices(GLP), Aseptic Techniques, Preparation and importance SOP, Handling of infectious materials: Emergency responses and Sharps protocol; Decontamination and disposal of hazardous waste		1
	1.4	Primary containment devices-Biosafety cabinets, Personal protection equipment(PPE), Training and evaluating personnel.		1
2		MICROBIAL TESTING METHODS FOR QUALITY ASSURANCE	15	2
	2.1	Sterility testing, endotoxin testing, bioburden determination, Control of equipment, and quality control of media. Internal quality control(IQC),External quality control(EQA),		2
	2.2	Application of automation in quality control		2
	2.3	National and International Agencies –AGMARK, FSSAI, FPO, EHO, Five key principles of food hygiene by WHO.EFSA and FAO. Motives of ISO22001, ISO22002, ISO 22003, ISO 22004, ISO22005.		2
	2.4	Documentation, validation and Record keeping-audits, inspections and corrective actions. Applications of artificial intelligence in microbial control.		2
3.		QUALITY ASSURANCE AND REGULATORY COMPLIANCE	30	3
	3.1	Evaluation of microbiological quality of packed foods, export quality foods, pharmaceuticals, canned foods, packaged water		3
	3.2	Detection of common food adulterants, Organoleptic tests, Detection of total sugars , Detection of total acidity		3
4		HANDS-ON EXPERIENCE	30	4
	4.1	Identification of microbes using biochemical tests; Broth microdilution method		
	4.2	Laboratory preparation of food products and their sensory analysis		4
	4.3	Visits to quality control laboratories of the food industry, and educational institutions.		4
5		Teacher specific contents		

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<tr><td rowspan="11">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
2 Credit Theory: 15 Marks
2 Credit Practical: 15 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>2.5</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>2.5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>15</td><td>Total</td><td>15</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
2 Credit Theory: 35 Marks
Time: 1.5 Hours

2 Credit Practical: 35 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 1= 10</td><td>Experiments</td><td>25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>3 X 5 = 15</td><td rowspan="2">Record</td><td rowspan="2">5</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td></tr>
<tr><td>Total:</td><td>35 marks</td><td>Total</td><td>35</td></tr>
</table>

REFERENCES

1. Adams, M. R., & Moss, M. O. (2000). *Food microbiology*. Royal society of chemistry.
2. Arora, D. R. (2004). Quality assurance in microbiology. *Indian Journal of Medical Microbiology*, *22*(2), 81-86.
3. Baird, R. M., Hodges, N. A., & Denyer, S. P. (Eds.). (2000). *Handbook of microbiological quality control in pharmaceuticals and medical devices*. CRC Press.
4. Bolton, F. J. (1998). Quality assurance in food microbiology—a novel approach. *International journal of food microbiology*, *45*(1), 7-11.
5. Dubey, R. C., & Maheshwari, D. K. (2023). *A textbook of microbiology*. S. Chand Publishing.
6. Frazier, W. C., & Westcoff, C. (1979). American journals
7. Frazier, W. C., Marth, E. H., & Deibel, R. H. (1968). Laboratory manual for food microbiology.
8. Harrigan, W. F. (1998). *Laboratory methods in food microbiology*. Gulf Professional Publishing.
9. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). The HACCP and FSO systems for food safety. *Modern Food Microbiology*, 497-515.

Suggested Reading

1. Lightfoot, N. F., & Maier, E. A. (Eds.). (1998). *Microbiological analysis of food and water: Guidelines for quality assurance*. Elsevier.
2. Marriott, N. G., & Robertson, G. (1997). *Essentials of food sanitation*. Springer Science & Business Media.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**MICROBIAL INOCULANTS AND MUSHROOM CULTIVATION**					
Type of Course	**DCE**					
Course Code	**MG8DCEMBG401**					
Course Level	**400 - 499**					
Course Summary	This is a practical-oriented paper that equips students with theoretical and practical skills in the production of microbial inoculants and mushrooms.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	2	0	90
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the properties of soil, soil horizons, physiology and genetics of nitrogen fixation, and types of composting; Explain the advantages, applications and production of biofertilizers	A	1,2
2	Analyse the procedures and application of blue-green algae biofertilizers & the production and application of actinomycetes biofertilizers	An	1
3	To acquire skills in the production and application of fungal biofertilizers	S	1,9,10
4	Compare the types of mushrooms and their effects on human health & cultivation of *Agaricus bisporus, Pleurotus flagellates,* oyster and paddy straw mushroom	E	1,9,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Properties of soil- physical and chemical, soil horizons	15	1
	1.2	Biological Nitrogen fixation- symbiotic and asymbiotic, physiology and genetics of nitrogen fixers, root nodulation, types of composting.		
	1.3	Introduction to biofertilizers, types, advantages and applications.		1
	1.4	Bacterial biofertilizers- free-living forms- *Acetobacter, Azospirillum,* symbiotic- *Rhizobium* legume association (production and application		1
2	2.1	Blue-green algae biofertilizers- *Nostoc, Anabaena* and *Azolla* (production and application)	15	2
	2.2	Actinomycetes biofertilizers- *Frankia* (production and application		2
3	3.1	Fungal biofertilizers- ectomycorrhizal and endomycorrhizal (production and application)	30	3
	3.2	Edible and non-edible mushrooms, poisonous mushrooms, identification and effect on human health		3
	3.3	Cultivation of button mushroom, raising a pure culture and spawn preparation, preparation of compost, cultivation of *Agaricus bisporus, Pleurotus flabelltus.* Cultivation of oyster and paddy straw mushroom		3
4	4.1	Screening of *Rhizobium* from root nodule Production of rhizobial biofertilizers. Production of *Azolla* biofertilizers	30	4
	4.2	Composting		4
5		Teacher-specific contents		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="12">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="5">Continuous Comprehensive Assessment (CCA)
2 Credit Theory: 15 Marks
2 Credit Practical: 15 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>2.5</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>2.5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>15</td><td>Total</td><td>15</td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
2 Credit Theory: 35 Marks
Time: 1.5 Hours

2 Credit Practical: 35 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks Any 10 out of 12</td><td>10 X 1= 10</td><td>Experiments</td><td>25</td></tr>
<tr><td>Part - B: 5 Marks Any 4 out of 6</td><td>3 X 5 = 15</td><td>Record</td><td>5</td></tr>
<tr><td>Part – C: 10Marks Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>35 marks</td><td>Total</td><td>35</td></tr>
</table>

References

1. S Biswas, M. Datta and S.V. Ngachan (2012) Mushrooms: A Manual for Cultivation, , PHI Learning Private Limited.
2. Dhar and Kaul, (2007)Biology and Cultivation of Edible Mushrooms, Westville Publishing House.
3. Mahendra Rai, Handbook of Microbial Biofertilizers, 2008, CRC Press.
4. Rao, N.S., (2007). Biofertilizers in Agriculture. Oxford & IBH Publishing Co., Pvt., Ltd., Bombay.
5. Totawat, K.L., Somani, L.L., Sharma, R.A. and Maloo, S.R., (2008) Biofertilizers Technology. Agrotech Publishing Academy. Udaipur, Rajasthan.

SUGGESTED READINGS

1. http://www.csir.res.in/ruralsectors/button-mushroom-cultivation
2. https://www.crcpress.com/Handbook-of-Microbial- Biofertilizers/Rai/p/book/9781560222705
3. http://www.fungaldiversity.org/fdp/sfdp/FD38-2.pdf
4. https://www.jstor.org/stable/4354403

Mahatma Gandhi University

Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Pharmaceutical Microbiology**					
Type of Course	DCE					
Course Code	**MG8DCEMBG402**					
Course Level	**400 – 499**					
Course Summary & Justification	Practical-oriented course on drug development					
Semester	VIII	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites	Basic knowledge in microbiology, bioinformatics, bioprocess technology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No
1	Explain the principles of chemotherapy and antimicrobial agents.	A	1,2
2	Analyse the spoilage and sterilization of pharmaceutical products.	An	1,2,9
3	Distinguish methods of sterility testing and preservation of pharmaceutical products.	An	1,2,6,9
4	Determine the role of microbial metabolites in the pharmaceutical field.	An	1,2
5	Checking the concepts of drug designing and quality management in pharmaceuticals.	E	1,2,3,9,10
6	Demonstrate the isolation of antibiotic-producing microbes and determine the MIC of different antibiotics; Analyze the microbial quality of pharmaceutical products	A	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		Introduction to Pharmaceutical Microbiology	18	
	1.1	History of Chemotherapy- Paul Ehrlich, Joseph Lister, Alexander Fleming, Florey and chain contributions.		1
	1.2	Brief study on Antibiotics and synthetic antimicrobial agents, Antifungal agents, Antiviral agents, and Anti-protozoan agents.		1
	1.3	Sterilization methods for pharmaceutical products – Thermal methods- Steam sterilization, dry heat, radiations – gamma radiations, Filtration, Chemical sterilization – gaseous method-ethylene oxide		2
	1.4	Types of microbial spoilage, factors affecting the microbial spoilage of pharmaceutical products, and sources of microbial contaminants.		2
2		Sterilization and sterility testing of Pharmaceutical products	12	3
	2.1	Microbial Sterility testing of different pharmaceutical preparations (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.		3
	2.2	Preservation of pharmaceutical products using antimicrobial agents.		3
3		Microbial Products in Pharmaceuticals	15	4
	3.1	Microbial metabolites in the pharmaceutical industry- impacts and opportunities. Screening and development approaches for new microbial natural products. Factors affecting stability and storage of pharmaceutical products.		4
	3.2	Pharmaceuticals produced by microbial fermentations (Antibiotics – Penicillin, Streptomycin, Vitamins - Cyanocobalamine).		4
	3.3	A brief account of New vaccine technology, DNA vaccines, synthetic peptide vaccines, and multivalent subunit vaccines. Vaccine clinical trials.		4
	3.4	Rational drug design- Basic concept and steps of drug design. Briefly explain Lead drug and Pro-drug with examples		5
	3.5	Brief study on Structure-based and combinatorial approach of drug design. Peptidomimetics.		5

	3.6	Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.		5
4		**HANDS-ON TRAINING**	30	
		1. Isolation of antibiotic-producing organisms by Crowded Plate technique 2. Microbiological assay of antibiotics by cup plate method. 3. Determine MIC of Beta-lactam/aminoglycoside/ tetracycline 4. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations). 5. Determination of antimicrobial activity of a disinfectant		6
5		Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)
➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
➢ Interactive Instruction: Active cooperative learning, Assignments and discussions, Peer teaching and learning, Quiz, ICT-enabled learning
Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="11">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="6">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Component</td><td>Mark</td><td>Component</td><td>Marks</td></tr>
<tr><td>Test/Quiz</td><td>10</td><td>Test/Quiz</td><td>5</td></tr>
<tr><td>Seminar</td><td>10</td><td>Lab involvement</td><td>2.5</td></tr>
<tr><td>Assignment</td><td>5</td><td>*Activity (related to teacher-specific content)</td><td>7.5</td></tr>
<tr><td>Total</td><td>25</td><td>Total</td><td>15*</td></tr>
<tr><td colspan="4">* Adjusted to 7.5 Marks for final calculation</td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours

1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
<tr><td>Part -A: 2 marks
Any 10 out of 12</td><td>10 X 2 = 20</td><td>Experiments</td><td>25</td></tr>
<tr><td>Part - B: 5 Marks
Any 4 out of 6</td><td>4 X 5 = 20</td><td>Record</td><td>5</td></tr>
<tr><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
<tr><td>Total:</td><td>50 marks</td><td>Total</td><td>35**</td></tr>
<tr><td></td><td></td><td colspan="2">** Adjusted to 17.5 Marks for final calculation</td></tr>
</table>

References

1. W.B.Hugo&A.D.Russell Sixth edition. Pharmaceutical Microbiology, Blackwell Scientific Publications.
2. Geoff Hanlon & Norman A (2013). Hodges. Essential Microbiology for Pharmacy and Pharmaceutical Science, Wiley-Blackwell
3. Ashutosh Kar, Pharmaceutical Microbiology. 1St Edition 2019, New Age International (P) Ltd Publishers
4. Chakraborty C and Bhattacharya A (2004) Pharmacogenomics: An approach to New Drug Development. Biotech Books, New Delhi (ISBN: 81-7622-105-8).
5. S.P.Vyas&V.K.Dixit . Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi
6. Murray S. Cooper. Quality control in the Pharmaceutical Industry - Edt. by Vol.2. Academic Press New York.
7. Madhu Raju Saghee, Tim Sandle, Edward C. Tidswell (2011). Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices, Business Horizons.
8. Seth SD (2004) Textbook of Pharmacology, 2nd edn., Elsevier, New Delhi (ISBN:81-8147-553-4)

Suggested Reading

1. Dutton CJ, Haxell MA, McArthur HAI and Wax RG (2002) Peptide Antibiotics, Marcel Dekker Inc., NY, USA (ISBN: 0-8247-0245-X)
2. Krogsgaard-Larsen P, Lilijefors T and Madsen U (2004) Textbook of Drug Design and Discovery, 3rd edn., Taylor and Francis, London (ISBN: 0-415-28288 PB).

Project Evaluation

The project evaluation shall be done by Continuous Comprehensive Assessment (CCA) for 30 marks and the End Semester Evaluation (ESE) for 70 marks.

The faculty mentor shall do continuous evaluation as per the following Scheme:

Continuous Comprehensive Evaluation	
Component	**Marks**
Overall involvement	20
Quiz/viva- voce/written exam	20
Knowledge of the project content/ attainment of objectives	20
Total	**60**

The end-semester evaluation will be done by two examiners appointed by the chairman of the examination board. Each candidate shall be evaluated separately. The end-semester evaluation shall be done by the following Scheme:

End-Semester Evaluation	
Component	**Marks**
Evaluation of Dissertation/ Project Report 1. Quality Format (Abstract, Introduction; objectives & scope of study; appropriate methodology; result presentation; interpretation and discussion of result; Conclusion & References)- 30marks 2. Originality; experimental approach; data presentation – 20 marks 3. Relevance of the study/ novelty/ outcome - 10 marks	60
Presentation 1. PowerPoint presentation; presentation of data - 20 marks 2. Clarity in presentation and interactions – 20 marks	40
Viva voce 1. Understanding of objectives (20 marks) 2. Background knowledge of the topic (20 marks)	40
Total	**140**

Internship Evaluation

The objective of the internship is that each student shall learn through "hands-on" experiences at a qualified institution with the scope for employability. Each student should complete the internship for a minimum of 5 days. Student's engagement in internship-related activities is to be supervised by an internal mentor from the institution. Upon successful completion of the internship, each student has to submit a report and a bona fide certificate of completion from the institutional mentor. Internship evaluation will be done by a faculty member appointed by the Chairman of Examination.

Internship evaluation is for 50 marks with the following components:

Components	**Marks**
Continuous Comprehensive Evaluation - CCA	15 marks
End Semester Evaluation - ESE Report evaluation 1. Objective & scope of the internship 2. Skills and learning outcomes attained 3. Awareness of the institution	35 marks

List of Experts who participated in the 5-Day Residential Workshop on FYUGP Curriculum Restructuring:

Dr. Jithasha Balan, Coordinator, Assistant Professor, Sree Sankara College, Kalady.

Dr. Arun A.U., Member, FYUGP Apex Committee

Dr.Vinoj M.N., Master Trainer, Associate Professor, St. Peter's College, Kolencherry

Amritha Dinesh, Assistant Professor, M.E.S.College, Marampally

Anu Ruby Benny, Assistant Professor, M.E.S.College, Marampally

Bismimol Francis, Assistant Professor, Cochin Arts and Science College, Manakkakadavu

Cindhu K George, Assistant Professor, St Mary's College for Women, Thiruvalla

Dayana Joseph, Assistant Professor, Presentation College of Applied Sciences, Puthenvelikkara

Dr. Ally C Antony, Associate Professor, M.E.S.College, Marampally

Dr. Aneymol V. S., Associate Professor, St Xavier's College, Aluva

Dr. Ganga G, Assistant Professor, Sree Ayyappa College, Eramallikkara, Chengannur

Dr. K.Manjusha, Assistant Professor, Faculty of Ocean Science &Technology, KUFOS

Dr. S. Mohan, Associate Professor & Head, Sree Sankara College, Kalady.

Dr. Nisha P., Assistant Professor, M.E.S.College, Marampally

Dr. Rashmi P A, Assistant Professor, Presentation College of Applied Sciences, Puthenvelikkara

Dr. Sherin Joy Parappilly, Assistant Professor, M.E.S.College, Marampally

Dr. Soorej M Basheer, Associate Professor & HOD, Kannur University

Dr. Sudha K., Associate Professor, St Peter's College, Kolenchery

Dr. Sumi Mary George, Associate Professor, Sree Sankara College, Kalady

Elza Paulose Assistant Professor Indira Gandhi College of Arts & Science

Jeen Abraham Associate Professor, PGM College, Kangazha

Jiya Paul, Assistant Professor, Sree Sankara College, Kalady

Lakshmi Suresh K, Assistant Professor, Presentation College of Applied Sciences, Puthenvelikkara

Linju PJ, Assistant Professor, Presentation College of Applied Sciences, Puthenvelikkara

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Princy P Paulose, Assistant Professor, Indira Gandhi College of Arts & Science

Rakhi S Unnikrishnan, Assistant Professor, St Mary's College for Women, Thiruvalla

Reenu Anna Thomas, Assistant Professor, St Mary's College for Women, Thiruvalla

Sajeena T A, Assistant Professor, M.E.S.College, Marampally

Seena Kuruvila, Assistant Professor, Sree Sankara College, Kalady

Sinda Paul, Assistant Professor, SNGIST, N.Paravur

Subi B S, Assistant Professor, Indira Gandhi College of Arts & Science

Sulfath Nassim, Assistant Professor, Indira Gandhi College of Arts & Science

Vincy Mathai, Assistant Professor, SNGIST, N.Paravur

Appendix-I

Subject: Food Microbiology

Minor programme to B. Sc. (Hons.) Botany & Zoology

Preface

Food microbiology is an applied branch of science that involves the study of microorganisms that inhabit, produce, or contaminate food. Food microbiology deals with the examination of microorganisms impacting, generating, or polluting food, encompassing their roles in food and their utilization in food production. It concentrates on areas such as food poisoning, food spoilage, food preservation, and food legislation. The primary focus of this discipline is to identify foodborne microorganisms, mitigate contamination risks, and avert foodborne disease outbreaks. Given the public health challenge posed by disease-causing microorganisms, Food Microbiology specifically addresses the role of these organisms and their toxins in potential food contaminations. The thrust areas of focus include exploring the scope of food microbiology and safety, gaining knowledge about significant genera of microorganisms associated with food and their characteristics, learning various techniques to enumerate and control microorganisms in food, acquiring essential knowledge and applications of preservation techniques (from traditional to advanced), understanding the roles of microorganisms in food spoilage, fermentation, and food-borne diseases, grasping microbiological quality control and procedures for investigating food-borne illnesses to ensure food safety and hygiene, understanding current national and international food safety regulations, familiarizing oneself with the requirements and components of a food safety management system (FSMS) and the use of microbiological risk assessment (MRA) tools for assessing food safety risks in the food sector. The food industry is a highly relevant and leading industrial sector due to its extensive scope in ensuring food safety and quality. With an increasing focus on public health and consumer awareness, there is a growing demand for experts who can address the challenges posed by microorganisms in the food supply chain. Professionals in food microbiology are vital to the booming food industry because they prevent foodborne illnesses, maintain product quality, and comply with strict regulations through appropriate control strategies, quality assurance measures, and adherence to international food safety standards.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Wonders of the Microbial World**					
Type of Course	**DSC**					
Course Code	**MG1DSCMBG101**					
Course Level	**100-199**					
Course Summary	In this course, the students will explore the fascinating world of microbes, trace the history and scope of microbiology, explore and apply sterilization and disinfection techniques and uncover the intricacies of bacteria, viruses, fungi and acellular infectious agents. The students will master microscopy and staining methods, gaining essential skills, for a profound understanding of microbial life.					
Semester	**I**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	30	0	75
Pre-requisites, if any	A basic understanding of biology is beneficial for grasping the fundamentals of microbiology.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Elaborate on the significant contributions and theories proposed by renowned scientists that have advanced the field of microbiology	U	3
2	Implement diverse specimen preparation techniques to observe microorganisms through microscopy and apply the principles and uses of various microscope types	A	1,2
3	Demonstrate a comprehensive understanding of microorganisms and analyze the general properties of bacteria, fungi, viruses, viroids and prions	U, An	1
4	Explain the principles of sterilization using physical and chemical agents and employ sterilizing instruments and also antibiotics for the control of microorganisms	U, A	6,8
5	Execute good laboratory practices and protocols, safely handle bacteria and fungi and identify bacteria and fungi using staining techniques	A, S	1,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Unit	Course Description	Hrs	CO No.
1	1.1	History and Scope of Microbiology - Theory of spontaneous generation - Theory of biogenesis	3	1
	1.2	Contributions of early microbiologists – Anton van Leeuwenhoek, Robert Koch, Edward Jenner, Louis Pasteur, Paul Ehrlich, Alexander Fleming and Joseph Lister	4	1
2	2.1	Fundamentals of microscopy : Resolution, Limit of resolution, Magnification Light Microscopy – Parts, principle and working of Bright field microscopy, Dark field microscopy, Fluorescence microscopy and Phase contrast microscopy	6	2
	2.2	Specimen preparation for light microscopy – Wet mount, hanging drop method, Smear preparation & heat fixation	2	2
	2.3	Stains, Types of stains – acidic and basic stains Bacterial staining : Simple staining Differential staining - Gram's staining, Acid fast staining Special staining:- Capsule staining, Spore staining Negative staining - Indian ink staining	5	2
3	3.1	Prokaryotic cell structure : Size, shape and arrangement Cell wall structure - Peptidoglycan structure, Gram positive and Gram-negative cell walls Cell organization, membrane system, nucleoid and other intra-cytoplasmic features Components external to the cell wall - Capsule, Slime layer, Pili and fimbriae, Flagella, Endospores and Cysts	6	3
	3.2	Morphological features, cultivation and classification of fungi (brief) General properties, structure and reproduction of viruses and bacteriophages General characters of viroids and prions	6	3
	3.3	Principles of sterilization - Control of microorganisms by physical agents: dry heat, moist heat, filtration and radiation	4	4
	3.4	Control of microorganisms by chemical agents: phenolic compounds, alcohol, halogens, aldehydes and gaseous agents	3	4
	3.5	Microbicidal and microbistatic agents Characteristics of antimicrobial agents Antibiotics and their classifications (based on mode of action) Evaluation of antimicrobial agents : Tube dilution and agar plate techniques, Well diffusion and disk diffusion methods, MIC and MBC	6	4

4	4.1	Practical Good laboratory practices: Familiarize lab safety rules and guidelines Hand sanitation - Disinfection of work areas - Flame sterilization - Reporting and handling spills and accidents - Safe handling of bacteria and fungi	6	5
	4.2	Practical Specimen preparation for microscopy - Wet mount - Hanging drop method Simple staining – Differential staining of bacteria : Gram staining – Special staining : Endospore staining	16	5
	4.3	Practical Antibiotic sensitivity testing by disc diffusion and tube dilution methods Activity : Visit to a Microbiology Research Lab & Interaction with Scientists; Submit a report	8	5
5	5.1	Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
Direct Instruction: Lecture, Explicit Teaching, E-learning
Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
Microbiology Lab Visit</td></tr>
<tr><td>Assessment Types</td><td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
A. CCA for 3 Credits Theory : 25 Marks
B. CCA for 1 Credit Practical : 7.5 Marks

Scheme for CCA
Theory
<table>
<tr><th colspan="2">Components</th><th>Marks</th></tr>
<tr><td colspan="2">Test (MCQ/short answer/Illustrations/Long answers) or Quiz</td><td>10</td></tr>
<tr><td>Seminar – Introduction of topic</td><td>2</td><td rowspan="4">10</td></tr>
<tr><td>Topic clarity</td><td>3</td></tr>
<tr><td>Presentation skill</td><td>3</td></tr>
<tr><td>Interacting with the audience</td><td>2</td></tr>
<tr><td colspan="2">*Assignment/an activity</td><td>5</td></tr>
<tr><td colspan="2">Total</td><td>25</td></tr>
</table>
*Based on Teacher specific content
Practical
<table>
<tr><th>Components</th><th>Marks</th></tr>
<tr><td>Evaluation of Practical Skill (Test/Experimentation)</td><td>8</td></tr>
<tr><td>Lab involvement</td><td>5</td></tr>
<tr><td>Report of Lab visit</td><td>2</td></tr>
<tr><td>**Total</td><td>15</td></tr>
</table>
**CCA for Practical = Total marks x 0.5</td></tr>
</table>

End Semester Examination (ESE)

C. ESE for 3 Credits Theory : 50 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	10	10
Short answer questions	3	4	12
Long answer questions	1	8	8
Total			**50**

D. ESE for 1 Credit Practical : 17.5 marks

Components	Total Marks
Evaluation of Practical skill	25
Record	10
***Total**	**35**

*ESE for Practical = Total marks x 0.5

References

1. Pelczar Jr., M. J., Chan, E. C. S. & Krieg, N. R. Microbiology. (1985). (5th ed.). Tata Mc-Graw Hill Inc. Publishers, New York.
2. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
3. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
4. Caldwell, D. R. (1995). Microbial Physiology and Metabolism. Wm. C. Brown Publishers, Dubuque, Iowa.
5. Powar, C. B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
6. Ananthanarayanan, C. K. & Panikar, J. (2006). Ananthanarayan & Paniker's Textbook of Microbiology (8th ed.). Orient Longman
7. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
8. Salle, A. J. (2001). Fundamentals & Principles of Bacteriology (7th ed.). Tata McGraw-Hill, New York.
9. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
10. Gerhardt, P., Murray, R. G. E., Wood, W. A. & Krieg, N. R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington DC

11. Ramana Rao, P. V. (2005). Essentials of Microbiology. CBS Publishers and Distributors, New Delhi.
12. Atlas, R. M. (2015). Principles of Microbiology. (2nd ed.). McGraw Hill Education (India) Private Limited, Green Park Extension, New Delhi.
13. Black, J. G. (2012). Microbiology: Principles and Explorations (8th ed.). John Wiley & Sons Inc., New York.
14. Alcamo, I. E. & Warner J. M. Schaum's Outline of Theory and Problems of Microbiology. (2nd ed.). The McGraw Hill Companies Inc., New Delhi.
15. Wheelis, M. (2010). Principles of Modern Microbiology. Jones and Bartlett India Pvt. Ltd., Daryaganj, New Delhi.
16. Banerjee, A. K. & Banerjee, N. (2012). Fundamentals of Microbiology and Immunology. (2nd ed.). New Central Book Agency (P) Ltd., Sankrail, Howrah.
17. Arora, D. R. & Arora, B. (2008). Text Book of Microbiology. (3rd ed.). CBS Publishers & Distributors, New Delhi.
18. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
19. Sharma, K. (2009). Manual of Microbiology Tools and Techniques. (2nd ed.). Ane Books India, New Delhi.
20. Aneja, K. R. (2005). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. (4th ed.).New Age International (P) Limited Publishers, Bangalore.
21. Thomas, K. E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
22. Kannan, N. (2002). Laboratory Manual in General Microbiology. Panima Publishing Corporation, New Delhi.
23. Gunasekaran, P. (2005). Laboratory Manual in Microbiology. New Age International (P) Limited Publishers, New Delhi.

SUGGESTED READINGS

1. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
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Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Microbiology in Everyday Life**					
Type of Course	**MDC**					
Course Code	**MG1MDCMBG101**					
Course Level	**100-199**					
Course Summary	This course gives an understanding of microbiology in everyday life and also provides valuable insights into the need for maintaining a healthy environment, ensuring safe food, personal hygiene and preventing spread of diseases. The course explains how microorganisms coexist with us and help us in our overall well being. Each module will equip the students with specific knowledge and skills related to microbiology, hygiene practices and their applications in daily life.					
Semester	**I**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		30	0	30	0	60
Pre-requisites, if any	General understanding of fundamentals of biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the scope, basic concepts, and types of microorganisms and underscore the importance of microbiology for maintaining good personal and environmental hygiene	U	2, 10
2	Compare the beneficial and harmful interventions of microorganisms in household kitchen	An	2, 6
3	Associate communicable diseases with waste management and indicate preventive measures to safeguard families from malaria, dengue, food poisonings and fungal infections	U	2
4	Practice responsible antibiotic usage to reduce antibiotic resistance, and show their proper storage practices	A	6, 8
5	Understand safe laboratory procedures and safe microorganism handling methods.	U	6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	General introduction to microbiology – scope of microbiology (brief) - Need for microbiology literacy in society Importance of microbiology in personal hygiene Personal hygiene components Personal hygiene for food handlers - Case study of Typhoid Mary	5	1
	1.2	Environment hygiene, fundamentals of environmental health, microbiology of air, microflora of air, aerosols, droplet nuclei, infectious dust - Recommended practices for environmental hygiene	3	1
	1.3	Beneficial microorganisms in food – Yeast in baking and alcohol production, Lactic acid bacteria in dairy products Algae as food: Single cell proteins - Fungi as food : edible mushrooms – Food as medicine : Probiotics, nutraceuticals Fermented food products we use in daily life – Bread, idli, appam, dahi, yogurt, lassi, cheese, butter, sausages, wine, beer	7	2
	1.4	Importance of microbiology in Kitchen, Food contaminations, Contamination of kitchen utensils and other food contact surfaces, Cross Contamination from raw to cooked foods - Food Spoilage	2	2
2	2.1	Water supplies, water disinfection systems in households, environmental health in recreational areas	3	3
	2.2	Waste management - Solid and hazardous waste management - Vectors and their control to prevent malaria, dengue- Survey/study of solid waste management practices in households or in a small community	4	3
	2.3	Food and waterborne diseases: Respiratory diseases faeco - oral route contamination, insect/flies/rodent contamination - Household measures for control – Quarantine and isolation - Preventive measures Fungal infections and their control	3	3
	2.4	General awareness on antibiotics – Do's & Don'ts Rx drugs vs OTC drugs - Antimicrobial Resistance (AMR) and One Health Approach. Safe storage of antibiotics and medicines	3	4
3	3.1	Practical: Good laboratory practices : Familiarize lab safety rules and guidelines. Hand sanitation, Disinfection of work areas, Flame sterilization, Reporting and handling spills and accidents	10	4
	3.2	Practical : Microscopic observation of bacteria, yeast and mold Practice of sterilization and disinfection techniques Isolation of bacteria and fungi from contaminated food	12	4
	3.3	Practical : Demonstration of yeast fermentation by testing total/volatile acidity of fermented juices	8	4
	3.4	Activity : Visit to a Microbiology Research Lab (Recommended)	-	4
4	4.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Microbiology Lab Visit

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 2 Credits Theory : 15 Marks

B. CCA for 1 Credit Practical : 7.5 Marks

Scheme for CCA

Theory

Components		**Marks**
Test (MCQ/short answer) or Quiz		8
Seminar – Introduction of topic	1	5
Topic clarity	1	
Presentation skill	2	
Interacting with the audience	1	
*Assignment/an activity		2
Total		**15**

*Based on Teacher specific content

Practical

Components	**Marks**
Evaluation of Practical Skill (Test/Experimentation)	8
Lab involvement	5
Report of Lab visit	2
****Total**	**15**

**CCA for Practical = Total marks x 0.5

End Semester Examination (ESE)

C. ESE for 2 Credits Theory : 35 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	5	10
Total			**35**

D. ESE for 1 Credit Practical : 17.5 marks

Components	Total Marks
Evaluation of Practical skill	30
Record	5
***Total**	**35**

*ESE for Practical = Total marks x 0.5

References

1. Powar, C.B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
2. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
3. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
4. Salle, A. J. (2001). Fundamentals & Principles of Bacteriology (7th ed.). Tata McGraw-Hill, New York.
5. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
6. Willey, J. M., Sherwood, L. M. & Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
7. Pelczar Jr., M. J., Chan, E. C. S. & Krieg, N. R. Microbiology. (1985). (5th ed.). Tata Mc-Graw Hill Inc. Publishers, New York.
8. Daniel, J. C. (1996). Environmental Aspects of Microbiology. (1st ed.). Bright Sun Publications, Chennai.
9. Reed, M. (1992). Environmental Microbiology. John Wiley and Sons, New York.
10. Ananthanarayanan, R. & Jayaram Panikar, C. K. (2006) Ananthanarayan & Paniker's Textbook of Microbiology (7th ed.). Orient Longman Private Limited, Bengaluru, Karnataka.
11. Purohit, S. S. (2006). Microbiology - Fundamentals and Applications. (7th ed.). Student Edition Publishers, Jodhpur.
12. Ramana Rao, P. V. (2005). Essentials of Microbiology. CBS Publishers and Distributors, New Delhi.
13. Srilakshmi, B. (2005). Food Science (3rd ed.). New Age International (P) Ltd., New Delhi.
14. Potter N. M. & Hotchkiss J. H. (2021). Food Science (5th ed.). CBS Publishers and Distributors, New Delhi.

15. Vijaya Ramesh, K. (2019). Food Microbiology, MJP Publishers, Chennai.
16. Swaminathan, N. (1987). Food Science and Experimental Foods. Ganesh Publications, Madras.
17. Manay, S. N. & Shadaksharaswamy, M. (2005). Foods-Facts and Principles. (2nd ed.). New Age International (P) Ltd, New Delhi.

SUGGESTED READINGS

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2. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
3. Willey, J. M., Sherwood, L. M. & Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
4. Reed, M. (1992). Environmental Microbiology. John Wiley and Sons, New York.
5. Daniel, J. C. (1996). Environmental Aspects of Microbiology. (1st ed.). Bright Sun Publications, Chennai.
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7. Potter N. M. & Hotchkiss J. H. (2021). Food Science (5th ed.). CBS Publishers and Distributors, New Delhi.
8. Manay, S. N. & Shadaksharaswamy, M. (2005). Foods-Facts and Principles. (2nd ed.). New Age International (P) Ltd, New Delhi.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Microbial Physiology and Food Microbiology**					
Type of Course	**DSC**					
Course Code	**MG2DSCMBG101**					
Course Level	**100-199**					
Course Summary	The course outlines the influence of nutritional and environmental factors on growth of microorganisms and the media requirements for their cultivation. The course also compiles information about the contamination sources, and spoilage of food. The course content explains the use of traditional and advanced recent methods of food preservation. The practical sessions in this course will benefit the students to sharpen their analytical skills for cultivation, isolation, identification and enumeration of microorganisms.					
Semester	**II**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	30	0	75
Pre-requisites, if any	A basic understanding of the fundamentals of microbiology.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the nutritional requirements and nutritional types of bacteria, their growth pattern in batch and continuous cultures, and the influence of environmental factors on microbial growth	U	2, 3
2	Prepare different types of culture media and employ bacterial cultivation methods as well as isolation techniques through serial dilution and pure culture methods	A, C	2, 3,10
3	Indicate the role of food as a substrate for microorganisms, and explain the morphological, cultural, and physiological characteristics of bacteria, yeast, and mold in food products	U	2,10
4	Summarise the methods of contamination, the causes of spoilage and the methods of preservation in foods	An	2,3,10
5	Acquire practical skills in the microbiological examination of foods, and use routine as well as rapid methods for detecting specific organisms	An, E	3,9,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Nutritional requirements of bacteria - Macro and Micro Nutrients - Nutritional classification of microorganisms Bacterial growth - Modes of cell division in bacteria - Binary fission Bacterial growth curve – Batch and continuous culture of microorganisms Influence of environmental factors on microbial growth	7	1
	1.2	Culture Media and basic media components Types of media - Liquid, Semi solid and Solid media - Synthetic media, Complex media, Basic media, Enriched and Enrichment media, Selective media, Differential media and Transport media Composition and preparation of Nutrient broth, Nutrient agar, Potato Dextrose Agar, Blood agar and MacConkey agar	6	2
	1.3	Cultivation of Bacteria – Aerobic and anaerobic culture methods Isolation of microbes – Serial dilution, pure culture techniques : Pour plate, spread plate and streak plate methods	5	2
2	2.1	Food as a substrate for microorganisms – Factors affecting microbial growth in food: Extrinsic factors – Temperature, Relative humidity and Concentration of gases	2	3
	2.2	Intrinsic factors - Hydrogen ion concentration (pH), Water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure	3	3
	2.3	Microorganisms important in food microbiology: Bacteria, yeasts and molds (Morphological, cultural and physiological characteristics important in food microbiology)	4	3
	2.4	Sources of contamination of food : Pre-harvest contamination from green plants and fruits, animals, soil, air, sewage, water - Post-harvest contamination from processing equipments, during transport, workers, during handling and processing	2	3
	2.5	General principles underlying spoilage of food – Chemical changes caused by microorganisms in proteins, carbohydrates and fats – Causes of spoilage - Classification of food by ease of spoilage	2	3
3	3.1	General principles of food preservation - Asepsis – Removal & maintenance of anaerobic conditions - Preservation using high temperature : Heat resistance, heat penetration, thermal processes - Canning	4	4
	3.2	Preservation using low temperature : Cellar storage, chilling storage, freezing storage, cryopreservation Preservation by drying – Drying methods, Treatment of food before and after drying, Microbiology of dried foods	4	4
	3.3	Preservation by radiation : UV rays, ionizing radiations, microwaves Use of chemical preservatives : Food additives, added inorganic and organic preservatives – developed preservatives	4	4
	3.4	Hurdle technology in food preservation	2	4

4	4.1	Practical : Media preparation and sterilization – Preparation of Nutrient agar, Potato dextrose agar, Nutrient broth, peptone water	6	5
	4.2	Practical : Methods for the microbiological examination of foods – Indicator organisms, direct examination, culture techniques – Isolation of bacteria by quadrant and continuous streak methods	12	5
	4.3	Practical : Enumeration methods – Plate counts, most probable number counts – dye reduction test Biochemical tests used for identification of bacteria Activity : Enumeration of bacteria, yeast and mold from foods	12	5
5	5.1	Teacher specific content		

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
Direct Instruction: Lecture, Explicit Teaching, E-learning
Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
Lab Activity</td></tr>
<tr><td>Assessment Types</td><td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
A. CCA for 3 Credits Theory : 25 Marks
B. CCA for 1 Credit Practical : 7.5 Marks

Scheme for CCA
Theory
<table>
<tr><th colspan="2">Components</th><th>Marks</th></tr>
<tr><td colspan="2">Test (MCQ/short answer/Long answers) or Quiz</td><td>10</td></tr>
<tr><td>Seminar – Introduction of topic</td><td>2</td><td rowspan="4">10</td></tr>
<tr><td>Topic clarity</td><td>3</td></tr>
<tr><td>Presentation skill</td><td>3</td></tr>
<tr><td>Interacting with the audience</td><td>2</td></tr>
<tr><td colspan="2">*Assignment/an activity</td><td>5</td></tr>
<tr><td colspan="2">Total</td><td>25</td></tr>
</table>
*Based on Teacher specific content
Practical
<table>
<tr><th>Components</th><th>Marks</th></tr>
<tr><td>Evaluation of Practical Skill (Test/Experimentation)</td><td>8</td></tr>
<tr><td>Lab involvement</td><td>5</td></tr>
<tr><td>Evaluation/Report of activity</td><td>2</td></tr>
<tr><td>**Total</td><td>15</td></tr>
</table>
**CCA for Practical = Total marks x 0.5</td></tr>
</table>

End Semester Examination (ESE)

C. ESE for 3 Credits Theory : 50 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	10	10
Short answer questions	3	4	12
Long answer questions	1	8	8
Total			**50**

D. ESE for 1 Credit Practical : 17.5 marks

Components	Total Marks
Evaluation of Practical skill	25
Record	10
***Total**	**35**

*ESE for Practical = Total marks x 0.5

References

1. Pelczar Jr., M. J., Chan, E. C. S. & Krieg, N. R. Microbiology. (1985). (5th ed.). Tata Mc-Graw Hill Inc. Publishers, New York.
2. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
3. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
4. Caldwell, D. R. (1995). Microbial Physiology and Metabolism. Wm. C. Brown Publishers, Dubuque, Iowa.
5. Powar, C. B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
6. Ananthanarayanan, C. K. & Panikar, J. (2006). Ananthanarayan & Paniker's Textbook of Microbiology (8th ed.). Orient Longman
7. Atlas, R. M. (2015). Principles of Microbiology. (2nd ed.). McGraw Hill Education (India) Private Limited, Green Park Extension, New Delhi.
8. Black, J. G. (2012). Microbiology: Principles and Explorations (8th ed.). John Wiley & Sons Inc., New York.
9. Alcamo, I. E. & Warner J. M. Schaum's Outline of Theory and Problems of Microbiology. (2nd ed.). The McGraw Hill Companies Inc., New Delhi.
10. Wheelis, M. (2010). Principles of Modern Microbiology. Jones and Bartlett India Pvt. Ltd., Daryaganj, New Delhi.
11. Banerjee, A. K. & Banerjee, N. (2012). Fundamentals of Microbiology and Immunology. (2nd ed.). New Central Book Agency (P) Ltd., Sankrail, Howrah.
12. Arora, D. R. & Arora, B. (2008). Text Book of Microbiology. (3rd ed.). CBS Publishers & Distributors, New Delhi.

13. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
14. Sharma, K. (2009). Manual of Microbiology Tools and Techniques. (2nd ed.). Ane Books India, New Delhi.
15. Aneja, K. R. (2005). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. (4th ed.).New Age International (P) Limited Publishers, Bangalore.
16. Thomas, K. E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
17. Kannan, N. (2002). Laboratory Manual in General Microbiology. Panima Publishing Corporation, New Delhi.
18. Gunasekaran, P. (2005). Laboratory Manual in Microbiology. New Age International (P) Limited Publishers, New Delhi.
19. Doyle, M. P. (1997). Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington.
20. Joshi, V. K. & Pandey A. (1999). Biotechnology: Food FermentationVol. 1 & 2, Education Publisher and Distributer, New Delhi.
21. Marwaha S.S. and Arora, J.K. (2000), *Food Processing: Biotechnological Applications*, Asia tech Publishers Inc., New Delhi.
22. Frazier, W. C. & Westhoff, D.C. (1995). Food Microbiology. (4th ed.). Tata McGraw Hill Publishing Company Limited, New Delhi.
23. Nair, M. C. & Balakrishnan, S. (1986). Beneficial Fungi and their Utilization. Scientific Publishers, Jodhpur.
24. Shakuntala Manay, N. & Shadaksharaswamy, M. (2001). Foods-Facts and Principles. New Age International (P) Ltd, New Delhi.
25. Fellows P. J. Food Processing Technology Principles & Practices. (3rd ed.). CRC Press, Washington DC; Woodhead Publishing Limited, New Delhi.
26. Swaminathan, N. (1987). Food Science and Experimental Foods. Ganesh Publications, Madras.
27. James M. Jay. (2004). Modern Food Microbiology (4th ed.). CBS Publishers and Distributors, New Delhi.
28. Norman N. Potter. (1987). Food Science (3rd Edn). New Delhi: CBS Publ. and Distributors.
29. Patel A. H. (2005). Industrial Microbiology. Macmillan India Ltd., New Delhi.
30. Balakrishnan Iyer. (2011). Introductory Food Microbiology. BIO-GREEN BOOKS, Chawla offset Printers, New Delhi.

SUGGESTED READINGS

1. Frazier, W. C. & Westhoff, D.C. (1995). Food Microbiology. (4th ed.). Tata McGraw Hill Publishing Company Limited, New Delhi.
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Mahatma Gandhi University
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Programme						
Course Name	**Industrial and Entrepreneurial Microbiology**					
Type of Course	**MDC**					
Course Code	**MG2MDCMBG101**					
Course Level	**100-199**					
Course Summary	The course equips the students with skills in applied microbiology, foster innovation and proficiency in microbial processes for industry. The course content includes theory as well as hands-on training for production of food products and organic acids using microorganisms.					
Semester	**II**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		30	0	30	0	60
Pre-requisites, if any	A mindset geared towards entrepreneurship in microbiology-biotechnology sectors					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain diverse fermentation methods and their application in food products	U	3
2	Explain the involvement of microorganisms and develop hands-on skills in the production of fermented and other products of industrial importance	U,S	3,10
3	Outline how the fermented dairy foods contribute to gut health and overall well-being	An	3, 5, 10
4	Outline the steps in mushroom production; produce edible mushrooms for commercialization	A,S	10
5	Indicate the biosafety and ethical concerns with GMOs and GM foods	A	4, 9, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to fermented foods : Definition and characteristics - Food fermentation and health benefits Major types of fermentation in foods – Basic design of a fermenter/bioreactor	6	1
	1.2	Production of wine and beer – Health benefits of wine, uses in cooking and medicine Production of vinegar and citric acid – Industrial applications	6	2
	1.3	Microbial production of enzymes – Cellulase, Pectinase, Amylase, Protease - Uses in food industry Production of bread, sauerkraut, soy sauce, tempeh and sausages	8	2
2	2.1	Production of fermented dairy products :dahi, cheese, butter, buttermilk, lassi Probiotics and health benefits - Probiotic dairy products : Yoghurt, Kefir and Kumis	4	3
	2.2	Edible and poisonous mushrooms - Health benefits of mushrooms - Production of edible mushrooms	3	4
	2.3	GMOs, GM Foods and GM Crops – Applications – Ethical and biosafety issues – Guidelines for the production, release and movement of GMOs	3	5
3	3.1	Practical : Hands on training for preparation of wine, vinegar, dairy products, amylase, sauerkraut, mushrooms, fish amino acid	30	2
	3.2	Activity : Industry Visit (IV) to milk processing unit/baking unit/winery/distillery Submit a report		2
	3.3	Tie up with Koonpura, the Mushroom Farmers and By-products Producers Welfare Society for classes and for marketing of mushroom	-	4
4	4.1	Teacher specific content		

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<tr><td>**Total</td><td>15</td></tr>
</table>
**CCA for Practical = Total marks x 0.5</td></tr>
</table>

End Semester Examination (ESE)

C. ESE for 2 Credits Theory : 35 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	5	10
Total			**35**

D. ESE for 1 Credit Practical : 17.5 marks

Components	Total Marks
Evaluation of Practical skill	30
Record	5
***Total**	**35**

*ESE for Practical = Total marks x 0.5

References

1. Crueger, W. & Crueger, A. (2017). Crueger's Biotechnology: A Textbook Of Industrial Microbiology. (3rd ed.). K. R. Aneja eds. Panima Publishing Corporation, New Delhi.
2. Caseda JR, L. E. (2009). Industrial Microbiology. (2nd ed.). New Age International (P) Limited Publishers, Bangalore.
3. Patel A. H. (2016). Industrial Microbiology. (2nd ed.). Trinity Press (An Imprint of Laxmi Publication Pvt. Ltd.), New Delhi.
4. Baltz, R. H., Davies J. E. & Demain, A. L. (2010). Manual of Industrial Microbiology and Biotechnology (3rd ed.). ASM Publications, Washington DC.
5. Reed G. (2020). Prescott & Dunn's Industrial Microbiology. (4th ed.). CBS Publishers and Distributors Pvt. Ltd., New Delhi.
6. Nath S. K. (2022). Industrial and Environmental Microbiology. Mahaveer Publications, Dibrugarh, Assam
7. Stanbury, P. F., Whitaker, A. & Hall, S.J. (2017). Principles of Fermentation Technology. (3rd ed.). Elsevier Ltd., Cambridge, USA.
8. Frazier, W. C. & Westhoff, D.C. (1995). Food Microbiology. (4th ed.). Tata McGraw Hill Publishing Company Limited, New Delhi.
9. James M. Jay. (2004). Modern Food Microbiology (4th ed.). CBS Publishers and Distributors, New Delhi.
10. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
11. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
12. Salle, A. J. (2001). Fundamentals & Principles of Bacteriology (7th ed.). Tata McGraw-Hill, New York.

13. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
14. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
15. Gerhardt, P., Murray, R. G. E., Wood, W. A. & Krieg, N. R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington DC
16. Arora, D. R. & Arora, B. (2008). Text Book of Microbiology. (3rd ed.). CBS Publishers & Distributors, New Delhi.
17. Atlas, R. M. (2015). Principles of Microbiology. (2nd ed.). McGraw Hill Education (India) Private Limited, Green Park Extension, New Delhi.
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SUGGESTED READINGS

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2. Caseda JR, L. E. (2009). Industrial Microbiology. (2nd ed.). New Age International (P) Limited Publishers, Bangalore.
3. Patel A. H. (2016). Industrial Microbiology. (2nd ed.). Trinity Press (An Imprint of Laxmi Publication Pvt. Ltd.), New Delhi.
4. Baltz, R. H., Davies J. E. & Demain, A. L. (2010). Manual of Industrial Microbiology and Biotechnology (3rd ed.). ASM Publications, Washington DC.
5. Reed G. (2020). Prescott & Dunn's Industrial Microbiology. (4th ed.). CBS Publishers and Distributors Pvt. Ltd., New Delhi.
6. Nath S. K. (2022). Industrial and Environmental Microbiology. Mahaveer Publications, Dibrugarh, Assam
7. Stanbury, P. F., Whitaker, A. & Hall, S.J. (2017). Principles of Fermentation Technology. (3rd ed.). Elsevier Ltd., Cambridge, USA.
8. Frazier, W. C. & Westhoff, D.C. (1995). Food Microbiology. (4th ed.). Tata McGraw Hill Publishing Company Limited, New Delhi.
9. James M. Jay. (2004). Modern Food Microbiology (4th ed.). CBS Publishers and Distributors, New Delhi.
10. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Applied Microbiology**					
Type of Course	**MDC**					
Course Code	**MG3MDCMBG201**					
Course Level	**200-299**					
Course Summary	The course elucidates how microbes contribute to enhancing soil quality, controlling pests, ensuring the safety of drinking water, and managing wastewater. Additionally, it delves into their involvement in biodeterioration and bioterrorism. Safety considerations related to drinking water, wastewater treatment methods, and an exploration of microbial diseases in humans are also covered in the course content.					
Semester	**III**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	0	0	45
Pre-requisites, if any	Basic understanding of microbiology and microorganisms					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Relate the beneficial role of microorganisms in improving soil quality and pest control and also indicate the harmful effects of microbes	U	2,7
2	Assess safe disposal of waste water and safe supply of drinking water	E	7,10
3	Outline the immune response mechanisms and conclude the causatives, symptoms and control measures of common bacterial and viral diseases	An, E	2,3,10
4	Prepare organic fertilizers and practice organic farming and also test the bacteriological quality of soil and water	A,S	2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Beneficial roles of microorganisms in agriculture : Maintaining soil fertility – organic farming – Organic manure, Biofertilizers, Biological nitrogen fixation *Lab activity :* Production of bio compost/vermicompost, biopesticides and practice organic farming - Submit a report	8	1
	1.2	Cycling of nutrients between living and non-living systems : – Mineralization and fixation of carbon and nitrogen in biogeochemical cycling Biocontrol of insects and pests – Bioremediation Biodeterioration – Bioterrorism *Lab activity:* Isolation of root nodule bacteria, Isolation and enumeration of bacteria from soil	9	1
2	2.1	Treatment of wastewater and its safe disposal – Primary, secondary and tertiary treatments, Concept of BOD & COD *Lab activity :* Visit to waste water treatment system/Biocompost production unit - Submit a report	6	2
	2.2	Safe drinking (potable) water - Sanitary analysis of water - Faecal contamination and coliforms - Most common methods of water purification : Boiling, filtration, distillation, chlorination, UV treatment, and reverse osmosis	4	2
	2.3	Immunity – Innate and acquired immunity - Natural and artificial immunity – Passive and active immunity Antigens and antibodies – Protective mechanisms against infections : AMI & CMI – Vaccines Allergies and allergic reactions (brief study) – Common allergens	7	3
3	3.1	Food poisoning : Diarrhea - Dysentery, Cholera, Typhoid, Stomach flu (gastroenteritis), Polio, Viral hepatitis,	5	3
	3.2	Other communicable diseases : Common cold , flu (influenza), conjunctivitis, chicken pox Infection spread by mosquitoes – Malaria, Dengue	3	3
	3.3	Major respiratory infections : Tuberculosis, Pneumonia Sexually transmitted diseases : Syphilis, Hepatitis, AIDS (brief study)	3	3
4	4.1	Teacher specific content		

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<tr><td>Assessment Types</td><td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
A. CCA for 3 Credits Theory: 25 Marks

Scheme for CCA Theory
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<tr><td></td><td>End Semester Examination (ESE)
B. ESE for 3 Credits Theory : 50 Marks
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<tr><td>Multiple choice Questions</td><td>1</td><td>10</td><td>10</td></tr>
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References

1. Powar, C.B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
2. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.

3. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
4. Salle, A. J. (2001). Fundamentals & Principles of Bacteriology (7th ed.). Tata McGraw-Hill, New York.
5. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
6. Willey, J. M., Sherwood, L. M. & Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
7. Pelczar Jr., M. J., Chan, E. C. S. & Krieg, N. R. Microbiology. (1985). (5th ed.). Tata Mc-Graw Hill Inc. Publishers, New York.
8. Daniel, J. C. (1996). Environmental Aspects of Microbiology. (1st ed.). Bright Sun Publications, Chennai.
9. Reed, M. (1992). Environmental Microbiology. John Wiley and Sons, New York.
10. Ananthanarayanan, R. & Jayaram Panikar, C. K. (2006) Ananthanarayan & Paniker's Textbook of Microbiology (7th ed.). Orient Longman Private Limited, Bengaluru, Karnataka.
11. Purohit, S. S. (2006). Microbiology - Fundamentals and Applications. (7th ed.). Student Edition Publishers, Jodhpur.
12. Ramana Rao, P. V. (2005). Essentials of Microbiology. CBS Publishers and Distributors, New Delhi.

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Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Sensory Evaluation of Foods**					
Type of Course	**VAC**					
Course Code	**MG3VACMBG201**					
Course Level	**200-299**					
	In this course, the student dives into the world of distinguishing flavours, and fine textures. The course unveils the sensory attributes of food that influence food preferences. The course content describes how the sensory tests for food evaluation helps to identify flavours, enhanced palate sensitivity, and thus gain a better understanding of consumer preferences.					
Semester	**III**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	0	0	45
Pre-requisites, if any	Understanding of basics in biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the sensory characters of food	U	1, 2
2	Explain the layout of tasting lab, the type of panels and the environmental factors in relation to sensory analysis	U	2
3	Employ sensory evaluation tests to identify the sensory characteristics and consumer food preferences of various foods	A	1, 2
4	Present career opportunities of this course in food sector	A	2
5	Develop skills to organize and perform sensory evaluation of foods	E,S	10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Definition of food – Sensory or organoleptic factors Appearance factors : size, shape, colour, gloss, consistency, wholeness, patterns etc. Textural factors – Texture changes – Flavour factors :smell, taste, mouth feel, temperature – Taste interactions	3	1
	1.2	Sensory evaluation – Definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects. Factors affecting food acceptance - Terminologies related to sensory evaluation	6	2
	1.3	Basic steps to perform the sensory analysis – Selection of Panel – Types of panel : Trained Panel , Discriminative and Communicative Panel, Untrained Panel/Consumer Panel – Qualifications for panellists	4	2
2	2.1	Methodology for Sensory Evaluation : Screening, Training, Briefing of panel Environmental factors – lighting, aeration, humidity Facilities – Tasting table, wash area, utensils Layout of sensory laboratory : Reception and briefing room, Panel booths, Preparation Room, Testing room and preparation of sample	5	2
	2.2	Types of sensory tests - Analytical sensory tests and affective tests (like–dislike) Analytical tests : Discrimination & descriptive tests Discriminative tests : Difference tests, sensitivity tests	4	3,5
	2.3	Difference Tests : Paired-comparison test, Duo-trio test, Triangle test, Ranking test, Rating difference/scalar difference from control *Lab activity :* Sensory analysis of food samples by Paired-comparison test, Duo-trio test, Triangle test	7	3,5
3	3.1	Sensitivity tests : Threshold test, Dilution test, Rating difference/ Scalar difference from control Descriptive tests : Attribute rating like Category scaling, Ratio scaling (Magnitude Estimation), Flavour profile analysis, Texture profile analysis, Quantitative descriptive analysis	6	3
	3.2	Affective tests : Paired-performance, Ranking, Rating : Hedonic scale (verbal or facial) and Food action scale Applications of sensory evaluation : New Product Development, Product Improvement/Process change/cost reduction, Quality Control, Storage stability studies, Product grading or Rating *Lab activity :* Sensory analysis of food samples by affective tests	6	3,4,5
	3.3	Tasting as a Career opportunity : Career as Tea Sommelier – Beer sommelier – Coffee Connoisseur (coffee expert) – Coffee cupper (Coffee taster) – Barista (coffee artist) – Wine taster	4	3,4,5
4	4.1	Teacher specific content		

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References

1. Sensory Evaluation of Food Products. https://egyankosh.ac.in/bitstream/123456789/12396/1/Unit-14.pdf
2. Srilakshmi, B. (2005). Food Science (3rd ed.). New Age International (P) Ltd., New Delhi.

3. Lawless , H. T. & Heymann, H. (1999). Sensory Evaluation of Food : Principles and Practices. Springer, New York. https://doi.org/10.1007/978-1-4419-7452-5.
4. Clark, S., Drake, M. A. & Kaylegian, K. Eds. (2023). The Sensory Evaluation of Dairy Products. (3rd ed.). Springer Cham, New York. https://doi.org/10.1007/978-3-031-30019-6
5. Kemp, S. E., Hollowood, T. & Hort, J. (2009). Sensory Evaluation: A Practical Handbook. John Wiley & Sons Ltd., New Jersey, United States. DOI:10.1002/9781118688076
6. Kilkast, D. Eds. (2017). Sensory Analysis for Food and Beverage Quality Control- A Practical Guide. Elsevier Ltd., Woodhead Publishing, UK.
7. Sharif, M. K., Butt, M. S., Sharifm H. R. & Nazir, M. (2017). Sensory Evaluation and Consumer Acceptability. In book: Handbook of Food Science and Technology (pp.362-386). https://www.researchgate.net/publication/320466080
8. O' Sullivan, M. G. (2017). A Handbook for Sensory and Consumer Driven New Product Development: Innovative Technologies for the Food and Beverage Industry. Elsevier Ltd., Woodhead Publishing, UK.
9. Civille, G. V. & Carr, B. T. (2016). Sensory Evaluation Techniques. (5th ed.). CRC Press, Taylor & Francis, Boca Raton, Florida.
10. Potter N. M. & Hotchkiss J. H. (2021). Food Science. (5th ed.). CBS Publishers and Distributors, New Delhi.
11. Vijaya Ramesh, K. (2019). Food Microbiology, MJP Publishers, Chennai.
12. Swaminathan, N. (1987). Food Science and Experimental Foods. Ganesh Publications, Madras.
13. Manay, S. N. & Shadaksharaswamy, M. (2005). Foods-Facts and Principles. (2nd ed.). New Age International (P) Ltd, New Delhi.

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Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Foodborne Diseases, Food Sanitation and Food Safety**					
Type of Course	**DSC**					
Course Code	**MG3DSCMBG203 & MG4DSCMBG203**					
Course Level	**200-299**					
Course Summary	The course compiles the details of the causatives, clinical features and prophylactic measures of various foodborne pathogens. The course content discusses the significance of cleaning and sanitation for quality control and quality assurance in food processing/production units. The students will familiarize with the national and international food safety standards and their significance in national and international food trade.					
Semester	**III & IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	30	0	75
Pre-requisites, if any	A basic understanding of the fundamentals of general/applied/food microbiology.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the hazards in various stages of food production and processing	U	2, 3
2	Compare food poisonings caused by bacteria, fungi, viruses and protozoa and suggest methods for prophylaxis and prevention	U	1, 2, 3
3	Use appropriate cleaning and sanitation methods in food production units	A	3, 10
4	Design methods and formulate policies for quality assurance in food processing and production units and employ food safety standards in national and international food trade	A	2, 3
5	Examine food samples and identify foodborne bacterial pathogens	C	2, 3, 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Hazards in Food – Physical, chemical and biological hazards; Mycotoxins and mycotoxicosis – Aflatoxins and aflatoxicosis	4	1,2
	1.2	Introduction to foodborne diseases – Food infections and food intoxications Food intoxications : Staphylococcal intoxication, Botulism Food and waterborne bacterial diseases : Salmonellosis, *E. coli* diarrhoea, Cholera, Bacillary dysentery, Typhoid, *C .jejuni* gastroenteritis, Listeriosis	9	1,2
	1.3	Foodborne viral diseases - Viral gastroenteritis (by Norovirus, Astrovirus, Adenovirus, Enteroviruses), Polio, Infectious hepatitis (by Hepatitis A & E viruses), Rotaviral diarrhoea	5	1,2
2	2.1	Food poisoning caused by Protozoans : *Entamoeba histolytica* Prevention of food borne outbreaks - Personal hygiene in food safety	3	1,2
	2.2	Food plant cleaning : Detergents in cleaning, cleaning methods of CIP & COP	3	3
	2.3	Food plant sanitation - Physical agents as sanitizers: Hot water, flowing steam , steam under pressure Chemical sanitizers: Halogens such as chlorine and chlorine compounds - quaternary ammonium compounds	5	3
3	3.1	Principles of quality control and quality assurance with reference to food analysis and testing –Role of QC in food processing unit	5	4
	3.2	Waste water and solid waste treatment in food industry - Pest and rodent control	3	4
	3.3	Food safety guidelines: Codex Alimentarius Commission, HACCP, FSSAI, AGMARK, ISO 22000 , GMP, Food safety symbols	8	4
4	4.1	Practical : Isolation of food borne pathogens : Enrichment culture of *Salmonella, Vibrio*	8	5
	4.2	Practical : Cultivation and study of foodborne pathogens and their characteristics in selective media (*Staphylococcus, Vibrio, Salmonella, Shigella, E. coli*)	12	5
	4.3	Activity : Industrial Visit (IV) to a food industry for understanding steps in food safety & food sanitation and to identify the role of QC in online food processing Submit a report	10	5
5	5.1	Teacher specific content		

MGU-UGP (HONOURS)

Syllabus

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B. CCA for 1 Credit Practical : 7.5 Marks
Scheme for CCA
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Practical
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<tr><th>Components</th><th>Marks</th></tr>
<tr><td>Evaluation of Practical Skill (Test/Experimentation)</td><td>8</td></tr>
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<tr><td>Industry Visit</td><td>5</td></tr>
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</table>
**CCA for Practical = Total marks x 0.5</td></tr>
</table>

End Semester Examination (ESE)

C. ESE for 3 Credits Theory : 50 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	10	10
Short answer questions	3	4	12
Long answer questions	1	8	8
Total			**50**

D. ESE for 1 Credit Practical : 17.5 marks

Components	Total Marks
Evaluation of Practical skill	25
Record	10
***Total**	**35**

*ESE for Practical = Total marks x 0.5

References

1. Doyle, M. P. (1997). Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington.
2. Joshi, V. K. & Pandey A. (1999). Biotechnology: Food Fermentation Vol. 1 & 2, Education Publisher and Distributor, New Delhi.
3. Marwaha S.S. and Arora, J.K. (2000), *Food Processing: Biotechnological Applications*, Asia tech Publishers Inc., New Delhi.
4. Frazier, W. C. & Westhoff, D.C. (1995). Food Microbiology. (4th ed.). Tata McGraw Hill Publishing Company Limited, New Delhi.
5. Nair, M. C. & Balakrishnan, S. (1986). Beneficial Fungi and their Utilization. Scientific Publishers, Jodhpur.
6. Shakuntala Manay, N. & Shadaksharaswamy, M. (2001). Foods-Facts and Principles. New Age International (P) Ltd, New Delhi.
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9. Norman N. Potter. (1987). Food Science (3rdEdn). New Delhi: CBS Publ. and Distributors.
10. Patel A. H. (2005). Industrial Microbiology. Macmillan India Ltd., New Delhi.
11. Balakrishnan Iyer. (2011). Introductory Food Microbiology. BIO-GREEN BOOKS, Chawla offset Printers, New Delhi.
12. David Greenwood, Mike Barer, Richard Slack, Will Irving. (2012). Medical Microbiology. 18th Edition. Churchill Livingstone Elsevier.

13. Murray, Rosenthal, Pfaller. (2013). Medical Microbiology. Seventh Edition. Elsevier Inc., Philadelphia.
14. Aneja K. R.(2005). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. New Age International (P) Limited Publishers, Bangalore.
15. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
16. Sharma, K. (2009). Manual of Microbiology Tools and Techniques. (2nd ed.). Ane Books India, New Delhi.
17. Thomas, K. E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
18. Kannan, N. (2002). Laboratory Manual in General Microbiology. Panima Publishing Corporation, New Delhi.

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Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Microbial Perspectives in Disaster Response and Forensic Investigations**					
Type of Course	**VAC**					
Course Code	**MG4VACMBG201**					
Course Level	**200-299**					
Course Summary	This course aims to foster a broad comprehension of different disaster types and the corresponding propagation of microbial infections. It will enhance students' readiness for disasters, fostering an understanding of disaster resilience, risk mitigation, and recovery policies. The course will provide essential mitigation measures, empowering students to apply their skills effectively in disaster scenarios.					
Semester	**IV**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	0	0	0	45
Pre-requisites, if any	Basin understanding of biology or any branch of science/disasters and their impacts on human life					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Relate microbiology with the advent of disasters and discuss the characteristics and behaviour of various microbial agents relevant to disaster scenarios and forensic investigations	U	2,3
2	Analyze strategies for preparing for disasters and identify potential microbial threats	An	2
3	Analyze the impact of disasters on microbial pathogens and their potential spread, and develop strategies for controlling and mitigating microbial risks in such scenarios	An	1,2
4	Employ forensic microbiology techniques for the investigation of biological evidence, aiding in the resolution of criminal cases or disaster-related incidents	A	2,3
5	Integrate knowledge from microbiology, forensics, and related fields and formulate a comprehensive approach to investigative processes	A	3,5,9

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Microbial Perspectives in Disasters : Natural and manmade disasters - Overview of microbial roles in disasters Importance of Microbiology in Disaster Response Microbial Threats and Risks - Hazards & spread of communicable diseases - Factors facilitating the spread of microorganisms during a disaster	5	1
	1.2	Role of NDMA, NDRF & SDRF (Brief) Case Studies on Microbial Impact in Disasters Microbial surveillance and monitoring in Disaster Preparedness - Spread of diseases in the various phases of natural disasters (Impact phase, Post impact phase & Recovery phase)	6	2,3
	1.3	Communicable diseases with epidemic potential - Diarrheal Diseases, Outbreaks of Leptospirosis (Brief) Diseases associated with crowding - Acute respiratory Infections (ARI) Common vectorborne diseases and tickborne infections in disasters (Brief) Mold infections following natural calamities: asthma, sick building syndrome, mucormycosis (Brief)	7	1,3
2	2.1	Infections in wounds and burns: Tetanus, Post-surgical infections, Bacterial and viral infections of wounds and burns (Brief) Risks posed by dead bodies after disasters: Tuberculosis, bloodborne viruses, gastrointestinal infections	3	1,3
	2.2	Impact of Disasters on Microbial Pathogens - Spread and Control of Microbial Risks - Risk Assessment and Mitigation Strategies Biosecurity Measures in Disaster Scenarios - Disaster preparedness and emergency response plans Practical Session : Simulation Exercise – Disaster Preparedness Plans	6	2,3
	2.3	Introduction to Forensic Microbiology - Microbial forensics today: Study of biodiversity, phylogenetics, phylogeography, and genomics - Establishment of biosurveillance mechanism Microbes in the forensics workspace - Spectrum of risks due to biological agents: Natural outbreak, Accidental release, Biocrimes, Bioterrorism, Biowarfare	5	4,5
3	3.1	Biological warfare and bioterrorism – Agro-terrorism – CDC's A, B, and C categories of bioterrorism agents - Examples from history : Yellow rain, The 'Amerithrax' (Case Study)	3	4
	3.2	Microbial Evidence Collection and Preservation - Inclusion & Exclusion hypothesis testing used in molecular forensics and epidemiology Laboratory Techniques in Forensic Microbiology- Biosafety-Level 3 laboratories Traditional methods in forensic : culture, phage sensitivity, staining, microscopy	2	4

	3.3	Rapid Analytical tools : Antibody-based & DNA based methods Real-Time PCR (qPCR), Genotyping tools like VNTRs, MLST, NGS (Brief) Interdisciplinary Approaches in Microbial Forensics Collaboration between Microbiology and Forensics Legal and Ethical Considerations in Microbial Forensics Activity: Case studies - Submit a report	8	4,5
4	4.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Case studies

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 3 Credits Theory: 25 Marks

Scheme for CCA
Theory

Components		**Marks**
Test (MCQ/short answer/Long answers) or Quiz		10
Seminar – Introduction of topic	1	5
Topic clarity	2	
Presentation skill	2	
Case study report		5
*Activity/Assignment		5
Total		**25**

*Based on Teacher specific content

End Semester Examination (ESE)

B. ESE for 3 Credits Theory : 50 Marks

Question type	**Marks per question**	**No of questions**	**Total Marks**
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
True or false questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	5	10
Long answer questions	5	3	15
Total			**50**

References

1. Waring, S. C. & Brown, B. J. (2005). The threat of Communicable Diseases following Natural Disasters: A Public Health Response. Disaster Management & Response 3:41-47.
2. Daniel, F. Q. S. & Casadevall, A. (2022). Disaster Microbiology – A New Field of Study. ASM Journals 13, (4). DOI: https://doi.org/10.1128/mbio.01680-22
3. Coppola, D. (2020). Introduction to International Disaster Management. (4th ed.). Elsevier.
4. Manesh, A. K. (2017). Handbook of Disaster and Emergency Management (1st ed.). Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg.
5. Pawar, A., Chaudhari, Y., Sonawane, N., Patil J., & Maule, J. (2021). Microbial Engineering for Natural Disaster Management: Review. International Journal of Microbial Science; 1(1):47-53.
6. Mulam, B. R. (2011). Emergency Medical Preparedness for Disaster Risk Reduction: The Role of Health Sector Personnel - An Overview. Prehospital and Disaster Medicine 26: s62-s63. http://dx.doi.org/10.1017/s1049023x11002160.
7. Joel M. (2013). Emergency and Disaster Management. Journal of Consumer Health on the Internet 17(1): 103-11. http://dx.doi.org/10.1080/15398285.2013.756347.
8. Austin, C. L., Finley, P. J., Mikkelson, D. R. & Tibbs, B. (2014). Mucormycosis: A Rare Fungal Infection in Tornado Victims. Journal of Burn Care & Research 35(3): e164-e171. https://doi.org/10.1097/BCR.0b013e318299d4bb
9. Zheng, J., Han, W., Jiang, B., Ma, W., & Zhang Y. (2017). Infectious Diseases and tropical cyclones in southeast China. International Journal of Environmental Research and Public Health 14(5): 494. doi: 10.3390/ijerph14050494.
10. Crook, B. & Burton, N. C. (2010). Indoor Molds, Sick Building Syndrome and Building Related Illness. Fungal Biology Reviews 24:106-113.
11. Morgan, O. (2004). Infectious Disease Risks from Dead Bodies following Natural disasters. Rev Panam Salud Publica 15(5): 307-312.
12. Kobziar, L. N. & Thompson, G. R. (2020). Wildfire Smoke, a Potential Infectious Agent. Science 370:1408-1410.
13. Sahli, Z. T., Bizri, A. R. & Abu-Sittah, G. S. (2016). Microbiology and Risk Factors associated with War-related Wound Infections in the Middle East. Epidemiology & Infection 144(13): 2848-2857.
14. Bhatia, M., Mishra, B., Thakur, A., Dogra, V. & Loomba P. S. (2016). Concept of Forensic Microbiology and its Applications. SMU Medical Journal 3(1): 275-294.
15. Committee on Science Needs for Microbial Forensics: Developing an Initial International Roadmap; Board on Life Sciences; Division on Earth and Life Studies; National Research Council (2014). Science Needs for Microbial Forensics: Initial International Research Priorities. The National academic Press, Washington DC.
16. Justice K. Kannan & K. Madhiharan Eds. (2012). A Textbook of Medical Jurisprudence and Toxicology. (24th ed.). LexisNexis, Butterworths Wadhwa, Nagpur
17. Carter D. O., Tomberlin,J. K., Benbow, M E. & Metcalf, J. L. Eds. (2017). Forensic Microbiology. John Wiley & Sons Ltd., United States.
18. Budowle B., Schutzer S. & Morse S. Eds. (2020). Microbial Forensics. (3rd ed.). Academic Press Publications (Elsevier), Oxford, united Kingdom.
19. Lehman, D. C. (2012). Forensic Microbiology. Clinical Laboratory Science 25(2): 114-119. Website : http://hwmaint.clsjournal.ascls.org/

20. McEwen, S.A., Wilson, T.M, Ashford, D.A., Heegaard, E.D., Kuiken, T. & Kournikakis, B. (2006). Microbial Forensics for Natural and Intentional Incidents of Infectious Disease involving Animals. Rev. sci. tech. Off. int. Epiz 25 (1). 329-339.
21. Yang, R. & Keim, P. (2012) Microbial Forensics: A Powerful Tool for Pursuing Bioterrorism Perpetrators and the Need for an International Database. Journal of Bioterrorism and Biodefense S3:007. doi:10.4172/2157-2526.S3-007
22. ul Gani Mir, T., Wani, A. K., Akhtar, N., Sena, S. & Singh, J. (2022). Microbial Forensics: A Potential Tool for Investigation and Response to Bioterrorism. Health Sciences Review 5:100068, https://doi.org/10.1016/j.hsr.2022.100068.
23. Castroa, A. E. & De Ungria, M. C. A. Methods used in Microbial Forensics and Epidemiological Investigations for Stronger Health Systems. (2022). Forensic Science Research 23;7(4):650-661. doi: 10.1080/20961790.2021.2023272. PMID: 36817258; PMCID: PMC9930754.
24. Narang, D., Kulshreshtra, R., Khan, F., Sur, J., Singh, A., Kulkarni, V., Desai, V. & Abhishek Pandey, A. (2016). Microbes in Forensic Medicine: A Microbiologist Perspective. International Journal of Bioassays 5.10: 4913-4919.
25. Oliveira, M. & Amorim, A. (2018). Microbial Forensics: New Breakthroughs and Future Prospects. Applied Microbiology and Biotechnology 102:10377-10391. https://doi.org/10.1007/s00253-018-9414-6
26. Pattnaik, P. & Sekhar, K (2008). Forensics for tracing microbial signatures: Biodefence Perspective and Preparedness for the Unforeseen. Indian Journal of Biotechnology l 7: 23-31.

SUGGESTED READINGS

1. Waring, S. C. & Brown, B. J. (2005). The threat of Communicable Diseases following Natural Disasters: A Public Health Response. Disaster Management & Response 3:41-47.
2. Daniel, F. Q. S. & Casadevall, A. (2022). Disaster Microbiology – A New Field of Study. ASM Journals 13, (4). DOI: https://doi.org/10.1128/mbio.01680-22
3. Coppola, D. (2020). Introduction to International Disaster Management. (4th ed.). Elsevier.
4. Bhatia,M., Mishra, B., Thakur, A., Dogra, V. & Loomba P. S. (2016). Concept of Forensic Microbiology and its Applications. SMU Medical Journal 3(1): 275-294.
5. Committee on Science Needs for Microbial Forensics: Developing an InitialInternational Roadmap; Board on Life Sciences; Division on Earth and LifeStudies; National Research Council (2014). Science Needs for Microbial Forensics: Initial International Research Priorities. The National academic Press, Washington DC.
6. Carter D. O., Tomberlin,J. K., Benbow, M E. & Metcalf, J. L. Eds. (2017). Forensic Microbiology. John Wiley & Sons Ltd., United States.
7. Budowle B., Schutzer S. & Morse S. Eds. (2020). Microbial Forensics. (3rd ed.). Academic Press Publications (Elsevier), Oxford, united Kingdom.
8. Lehman, D. C. (2012). Forensic Microbiology. Clinical Laboratory Science 25(2): 114-119. Website : http://hwmaint.clsjournal.ascls.org/

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**				
Course Name	**Fundamentals of Microbiological Analysis of Food and Water**				
Type of Course	**SEC**				
Course Code	**MG4SECMBG201**				
Course Level	**200-299**				
Course Summary	The course outlines the various foodborne hazards. The course content helps the students to acquire theoretical knowledge, practical skills and safety standards to work in a food or water testing lab, food processing units, R & D related to food and water analysis				
Semester	**IV**	Credits		3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		45	0	0	0
Pre-requisites, if any	Fundamental knowledge in chemistry, biology and allied branches of life sciences				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarize food safety hazards in food and water	U	3,6,10
2	Understand and demonstrate safe practices to be followed in handling and testing of bacteria and fungi	U,A	2,3
3	Prepare, sterilize and disinfect media for testing food and water samples	A,S	2,3
4	Identify and enumerate foodborne pathogens and coliforms in food and water	E,S	2,3,5
5	Develop practical skills to work in food / water testing labs and food processing units	C,S	5,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to foodborne pathogens and other contaminants - Hazards in food industry- Physical, chemical and biological hazards Microbiological lab safety measures, Quality control practices, Standard procedures for safe handling of bacteria and fungi Basics of sample collection – Types of samples Swab testing, sample preparation and sample disposal	5	1,2
	1.2	Staining techniques for identification bacteria and fungi - Simple staining & Gram staining of bacteria, Lactophenol cotton blue staining of fungi Principles of sterilization, fumigation and decontamination – Use of equipments for sterilization and decontamination *Lab activity :* Simple staining & Gram staining of bacteria, Lactophenol cotton blue staining of fungi	8	2,3, 5
	1.3	Media composition and preparation – Sterilization of media Specific media for food and water analysis – Nutrient agar Plate count agar, MacConkey agar *Lab activity :* Sterilization of glass wares - Preparation and sterilization of broth and agar media – Swab testing for sanitation	8	2,4, 5
2	2.1	Selective media : EMB agar & Sorbitol MacConkey (SMAC) agar for E. coli; Salmonella-Shigella (SS) agar, Desoxycholate-Citrate agar (DCA) & Xylose-Lysine-Desoxycholate (XLD) agar for *Salmonella*; Baird Parker agar and Mannitol Salt agar for *Staphylococcus aureus,* TCBS for *Vibrio* *Lab activity :* Study the characteristics of *E. coli*, *Salmonella*, *S. aureus* and *Vibrio* in differential and selective media	7	
	2.2	Techniques for enumeration of microorganisms – Direct count by haemocytometer Pure culture techniques : Isolation of bacteria by streak plate method Serial dilution & enumeration of bacteria by pour plate & spread plate - Membrane filtration method - Turbidimetric methods *Lab activity :* Isolation of bacteria by streak plate - Enumeration of bacteria from different food samples by serial dilution and plating methods - Enumeration by Haemocytometer	4	4,5
	2.3	*Water quality analysis – Coliforms as indicators,* Total plate count -Testing for coliforms and *E. coli* by MPN *Lab activity :* Demonstration of MPN test	4	4,5
3	3.1	Bacteriological quality of milk by MBRT Tests for rancidity of fats : Acid value, peroxide value *Lab activity :* MBRT for milk analysis - Acid value and Peroxide value	6	4,5
	3.2	BIS, FDA, EU, FSSAI regulations (brief study)	3	2,5
4	4.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Lab activity

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 3 Credits Theory : 25 Marks

Scheme for CCA Theory

Components		Marks
Test (MCQ/short answer) or Quiz		5
Seminar – Introduction of topic	1	5
Topic clarity	2	
Presentation skill	2	
Lab Activity		10
*Assignment		5
Total		**25**

*Based on Teacher specific content

End Semester Examination (ESE)

B. ESE for 3 Credits Theory : 50 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
True or false questions	1	5	5
One word/very short answer questions	1	10	10
Give reason questions	1	5	5
Short answer questions	2	5	10
Long answer questions	5	2	10
Total			**50**

References

1. Pelczar Jr., M. J., Chan, E. C. S. & Krieg, N. R. Microbiology. (1985). (5th ed.). Tata Mc-Graw Hill Inc. Publishers, New York.
2. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
3. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
4. Powar, C. B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
5. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
6. Salle, A. J. (2001). Fundamentals & Principles of Bacteriology (7th ed.). Tata McGraw-Hill, New York.
7. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
8. Gerhardt, P., Murray, R. G. E., Wood, W. A. & Krieg, N. R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington DC
9. Ramana Rao, P. V. (2005). Essentials of Microbiology. CBS Publishers and Distributors, New Delhi.
10. Atlas, R. M. (2015). Principles of Microbiology. (2nd ed.). McGraw Hill Education (India) Private Limited, Green Park Extension, New Delhi.
11. Black, J. G. (2012). Microbiology: Principles and Explorations(8th ed.). John Wiley & Sons Inc., New York.
12. Alcamo, I. E. & Warner J. M. Schaum's Outline of Theory and Problems of Microbiology. (2nd ed.). The McGraw Hill Companies Inc., New Delhi.
13. Wheelis, M. (2010). Principles of Modern Microbiology. Jones and Bartlett India Pvt. Ltd., Daryaganj, New Delhi.
14. Banerjee, A. K. & Banerjee, N. (2012). Fundamentals of Microbiology and Immunology. (2nd ed.).New Central Book Agency (P) Ltd., Sankrail, Howrah.
15. Arora, D. R. & Arora, B. (2008). Text Book of Microbiology. (3rd ed.). CBS Publishers & Distributors, New Delhi.
16. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
17. Sharma, K. (2009). Manual of Microbiology Tools and Techniques. (2nd ed.). Ane Books India, New Delhi.
18. Aneja, K. R. (2005). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. (4th ed.).New Age International (P) Limited Publishers, Bangalore.
19. Thomas, K. E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
20. Kannan, N. (2002). Laboratory Manual in General Microbiology. Panima Publishing Corporation, New Delhi.
21. Gunasekaran, P. (2005). Laboratory Manual in Microbiology. New Age International (P) Limited Publishers, New Delhi.

SUGGESTED READINGS

1. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
2. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.

3. Powar, C. B. & Daginawala, H. F. (2022). General Microbiology. Volume I. Himalaya Publishing House, New Delhi.
4. Davis, D., Delbecco, L., Eisen, N.H. & Ginsburg, S. H. (1990). Microbiology. (5th ed.). Harper & Raw, New York.
5. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
6. Sharma, K. (2009). Manual of Microbiology Tools and Techniques. (2nd ed.). Ane Books India, New Delhi.
7. Aneja, K. R. (2005). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. (4th ed.).New Age International (P) Limited Publishers, Bangalore.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Instrumentation and Advances in Food Analysis**					
Type of Course	**DSE**					
Course Code	**MG7DSEMBG400**					
Course Level	**400-499**					
Course Summary	The course prepares students to understand the principles and operations of different instruments and testing techniques essential for employment in food industries and research and development organizations. It provides both theoretical knowledge and practical experience in traditional, advanced, and automated methods used for quality assessment and the identification of contaminants and pathogens in meat, fish, poultry, milk, fruits, vegetables, and their derivatives.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		60	0	0	0	60
Pre-requisites, if any	A background in food science and microbiology and familiarity with laboratory techniques is beneficial.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarize the principle, working and use of various instruments used in analysis of food	U	2,3
2	Demonstrate proficiency in food analysis by outlining techniques for sample collection and applying these methods effectively in the analytical process.	An	1,2,3
3	Evaluate food and water to identify contaminants and pathogens	E	2,3
4	Apply sophisticated and automated techniques to detect contaminants and pathogens in food samples and address the issue of foodborne diseases	A	2,3,5,10
5	Test the quality of meat, fish, milk, fruits and vegetables	E,S	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Microscopy – Light microscope vs Electron microscope – Parts, Principle and working of SEM, TEM, STEM	4	1
	1.2	pH meter, TLC, HP-TLC, GC, GC-MS, HPLC, LC-MS, UV-Visible Spectroscopy, Atomic-Absorption Spectroscopy (AAS) , Nuclear Magnetic Resonance Spectroscopy (NMR), Fourier Transform Infrared Spectroscopy (FT-IR)	8	1
	1.3	Food sampling - Sample collection for food testing –Collection of food samples from cases and foodborne disease outbreaks Swabs for collection from equipments, food contact surfaces, packaging materials Sample collection from patients, workers – Transport of samples to testing *Lab activity :* Isolation and culture of foodborne pathogens: Serial dilution – Pour and spread plate methods	6	2,5
	1.4	Basics methods for food and water analysis – isolation and culture, enrichment culture, use of selective media - indicator organisms – coliforms and MPN – enumeration of microorganisms *Lab activity :* Water Analysis – TPC, MPN Test	7	3,5
2	2.1	Immunoassays using ELISA – Sandwich and competitive ELISA methods – ELISA methods to detect mycotoxin - Sandwich assays for testing of *E. coli* and *Listeria* - WIDAL test for *Salmonella* *Lab activity :* Enrichment culture , selective and differential media for identification of pathogens - Study of characteristics of foodborne pathogens on selective media	8	4,5
	2.2	PCR based methods – Mutiplex PCR, Real time PCR (RT-PCR) – Applications in detection of foodborne pathogens, GMOs, GM Foods *Lab activity :* DNA isolation, PCR , ELISA	7	4,5
	2.3	Quality analysis of Milk – MBRT, TPC, alkaline phosphatase test, clot on boiling test, Resazurin test TMA and TVBN estimation for quality analysis of fish and sea foods *Lab activity :* MBRT, TPC, alkaline phosphatase test, clot on boiling test and Resazurin tests for milk	6	5
3	3.1	Routine testing of fresh meat : aerobic plate count (APC), coliforms, faecal coliforms, molds, yeasts, some selected bacteria such as *E. coli, S. aureus, Clostridium perfringens, Salmonellae*	5	5
	3.2	Quality analysis of fruit and vegetables and their products : Detection of *E. coli, Salmonella, Staphylococcus aureus*, yeast and mold count and TPC, quality of juices, fermented products and beverages	5	5
	3.3	Automated methods, NABL accreditation for testing labs Activity : Visit to a Food Testing Lab, Submit a report	4	2,4,5

5	5.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Lab activity, Visit to a Food Testing Lab

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 3 Credits Theory: 30 Marks

Scheme for CCA Theory

Components		Marks
Test (MCQ/short answer/Illustrations) or Quiz		10
Seminar – Introduction of topic	1	5
Topic clarity	2	
Presentation skill	1	
Interacting with the audience	1	
Lab activity (Report/experimentation)		10
*Assignment/an activity		5
Total		**30**

*Based on Teacher specific content

End Semester Examination (ESE)

B. ESE for 3 Credits Theory : 70 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	10	20
Short essay questions	5	4	20
Long answer questions	10	1	10
Total			**70**

References

1. Green, M. R. & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. (4th ed.). Volume 1. Cold Spring Harbor Laboratory Press, Cold spring Harbor, New York.

2. Hill, W.E. (1988), Genetic Engineering: A Primer. CRC Press, Taylor and Francis Group, New York.
3. Willard, H.H., Merritt, L.L., Dean, J.A., & Settle, F. A.. Jr.(2022). Instrumental Methods of Analysis. (7th ed.). Wadsworth Publishing Company, Belmont, CA
4. Brown, T.A. (2002). Genomes (2nd ed.). John Wiley, New York.
5. Straughan, B.B. & Walker, S. Eds. Spectroscopy. Volume 1. Chapman and Hall Ltd.
6. Miller, J. (1988). Chromatography: Concepts and Contrasts. John Wiley and Sons. Inc., New York.
7. Glover, D.M. & Hames, B.D. (1995). DNA cloning: A Practical Approach. IRL Press, Oxford.
8. Primrose, S. B., Twyman, R., & Old B. (2001). Principles of Gene Manipulation: An Introduction to Genetic Engineering. (6th ed.). Wiley-Blackwell.
9. Chatwal, G. & Anand, S. (1989). Instrumental Methods of Chemical Analysis. Himalaya Publishing House, Mumbai.
10. Williams, B.L. & Wilson, K. A. (1975). A Biologist's Guide to Principles and Techniques of Practical Biochemistry (Contemporary Biology S). Hodder Publications.
11. Message, G. M. (1984). Practical Aspects of Gas Chromatography and Mass Spectrometry. John Wiley and Sons, New York.
12. K. R. Aneja. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology. New Age International (P) Limited Publishers, Bangalore.
13. Thomas, K.E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
14. Kannan, N. Laboratory Manual in General Microbiology. Panima Publishing Corporation, New Delhi.
15. P Gunasekaran, 1996. Laboratory Manual in Microbiology. New Age Internati
16. Chatwal, G. & Anand, S. (1989). Instrumental Methods of Chemical Analysis. Himalaya Publishing House, Mumbai.
17. Williams, B.L. & Wilson, K. A. (1975). A Biologist's Guide to Principles and Techniques of Practical Biochemistry (Contemporary Biology S). Hodder Publications.

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1. Green, M. R. & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. (4th ed.). Volume 1. Cold Spring Harbor Laboratory Press, Cold spring Harbor, New York.
2. Hill, W.E. (1988), Genetic Engineering: A Primer. CRC Press, Taylor and Francis Group, New York.
3. Willard, H.H., Merritt, L.L., Dean, J.A., & Settle, F. A.. Jr.(2022). Instrumental Methods of Analysis. (7th ed.). Wadsworth Publishing Company, Belm

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Food Biotechnology, Metabolic Engineering and Bioprocess Technology**					
Type of Course	**DSE**					
Course Code	**MG7DSEMBG401**					
Course Level	**300-399**					
Course Summary	This course is an intersection of fermentation technology, molecular biology, and metabolic engineering in the food domain with a key emphasis on producing GMOs, GM foods, food ingredients, biofuel, pharmaceuticals, and industrial chemicals. The students will also acquire skills in biosensors, understanding their role in detecting bacteria, metabolites, and ensuring food safety. The course further covers food packaging dynamics and navigating India's food labelling regulations.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		60	0	0	0	60
Pre-requisites, if any	An understanding of fundamentals of Food Microbiology/ Industrial Microbiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the intricacies of optimization and fermentation process control and also explore innovative bioprocesses in food industry	U	1,3
2	Employ the complex landscape of bioprocessing, from scale-up challenges to downstream processing and strain improvement, to contribute to advancements in food sector	A	3
3	Examine the significance of molecular biology and metabolic engineering in the food domain, particularly emphasizing their role in developing GM foods, producing food ingredients and industrial chemicals, and detecting bacteria or their metabolites in food through biosensors	An	3,8
4	Implement effective packaging solutions for food products and explain regulatory requirements for accurate labelling	A	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Overview of food fermentation processes – Food grade and GRAS organisms - Production of cultures for food fermentation - Culture maintenance and preparation – Culture preservation methods	5	1
	1.2	Bioreactor Design - Peripheral parts and accessories, additional accessories - Optimization and fermentation process control - Novel bioprocesses in food	4	1
	1.3	Design and formulation of media for industrial bioprocess - Criteria for medium design, carbon/nitrogen sources, nutrients - Sterilization of media - Advantages of continuous sterilization	6	1
2	2.1	Concept of scale up, scale up challenges. Influence of various bioprocess parameters viz. pH, temperature, medium components on product synthesis - Bioprocess monitoring and control	4	2
	2.2	Downstream processing : Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods, Extraction, Purification, Concentration, Product recovery	6	2
	2.3	Strain improvement - Mutation and Mutagenesis (brief) Recombination in bacteria : Conjugation, transduction, transformation - Recombinant DNA (rDNA) technology	5	2
3	3.1	Application of molecular biology in food - Production of GMO's and GM Foods - Transgenic Technology for Improving quality, quantity and storage life of fruits and vegetables – Molecular Pharming – Ethical issues and regulatory aspects	4	3
	3.2	Biosensors based on: enzymes, affinity and whole cells- Enzyme biosensor for liquor and beverages industry - Optical Biosensor for direct detection of bacteria in food - Bioluminescent Biosensors - Electrical impedance biosensors - Fluorescence labelled biosensors – Immuno-sensors and Flow immune sensors	6	3
	3.3	Metabolic engineering of bacteria for food ingredients : Pathway optimization, genetic modification, strain improvement and substrate utilization for biofuel production, pharmaceuticals, industrial chemicals (amino acids, organic acids, vitamins)	5	3
4	4.1	Food Packaging : Role in extending shelf life – Packaging materials (brief) - Different forms of packaging - Rigid, semi-rigid, flexible forms of packaging	4	4
	4.2	Advances in packaging : Active packaging - Modified atmosphere packaging–Controlled atmosphere packaging - Aseptic packaging – Vacuum Packing - Edible packaging - Biodegradable plastics	6	4

	4.3	Food labelling: Allergen labelling- Information related to Food Additives, Colours, and Flavours - Nutrition labelling: Calories and Reference Intake (RI) - Front of Pack (FOP) labels – Health Claims- Date labels - Storage instructions - Food Labelling Regulations in India	5	4
	4.4	Recommended Activities Lab activity : Demonstration of plasmid isolation, Restriction digestion, rDNA Technology using TA cloning, selection of recombinants Visit to a Food Research Institute/ Industry and understand genetic modification techniques, fermentation processes in food production and scaling up bioreactor operations for industrial applications	-	2,3
5	5.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Lab activity, Visit to a Food Research Institute/ Industry

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 3 Credits Theory: 30 Marks

Scheme for CCA Theory

Components		**Marks**
Test (MCQ/short answer/Illustrations) or Quiz		10
Seminar – Introduction of topic	2	10
Topic clarity	3	
Presentation skill	3	
Interacting with the audience	2	
Lab activity/Industry Visit		5
*Assignment/an activity		5
Total		**30**

*Based on Teacher specific content

End Semester Examination (ESE)

B. ESE for 3 Credits Theory : 70 Marks

Question type	**Marks per question**	**No of questions**	**Total Marks**
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	10	20
Short essay questions	5	4	20
Long answer questions	10	1	10
Total			**70**

References

1. Green, M. R. & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. (4th ed.). Volume 1. Cold Spring Harbor Laboratory Press, Cold spring Harbor, New York.
2. Hill, W.E. (1988), Genetic Engineering: A Primer. CRC Press, Taylor and Francis Group, New York.
3. Willey, J. M., Sherwood, L. M. & Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
4. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
5. Brown, T.A. (2002). Genomes (2nd ed.). John Wiley, New York.
6. Watson, J.D. (2000). A Passion for DNA: Genes, Genomes & Society. Cold Spring Harbor Laboratory Press (CSHL).
7. Glover, D.M. & Hames B.D. (1995). DNA cloning: A Practical Approach. IRL Press, Oxford.
8. Kingsman, S.M. &. Kingsman A.J (1998). Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes. Blackwell Scientific Publications, Oxford.
9. Hill W.E. (2000), Genetic Engineering: A Primer, Taylor and Francis.
10. Caldwell, D. R. (1995). Microbial Physiology and Metabolism. Wm. C. Brown Publishers, Dubuque, Iowa.
11. Purohit, S. S. (2005). Microbiology: Fundamentals and Applications. Student Edition Publishers, Jodhpur.
12. Gerhardt, P., Murray, R. G. E., Wood, W. A. & Krieg, N. R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington DC
13. Black, J. G. (2012). Microbiology: Principles and Explorations (8th ed.). John Wiley & Sons Inc., New York.
14. Alcamo, I. E. & Warner J. M. Schaum's Outline of Theory and Problems of Microbiology. (2nd ed.). The McGraw Hill Companies Inc., New Delhi.
15. Wheelis, M. (2010). Principles of Modern Microbiology. Jones and Bartlett India Pvt. Ltd., Daryaganj, New Delhi.
16. Thomas, K. E. (2011). Laboratory Manual of Microbiology for Biotechnology Students. Ane Books Pvt. Ltd., New Delhi.
17. Lee B. H. (1996). Fundamentals of Food Biotechnology. VCH Publisher.
18. Gutierrez-Lopez, G.F., Barbosa-Canovas, G.V. & Nathan, E.V. Eds. (2002). Food Science and Biotechnology. CRC Press.
19. Miquel Angelo, P. R. C., Ricardo Nuno, C, P,, Oscar Leandro, D. S. R., Jose Antonio. C. T. & Antonio Augusto, V. (2016). Edible Food Packaging: Materials and Processing Technologies. CRC Press, Taylor & Francis, Boca Raton, FL.
20. Luciano, P. & Sara, L. (2016). Food Packaging Materials. Springer Cham, Heildelberg, New York.
21. Robertson, G. L. (2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis.
22. NIIR. (2003). Food Packaging Technology Handbook. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
23. Ahvenainen, R. Eds. (2003). Novel Food Packaging Techniques. CRC Press,
24. Han, J.H. Eds. (2005). Innovations in Food Packaging. Elsevier Academic Press,
25. Coles, R., McDowell, D. &Kirwan, M.J. Eds. (2003). Food Packaging Technology. CRC Press.

SUGGESTED READINGS

1. Willey, J. M., Sherwood, L. M., Woolverton, C. J. (2011). Prescott's Microbiology. (8th ed.). McGraw-Hill International Edition, New York.
2. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
3. Cappuccino J. G. & Sherman, N. (1998). Microbiology - A Laboratory Manual. (5th ed.). Benjamin/Cummings Science Publishing, California.
4. Journals: Food Biotechnology, Trends in Food Science & Technology, Advances in Biochemical Engineering & Biotechnology, Applied Microbiology & Biotechnology, Applied and Environmental Microbiology, Journal of Applied Microbiology.
5. Luciano, P. & Sara, L. (2016). Food Packaging Materials. Springer Cham, Heildelberg, New York.
6. Robertson, G. L. (2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Nutraceutical Science**					
Type of Course	**DSC**					
Course Code	**To be prepared by the University**					
Course Level	**300-399**					
Course Summary	This course will give a deep understanding of the molecular composition of food, food components, their interactions and transformations in food during processing and storage and the potential health benefits of nutraceuticals and functional foods. The students could also gain practical skills in analyzing food compositions and assessing the nutritional value					
Semester	**VII**	Credits				Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		60	0	0	0	60
Pre-requisites, if any	A keen interest in exploring the intersection of science and health; foundation-level understanding of biology and nutrition.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify food components, and describe their characteristics, interactions and transformations during processing and storage	U	2
2	Explain the browning reactions in foods and the chemical intricacies involved in these reactions	U	3
3	Connect nutraceuticals and functional foods with their health benefits and describe how they prevent disease and promote overall health	An	3
4	Develop practical skills to examine the composition of food and evaluate its nutritional worth	A,S	2, 10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Energy – Unit of energy, food as a source of energy, energy value of food, the body's need for energy, B.M.R. activities. Utilization of food for energy requirements *Lab activity :* Preparation of solutions with different expressions (Molarity, Percentage, Normality, ppm), buffers	5	1,4
	1.2	Moisture in food: Chemistry of water and ice - Hydrogen bonding, Bound water, Free water, Water activity and food stability - Determination of moisture Plant acids, acidity, taste, acid-base balance. *Lab activity :* Determination of moisture and total solids by oven drying	6	1,4
	1.3	Carbohydrates : Starch and cellulose - Starch enzymes, Gel formation and starch degradation - Pectic substances, their occurrence, structure, properties and use in foods	5	1
2	2.1	Proteins - Classification - Physio-chemical properties - Functional properties in foods - Hydrolysis of proteins – Denaturation - Major food proteins and their sources - Modification of food protein through processing and storage - Determination of protein quality Enzymes added to food during processing - Modification of food by endogenous enzymes - Enzyme inhibitors in food *Lab activity :* Quantitative tests for carbohydrates proteins and nucleic acids	9	1,4
	2.2	Fats : Physico-chemical properties, rancidity and flavour reversion, inter-esterification, hydrogenation, shortenings and spreads Emulsions : Definition, surface activity, surface film theory of emulsions, properties and types of emulsions, emulsifying agents, their chemistry during processing Essential oils, Chemistry of occurrence, extraction, Terpene oils and their use in foods *Lab activity :* Detection and estimation of lipids - Determination of acid value and peroxide value	7	1,4
	2.3	Cereals : Chemical compositions and nutritional value of wheat, rice, corn Pulses: Nutritional value of prominent pulses (Moong, red gram, black gram, soybeans) Oilseeds: Chemical composition and nutritional value of sunflower, mustard, coconut Post-harvest physiology of fruits (ripening) and vegetables	5	1
3	3.1	Pigments indigenous to foods, structure, chemical and physical properties - Effect of processing and storage Flavours – Vegetables, fruit and spice flavours, fermented food, meat and seafood	4	1

	3.2	Vitamins and mineral functions : Bio-availability, and deficiency of Calcium, Iron, Iodine, Fluorine, Sodium & Potassium General causes for loss of vitamins and minerals in food - Fortifications, enrichment and restoration	4	1
	3.3	Chemistry of Food Processing - Browning reactions -Non-enzymatic browning : Maillard reactions and control, Caramelization, Ascorbic acid reaction - Inhibition of non-enzymatic browning Enzymatic Browning	4	2
4	4.1	Introduction to nutraceuticals and functional foods - Nutrient Vs Non-Nutrient nutraceuticals - Potential roles of nutraceuticals in disease prevention and health promotion (cardiovascular diseases, cancer therapy, Alzheimer's disease)	4	3
	4.2	Health benefits of fish oils, polyphenols , soy proteins and soy isoflavones, bran fibre, micronutrients (vitamins, minerals), dietary supplements (Coenzyme Q, carnitine), phytosterols, terpenoids (carotenoids, monoterpenes), phosphatidylcholine, lactoferrin, virgin oil	3	3
	4.3	Probiotics : - Probiotic bacteria and mode of action - Fermented milk products, non-milk products – health benefits of probiotics Prebiotics : Non-digestible CHO / Oligosaccharides - Dietary fibre, resistant starch, gums Synbiotics - Postbiotics – Eubiotics and gut health - Paraprobiotics	4	3
5	5.1	Teacher specific content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)

- Direct Instruction: Lecture, Explicit Teaching, E-learning
- Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work
- Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition
- Lab activity

Assessment Types

MODE OF ASSESSMENT

Continuous Comprehensive Assessment (CCA)

A. CCA for 3 Credits Theory: 30 Marks

Components		Marks
Test (MCQ/short answer/Illustrations) or Quiz		10
Seminar – Introduction of topic	2	10
Topic clarity	3	
Presentation skill	3	
Interacting with the audience	2	
Lab activity (Report/experimentation)		5
*Assignment/an activity		5
Total		**30**

End Semester Examination (ESE)

B. ESE for 3 Credits Theory : 70 Marks

Question type	Marks per question	No of questions	Total Marks
Multiple choice Questions	1	10	10
Fill in the blanks questions	1	5	5
One word/very short answer questions	1	5	5
Short answer questions	2	10	20
Short essay questions	5	4	20
Long answer questions	10	1	10
Total			**70**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ● Direct Instruction: Lecture, Explicit Teaching, E-learning ● Interactive Instruction: Active co-operative learning, Individual/ group assignments and discussions, Peer teaching and learning, Quiz, Technology-enabled learning, Library work ● Laboratory instructions: Demonstration of tests and methods, Hands on experiments, Skill acquisition ● Lab activity, Visit to a Food Research Institute/ Industry

References

1. Meyer L.H. (2022). Food Chemistry, CBS Publishers & Distributors Pvt. Ltd.
2. Damodran, S., Parkin, K.L., & Fennema, D.R. (2007). Fennema's Food Chemistry. (4th ed.). CRC Press.
3. Swaminathan, N. (1987). Food Science and Experimental Foods. Ganesh Publications, Madras.
4. Manay, S. N. & Shadaksharaswamy, M. (2005). Foods-Facts and Principles. (2nd ed.). New Age International (P) Ltd, New Delhi.
5. Cheung, C. K. & Mehta, B.M.(2015). Handbook of Food Chemistry. Springer, New York.
6. Mudambi, S.R., Rao, S.M. & Rajagopal, M.V.(2006). Food Science. (2nd ed.). New Age International Publishers.
7. Mudambi, S.R, & Rajgopal, M.V. (2001). Fundamentals of Foods and Nutrition. (4th ed.). New Age International Publishers.
8. Srilakshmi, B. (2005). Food Science (3rd ed.). New Age International (P) Ltd., New Delhi.
9. Potter N. M. & Hotchkiss J. H. (2021). Food Science (5th ed.). CBS Publishers and Distributors, New Delhi.
10. Swaminathan, N. (1987). Food Science and Experimental Foods. Ganesh Publications, Madras.
11. Manay, S. N. & Shadaksharaswamy, M. (2005). Foods-Facts and Principles. (2nd ed.). New Age International (P) Ltd, New Delhi.
12. Swaminathan, M. (2012). Advanced Text book on Food and Nutrition, Vol. II. The Bangalore Printing And.
13. Swaminathan, M. (2012). Handbook of Food & Nutrition. (5th ed.). Bangalore printing.
14. Willson, E. D. (1999). Principles of Nutrition. (4th ed.). John Willey & Sons, New York.
15. Cummings, J. (2001). Hand Book of Dietary Fibre. (1st ed.). Cho S. S. and Dreher M. L. Eds. Marcel Dekker Inc., New York.
16. Wildman, R.E.C. Eds. (2006). Handbook of Nutraceuticals and Functional Foods. (2nd ed.). CRC Press Taylor & Francis Group, Boca Raton. https://doi.org/10.1201/9781420006186
17. Puri, V., Nagpal, M., Singh, I., Singh, M., Dhingra, G. A., Huanbutta K., Dheer D., Ameya, S. & Sangnim, T. (2022). A Comprehensive Review on Nutraceuticals: Therapy Support and Formulation Challenges. Nutrients 14, 4637. https://doi.org/10.3390/nu14214637
18. Fuller, R. Eds. (1992). Probiotics: The Scientific Basis. Chapman & Hall, London. http://dx.doi.org/10.1007/978-94-011-2364-8
19. Gibson, G. R. & Williams, C. M. Eds. (2000). Functional Foods. (1st ed.). Woodhead Publishing Ltd., England.

20. Frei, B. Eds. (1994). Natural Antioxidants in Human Health and Disease. Academic Press, San Diego
21. Tannock, G. W. Eds. (1999). Probiotics: A Critical Review. Horizon Scientific Press. U.K.
22. Gibson, G. R. & William, C. M. (2000). Functional Foods - Concept to Product. Woodhead Publishing Ltd., England.
23. Goldberg, I. (1994). Functional Foods: Designer Foods, Pharmafoods, Nutraceuticals. Aspen Publication, Springer, New York.
24. Cupp, J. & Tracy, T. S. Eds. (2003). Dietary Supplements: Toxicology and Clinical Pharmacology. (1st ed.). New Jersey, United States.

SUGGESTED READINGS

1. Meyer L.H. (2022). Food Chemistry, CBS Publishers & Distributors Pvt. Ltd.
2. Damodran, S., Parkin, K.L., & Fennema, D.R. (2007). Fennema's Food Chemistry. (4th ed.). CRC Press.
3. Wildman, R.E.C. Eds. (2006). Handbook of Nutraceuticals and Functional Foods. (2nd ed.). CRC Press Taylor & Francis Group, Boca Raton. https://doi.org/10.1201/9781420006186
4. Fuller, R. Eds. (1992). Probiotics: The Scientific Basis. Chapman & Hall, London. http://dx.doi.org/10.1007/978-94-011-2364-8
5. Puri, V., Nagpal, M., Singh, I., Singh, M., Dhingra, G. A., Huanbutta K., Dheer D., Ameya, S. & Sangnim, T. (2022). A Comprehensive Review on Nutraceuticals: Therapy, Support and Formulation Challenges 14, 4637. https://doi.org/10.3390/nu14214637

Practical Evaluation

Practical Evaluation

CCA will be conducted for each candidate for 15 marks out of which half of the marks will be finally taken for ESE and further computing of marks (or in accordance with university norms).

The Practical Evaluation for the odd and even semesters will be conducted together at the end of the second and fourth semesters respectively.. The performance of students will be assessed by one or more external examiners assigned by the University - one examiner per batch of 15 students, respectively. The examination will be conducted in the centre for a period of two consecutive days. Two or more external examiners will be assigned in accordance with the need for batches with more than fifteen students. The external examination will be conducted for a total of 35 marks (or in accordance with university norms).

Internship Evaluation

Components	Marks
Certificate of completion	30
Report of activity 1.Objective and scope 2. Skills and learning outcomes attained 3. Presentation	20
Total	**50**

List of institutions for Internship

1. Indian Institute of Science, Bangalore
2. ICRISAT, Patancheru, Telangana
3. Indian Institute of Spices Research, Kozhikode
4. Central Food Technological Research Institute, Mysore
5. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur
6. Central Tuber Crops Research Institute, Trivandrum
7. Central Plantation Crops Research Institute, Kayamkulam, Alappuzha
8. Central Marine Fisheries Research Institute, Kochi
9. Central Institute of Fisheries Technology, Kochi
10. School of Biosciences, M. G. University, Kottayam
11. School of Food Science and Technology, M. G. University
12. University of Kerala, Thiruvananthapuram
13. Department of Microbiology, Kannur University, Kannur
14. Calicut University
15. National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram
16. Indian Institute of Science Education and Research, Thiruvananthapuram
17. Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
18. SCTIMST, Thiruvananthapuram
19. Food Quality Monitoring Laboratory (FQML), Konni, Kerala
20. Biocon Limited, Bangalore
21. Milma Milk Processing units in Kerala
22. Meat Products of India, Koothattukulam, Kerala
23. Dairy Development Center, Kottayam
24. Pushpagiri Medical College, Thiruvalla
25. Cashew Export Promotion Council of India, Kollam
26. Grain 'n' Grace Food Ingredients Manufacturing Unit, Palghat, Kerala
27. Vijayalakshmi Cashew Factory, Kollam.
28. Kitchen Treasures, Moovattupuzha
29. Kerala Agro Fruit Products, Punalur
30. Malanad Passion Fruit Plantations, Kothamangalam
31. KVK, Keraka
32. Elite Foods Pvt. Ltd., Kochi

List of MOOC Courses

1. 'Food Microbiology', offered by the University of Florida, on Coursera
   This course covers fundamental principles of food microbiology, including food spoilage, foodborne pathogens, and food safety measures.
2. 'Introduction to Food Science', offered by Wageningen University & Research, on edX
   While not specifically focused on food microbiology, this course provides a comprehensive overview of food science, including aspects related to food microbiology.
3. 'Food Safety, Food Quality: Fruits and Vegetables', offered by Wageningen University & Research, on edX
   This course focuses on the microbiological aspects of fruit and vegetable processing, storage, and safety.
4. 'Food Microbiology and Safety', by the University of Illinois, on Coursera
   This course provides an overview of food microbiology, emphasizing the role of microorganisms in food spoilage, fermentation, and foodborne illnesses.
5. 'Microbiology for Food Safety and Preservation', by the Indian Institute of Technology, Kharagpur, on NPTEL
   This course covers various aspects of microbiology relevant to food safety and preservation, including foodborne pathogens and food spoilage.
6. 'Food Biotechnology', by the Indian Institute of Technology, Kharagpur, on NPTEL
   While not exclusively focused on food microbiology, this course explores biotechnological approaches in food processing, which may include aspects related to food microbiology.

Appendix-II

Subject: Medical Microbiology

Minor programme to B. Sc. (Hons.) Botany & Zoology

Preface

This medical microbiology course provides a background in all aspects of microbial agents and disease. It covers the impact on human health, and public health approaches to microbial disease. This course provides minor, skill enhancement courses, value added areas and job training in the medical field.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**				
Course Name	**Understanding microbial world**				
Type of Course	**DSC**				
Course Code	**MG1DSCMBG102**				
Course Level	**100-199**				
Course Summary	The course in designed to give a basic understanding on the fundamental aspects of microbiology from historical development of the branch of microbiology to the structure and significance of bacteria. On completion of the cause the students are expected to have a clear understanding on microscopy, sterilization, disinfection, bacterial cultivation techniques, their growth processes and environmental factors affecting them. The practical laboratory exercises are designed to give the basic safety and handling protocol in a microbiology laboratory; hands on training on light microscopy –staining techniques, sterilization and disinfection principles and practice.				
Semester	I	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45		30		75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain scope of microbiology, identify key individuals in the history of Microbiology and outline the morphology of bacteria	U	1,4
2	Summarize the nutritional types, requirement of microbes, reproduction, growth curve and enumeration of microbes	U	1,4
3	Create understanding on microbial control methods and functioning of microscope	U	1,4,3 ,10
4	Develop basic skills of a microbiology lab	S	1,2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**History of Microbiology-** Discovery of the microscope, Discovery of microbial life, Abiogenesis vs. biogenesis–Spontaneous generation theory and its refutation, Pioneer contributors: Antony van Leuwenhoek, Louis Pasteur, Alexander Fleming, Robert Koch, Edward Jenner, Joseph Lister. Scope of Microbiology.	3	1
	1.2	**Ultrastructure of Bacteria -** Morphology of bacteria-size, shape and arrangement. Structure and arrangement of bacterial flagella, pili & capsule.	4	1
	1.3	Structure and composition of Gram-positive and Gram-negative cell wall, protoplasts, spheroplast. Cytoplasmic membrane, intracellular membrane systems-mesosomes, nuclear material, cell inclusions, and endospores.	4	1
2	2.1	**Microbial Nutrition** Elements of life: macro and micronutrients, Requirements of carbon, hydrogen, oxygen, and electrons. Nutritional types of microorganisms. Requirements for nitrogen phosphor and sulfur, growth factors.	3	2
	2.2	**Growth and Reproduction in Bacteria** Modes of cell division in bacteria- Binary fission. Bacterial growth curve. Effect of environmental factors on bacterial growth - temperature, pH, salinity, oxygen, water activity, and radiation.	3	2
	2.3	**Culture Media and Preservation of Microorganisms** Culture media - media components: peptone, yeast extract, beef extract, agar. Types-Enriched media, enrichment media, selective media, differential media, indicator media, transport media and anaerobic media. Culture preservation techniques and culture collection centres.	5	2
	2.4	Aerobic and anaerobic culture methods.	5	2
3	3.1	**Control of Microorganisms** Principle, working and application Physical -dry heat, moist heat, radiation, filtration and chemical sterilization- phenolics, alcohols, halogens, Quaternary ammonium compounds, aldehydes, sterilizing gases.	5	3
	3.2	Antibiotics - classification based on mode of action with one example each. Antibiotic sensitivity tests–Broth dilution technique, Kirby Bauer disc diffusion method, Epsilometer test, Brief mention on Automation in Antimicrobial Susceptibility Tests	4	3
	3.3	**Principles of Microscopy** Light microscopy- Bright field, Dark field, Phase contrast, and fluorescence microscopy, Electron microscopy–SEM & TEM. Newer techniques in microscopy--confocal, Scanning probe Microscopy	9	3

4		**Practical**		
	4.1	General rules in microbiology laboratory	1	4
	4.2	**Preparation of Liquid media** - Nutrient broth and Glucose broth	4	4
	4.3	**Preparation of Solid media**- Nutrient agar, Mac Conkey agar, Blood agar, Chocolate agar, SDA (for fungi)	5	4
	4.4	**Preparation of Semisolid media**- Manitol Motility medium	2	4
	4.5	**Isolation methods -** a. Serial dilution b. Pour plate, c. Spread plate d. Streak plate e. Stroke culture (Agar slant culture) f. Stab culture g. Lawn culture	8	4
	4.6	**Bacterial motility analysis** Wet mount technique	2	4
	4.7	Hanging drop technique	2	4
	4.8	**Instrumentation** a. Incubator b. Hot air oven c. Autoclave	1	4
	4.9	Simple staining	2	4
	4.10	Differential staining–Gram's staining	3	4
5		TEACHER SPECIFIC CONTENT		

<table>
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Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks

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End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
1 Credit Practical: 17.5 Marks

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<tr><td>Viva voce</td><td>5</td></tr>
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Reference

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2014). *Prescott's microbiology*. McGraw-Hill.
2. Sastry, A. S., & Bhat, S. (2018). *Essentials of medical microbiology*. JP Medical Ltd.
3. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
4. Tortora, G. J., Case, C. L., Bair III, W. B., Weber, D., & Funke, B. R. (2004). Microbiology: an introduction.
5. Dubey, R. C., and D. K. Maheshwari. *Practical Microbiology, 4/e*. S. Chand Publishing, 2002.

SUGGESTED READINGS

1. Dubey, R. C., & Maheshwari, D. K. (2023). *A textbook of microbiology*. S. Chand Publishing.
2. Pommerville, J. C. (2012). *Alcamo's fundamentals of microbiology: Body systems*. Jones & Bartlett Publishers.
3. Pelczar Jr, M. J., E. C. N. Chan, and N. R. Krieg. "Presscott, L. Harley, j. and Klein, D.(2005) Microbiology, 6" edition, Tata McGraw-Hill."

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**World of microbes**					
Type of Course	**MDC**					
Course Code	**MG1MDCMBG102**					
Course Level	**100-199**					
Course Summary	This course aims to provide students with a comprehensive introduction to microbiology including its history, diversity, benefits and harmful effects.					
Semester	I	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		30		30		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Remember** the historical aspects of microbiology by studying the various contributions of scientists in the development of microbiology	**R**	**2, 10**
2	**Explain** the diversity of microorganisms in our World	**U**	**1,2,6, 10**
3	Develop **an interest** in creating different beneficial products using microbes	**I**	**1,2,4,6,10**
4	**Recall** the role of harmful microbes	**K**	**1,2,6,8,10**
5			

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	History and development of microbiology, Contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming and Edward Jenner	6	1
	1.2	Types of microorganisms bacteria, fungi, virus, protozoa: A brief description. Normal flora of human beings	8	1
2	2.1	**Beneficial: Roles** The food industry (bread, pickles, vinegar), Pharmaceutical industry (Antibiotics, vaccines), Agriculture (biofertilizers (nitrogen & phosphate solubilizers), Biopesticide	7	2
	2.2	**Harmful Role :** Bacterial diseases Diarrhoea E.coli, Salmonella Tuberculosis- Mycobacterium tuberculosis Viral diseases- Chicken pox, Nipha, Corona), Fungal diseases- Candida sp., Aspergillus sp., Tinea sp.) Food spoilage (milk, fish and meat)	7	2
3	3.1	**Practical** Testing the quality of milk by MBRT	5	3
	3.2	Testing the quality of milk by standard plate count method	5	3
	3.3	Isolation and microscopic demonstration of *Lactobacillus* from curd.	8	5
	3.4	Isolation and microscopic demonstration of Nitrogen fixing bacteria –*Rhizobium*	7	5
4		Teacher Specific content		

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End Semester Evaluation (ESE)
2 Credit Theory: 35 Marks
1 Credit Practical: 17.5 Marks
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3. Ananthanarayan, R. *Ananthanarayan and Paniker's textbook of microbiology*.10th edition Orient Blackswan

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1. Willey, Joanne M., Linda M. Sherwood, and Christopher J. Woolverton. *Prescott, Harley, and Klein's microbiology*. McGraw-Hill, 2008.
2. Aneja, K. R. *Experiments in microbiology, plant pathology and biotechnology*. New Age International, 2007.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Unveiling the applications of microbiology**					
Type of Course	**DSC**					
Course Code	**MG2DSCMBG102**					
Course Level	**100**					
Course Summary	Applied Microbiology is an interesting and dynamic field where basic knowledge of micro-organisms is applied to human health, industry, agriculture, and the environment especially with water, food and milk. It also deals with the health care associated infection and their management.					
Semester	II	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45		30		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	State the significance of normal human flora and the role they play in human body	U	1,4,10
2	Understanding the microbial quality of air and potable water, milk and food	S	1,4,10
3	Interpret the health risks involved in a hospital environment and their management practices	E	1,4,10
4	Propose ideal methods for the microbial quality analysis of foods	S	1,4,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Normal Microbial Flora of the Human Body** Resident flora, transient flora, role of normal microbial flora, Normal flora of the skin, Normal flora of the conjunctiva, Normal flora of the nose, nasopharynx and sinuses, Normal flora of the mouth and upper respiratory tract	5	1
	1.2	Normal flora of the gastrointestinal tract, importance of gut microbiome, Normal flora of the genitourinary tract	5	1
2	2.1	**Bacteriology of water** Bacteriological examination of water: Plate count, Detection of coliform bacteria and *Escherichia coli*, Detection of faecal streptococci, Detection of *Clostridium perfringens*, Tests for pathogenic bacteria	5	2
	2.2	**Bacteriology of milk** Types of bacteria in milk, Milk borne diseases, Bacteriological examination of milk: Viable count, test for coliform bacilli, methylene blue reduction test, Phosphatase test, Turbidity test, Examination for specific pathogens	6	2
	2.3	**Bacteriology of food** Source of food contamination, Laboratory diagnosis of suspected foodborne infection or food poisoning Prevention	6	2
3	3.1	**Healthcare-associated (HCAI) infections**: iatrogenic infection, catheter-associated urinary tract infections (CAUTI), healthcare-associated bacteraemia, Bloodstream infections, healthcare-associated pneumonia and ventilator-associated pneumonia (VAP), Healthcare-associated wound infections, Healthcare-associated infections due to hepatitis viruses B and C (Transfusion-associated infections), Healthcare-associated episodes of acute gastroenteritis, Healthcare-associated episodes of tetanus,	8	3
	3.2	Sources and reservoirs of healthcare-associated infections, Endogenous source of infection, Cross-infection, Infections from environmental sources, Modes of transmission of microorganisms	5	3
	3.3	Measures to control infection in the healthcare setting. Standard precautions, Hand hygiene, Personal protective equipment, Injection safety (safe injection practices), Environmental cleaning, medical equipment, Respiratory hygiene/ cough etiquette	5	3
4		**Practical**		
	4.1	Isolation of bacteria from skin	4	4

	4.2	Isolation of bacteria from mouth	4	4
	4.3	Isolation of bacteria from milk sample	4	4
	4.4	Most Probable number method for coliform detection	6	4
	4.5	Total plate count for analysis of water	3	4
	4.6	MBRT of milk	3	4
	4.7	Phosphatase test of milk	3	4
	4.8	Viable count of milk sample	3	4
5		TEACHER SPECIFIC CONTENT		

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3. Denny, C. B. (1959). Food Microbiology. William Carroll Frazier. McGraw-Hill, New York, 1958. ix+ 472 pp. Illus. $9. *Science*, *129*(3350), 715-715.
4. Aneja, K. R. (2007). *Experiments in microbiology, plant pathology and biotechnology*. New Age International.

SUGGESTED READINGS

1. Mathur, P., Patan, S., & Shobhawat, A. S. (2012). Need of biomedical waste management system in hospitals-An emerging issue-a review. *Current World Environment*, *7*(1), 117.
2. Radha, K. V., Kalaivani, K., & Lavanya, R. (2009). A case study of biomedical waste management in hospitals. *Global journal of health science*, *1*(1), 82-88.
3. Tawde, M., & Trujillo, M. (2012). Review of: Microbiology: A Human Perspective, ; Nester Eugene Anderson Denise Evans Roberts C. Jr.;(2011). McGraw-Hill Science/Engineering/Math, New York, NY. 864 pages.
4. Jay, J. M., Loessner, M. J., & Golden, D. A. (2008). *Modern food microbiology*. Springer Science & Business Media.

Mahatma Gandhi University
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Programme						
Course Name	**Microbes in Daily Life**					
Type of Course	**MDC**					
Course Code	**MG2MDCMBG102**					
Course Level	**100**					
Course Summary	This course would provide students with a holistic understanding of the diverse roles of beneficial microbes in various domains emphasising their positive impact on human health and food industry					
Semester	II	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		30		30		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Understand** microbiology and its relevance in our daily life	**U**	**2,10**
2	**Produce** different varieties of fermented foods in home or in large scale in the future.	**A**	**1,2,6,10**
3	Analyse the best method for food preservation.	**An**	**1,2,4,6**
4	**Apply** the technique in day-to-day life to meet living expenses.	A	**1,2.6,8**
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Microbiology in and around us: Microbial flora of air, water, soil and human body. Microbes in food industry- Fermented Foods – Types, nutritional values and health benefits. Probiotics, prebiotics, synbiotics and nutraceuticals.	**5**	**1**
	1.2	Fermented food products: 1.Alcoholic-Wine, Beer and cider. 2.Non-Alcoholic-Coffee ,tea Dairy products-Cheese, Curd, Butter	**5**	**2**
2	2.1	Introduction to preservation, types of preservation, natural and artificial preservative agent.	**5**	**3**
	2.2	Methods of preservation: thermal process, drying and dehydration, cooking and freezing, food preservation by chemicals, minimal processing of fresh foods	**5**	**3**
3	3.1	**Practical-** Cheese production		4
	3.2	Wine production	**7**	**4**
	3.3	Detection of coliform by streak plate method on EMB agar	**8**	4
	3.4	Isolation of normal flora of skin on Nutrient agar media	**5**	4
	3.5	Isolation of normal flora of mouth on Nutrient agar media	**5**	4
4		Teacher Specific Content		

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4. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India

SUGGESTED READINGS

5. Jacquelin g Black, Microbiology principles and Explorations.
6. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India

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Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Microbes of medical importance**					
Type of Course	**DSC**					
Course Code	**MG3DSCMBG204**					
Course Level	**200**					
Course Summary	This course provides learning opportunities in the basic principles of medical microbiology and infectious disease. It covers mechanisms of infectious disease transmission, clinical features, diagnosis and prevention. Relevant clinical examples are provided. The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body. It also provides opportunities to develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45		30		75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Elaborate on the pathogenesis, diagnosis and epidemiology of diseases caused by bacteria of public health importance	An	1,4,10
2	Describe the pathogenesis, laboratory diagnosis, prevention and control of human viruses	An	1,4,10
3	Explain the pathogenesis, diagnosis, prevention and control of fungal diseases of human importance	An	1,4,10
4	Develop skill to apply techniques in medical microbiology lab for the identification of pathogens	S	1,4,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Gram Positive & Negative cocci:** Morphology, cultural& biochemical characteristics, pathogenicity, lab diagnosis, prophylaxis & treatment of *Staphylococcus aureus, Streptococcus pneumoniae, Neisseria meningitidis*	5	1
	1.2	**Gram Positive Rods** Morphology, cultural& biochemical characteristics, pathogenicity, lab diagnosis, prophylaxis & treatment of *Bacillus anthracis, Corynebacterium diphtheriae*	3	1
2	2.1	**Gram Negative Rods:** Morphology, cultural& biochemical characteristics, pathogenicity, lab diagnosis, prophylaxis & treatment of *Escherichia coli, Salmonella typhi, Shigella, Bordetella pertussis, Pseudomonas aeruginosa*	7	1
	2.2	**Branching, Spiral, Pleomorphic & cell wall less bacteria** Morphology, cultural& biochemical characteristics, pathogenicity, lab diagnosis, prophylaxis & treatment of *Mycobacterium tuberculosis, Actinomycetes, Treponema pallidum, Haemophilus influenza type B*	5	1
3	3.1	**Medical virology** Morphology, Pathogenicity, clinical features (in brief), lab diagnosis and treatment of : Herpes virus (HSV, Varicella Zoster), Orthomyxovirus (influenza), Paramyxoviruses, (mumps, measles)	5	2
	3.2	Morphology, Pathogenicity, clinical features (in brief), lab diagnosis and treatment of : HIV, Papilloma, Rota viruses, Corona virus-SARS Arboviruses(Chikun gunya, dengue, yellow fever, Zika, Ebola), Brief mention of oncogenic virus	5	2
	3.3	**Medical mycology** Distribution, etiological agents, clinical features, diagnosis, treatment of **Superficial-** Tinea versicolar, Tinea nigra, piedra (Black &White), **Cutaneous**- Dermatophytoses. **Subcutaneous**: Mycetoma	5	3
	3.4	**Systemic mycoses**- Causative agent, pathogenicity, clinical features, lab diagnosis & treatment of - Blastomycoses,	5	3
	3.5	**Opportunistic mycoses-** Causative agent, pathogenesis, clinical features, lab diagnosis & treatment of - Aspergillosis, Penicilliosis, Candidiasis	5	3
4	4.1	**Practical** Differential staining- Spore staining for endospore	3	4
	4.2	Negative staining for capsulated organism	3	4
	4.3	Identification of bacteria based on colony morphology - Cultural characteristics on NA and Mac Conkey agar	4	4

	4.4	Antimicrobial susceptibility test	4	4
	4.5	Identification of Gram positive bacteria *Staphylococcus aureus*	3	4
	4.6	Identification of Gram negative bacteria *Escherichia coli*	3	4
	4.7	Serological detection of any virus	2	4
	4.8	Slide culture method for cultivation of fungus	2	4
	4.9	Study of cultural characteristics of fungi on SDA- *Aspergillus, Penicillium*	2	4
	4.10	Identification of microorganism from a clinical sample	4	4
	4.11	On the Job training in a clinical microbiology lab		4
5		Teacher Specific Content		

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3. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). *Medical microbiology e-book: A guide to microbial infections: Pathogenesis, immunity, laboratory diagnosis and control*. Elsevier Health Sciences.

SUGGESTED READINGS

1. Tille, P. (2015). *Bailey & Scott's diagnostic microbiology-E-Book*. Elsevier Health Sciences.
2. Goering, R., Dockrell, H., Zuckerman, M., Roitt, I., & Chiodini, P. L. (2012). *Mims' medical microbiology*. Elsevier Health Sciences.

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Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Public Health Microbiology**					
Type of Course	MDC					
Course Code	**MG3MDCMBG202**					
Course Level	**200-299**					
Course Summary	This course will review a series of current issues and controversies in the prevention and control of infectious diseases with regard to public health. It will also serve as a forum for students to debate the merits of these issues and controversies.					
Semester	III	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	**Understand** the importance of public health and hazards related to health.	**U**	**2,10**
2	**Identify** air, food and water-borne diseases	**A**	**1,2,6,10**
3	**Solve the** situation when airborne infection happens in life	**Ap**	**1,2,4,6,10**
4	**Differentiate** various vector-borne infections.	A	**1,2,6,8,10**

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Role of microbiologists in public health, Concept of health and disease. Basic concept of pollution (air, water, noise, radiation and waste pollution). Public health hazards in the community.	8	1
	1.2	Foodborne diseases caused by viruses and bacteria. Source, transmission of pathogens and control measures. Waterborne diseases caused by bacteria, virus and protozoa. Control measures of waterborne diseases Water pollution and sanitation (brief note)	7	2
2	2.1	Air and its composition, Airborne diseases: Source and transmission of pathogens, Respiratory infection: Viral- Nipha, Zika, SARS. Bacterial- Pneumonia, Meningitis, tuberculosis and fungus (brief note). Sources of infection Control measures of air borne diseases. Microbial Indicator of air pollution.	8	3
	2.2	Definition of vectors, vector-borne diseases and control measures. Mosquito, aquatic snail, lice, sand flies, tsetse fly, ticks, black flies	7	4
3	3.1	Isolation of microorganism from food by streak plate method	6	2
	3.2	Isolation of microorganism from food by spread plate technique	6	2
	3.3	Isolation of bacteria from contaminated water	6	2
	3.4	Isolation of microorganism from air by open plate method	6	2
	3.5	Identification of vectors – Mosquito	6	4
4		TEACHER SPECIFIC CONTENT		

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<tr><td></td><td>End Semester examination
3 Credit Theory: 50 Marks
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</table>

References

1. Pelczar, Michael J., Eddie Chin Sun Chan, and Noel R. Kriec. *Microbiology*. Mc Graw Hill Education, 2017.
2. Tortora, Gerard J., et al. "Microbiology: an introduction." *(No Title)* (2004). Pearson Education Publication
3. Ananthanarayan, R. *Ananthanarayan and Paniker's textbook of microbiology*.10th edition, Orient Blackswan
4. Daniel, Joseph C. "Environmental Aspects of Microbiology." (1996). Bright Sun Publishers

SUGGESTED READINGS

1. Dr K.Dass, Public Health and hygiene 2021, Notion press publishers
2. Park's Textbook of preventive and social medicine. K Park Bhanot M/s Banarsidas Bhanot Publishers,22nd edition 2013

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Microbial products in health industry**					
Type of Course	VAC					
Course Code	**MG3VACMBG202**					
Course Level	**200-299**					
Course Summary	Course gives a comprehensive overview of the nutrients, probiotics, neutraceuticals with their potential therapeutic & health benefits. Enable to explore emerging trends and challenges, fostering the ability to adapt and contribute to the evolving landscape of health industry.					
Semester	III	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To understand various Fermented food and food ingredients as the Fermentation Products	**U**	1,3,4,8,9 ,10
2	To understand the Microbes beneficial in health care	**U**	1,2,3,48, 9,10
3	To analyse the newer technologies and applications for microbes in human food	**An**	2,3,4,5 6,8,9,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	General concepts of value addition – Nutritional profile of microbes. Fermented milk – Acidophilus milk, Yoghurt, Kefir. Fermented vegetables – Kanji. Gundruk, Soy sauce. Fermented fruit drinks – Banana beer, Mango wine. Fruit vinegar: Amla Cider, Guava Cider. Fermentation Products and their application - Enzymes – protease, Amylase, Cellulase, Hemicellulase. Antimicrobials- Nisin, Lysozyme, Vitamins – B 2, B12, K, Sweeteners, Stabilizers.	9	1
	1.2	**Microbes in health care industry Cosmeceuticals** - Definition, Role of microbes in the cosmetic industry, major pigments and their applications in cosmetics. New advancements with microbes in cosmetic and skin care products. **Skinceuticals** – Normal flora of skin- bacteria, fungi and their role. Skin conditions requiring SkinCeuticals, Skin prebiotics and skin probiotics and their effect. benefits of skinceuticals. **Neutraceuticals:** Synbiotics, prebiotics, probiotics, Health benefits, Challenges for probiotic formulations.	8	2
2	2.1	**Newer technologies and applications of microbes in human food** Microbes as a protein source in human food. Animal meat alternatives. Other animal product alternatives - dairy and eggs.	8	3
	2.2	Obstacles and future developments in the path to adopting widespread use of Microbial foods.	5	3
3	3.1	Identification of skin flora before and after the use of cosmetics to understand the effect of cosmetics on skin	6	3
	3.2	Preparation of vinegar	7	3
	3.3	Preparation of a fermented fruit drink	7	3
	3.4	Preparation of a healthy fermented probiotic drink-any one	5	3
	3.5	Isolation of gut microbiome on regular probiotic consumers	5	3
4		TEACHER SPECIFIC CONTENT		

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3 Credit Theory: 50 Marks
Theory
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</table>

References

1. Park, Kun-Young, et al. "Health benefits of kimchi (Korean fermented vegetables) as a probiotic food." *Journal of medicinal food* 17.1 (2014): 6-20.
2. Marco, Maria L., et al. "Health benefits of fermented foods: microbiota and beyond." *Current opinion in biotechnology* 44 (2017): 94-102.
3. Stanton, R. W. "Food Fermentation in the Tropics, in" Microbiology of Fermented Foods", edited by Wood." *BJB, Elsevier Applied Science Publishers, UK* (1985).
4. Peterson, C. S. "Microbiology of food fermentation." (1979)

SUGGESTED READINGS

5. Nature Communications | (2023) 14:2231

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Medical Microbiology: Clinical Perspective**					
Type of Course	DSC					
Course Code	**MG4DSCMBG204**					
Course Level	**200-299**					
Course Summary	The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body. It also provides opportunities to develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45		30		75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the laboratory safety, concepts of specimen collection, transport and diagnosis of clinical specimens.	E	1,4
2	Describe the epidemiology, clinical manifestations, pathogenesis and treatment of respiratory tract diseases	U	1,4,10
3	Describe the epidemiology, clinical manifestations, pathogenesis, and treatment of gastrointestinal tract diseases.	U	1,4,10
4	Describe the epidemiology, clinical manifestations, pathogenesis and treatment of urinary tract and sexually transmitted diseases.	U	1,4,10
5	Illustrate the epidemiology, clinical manifestations, pathogenesis, and treatment of central nerve system diseases.	U	1,4,10
6	Develop skill to apply techniques in medical microbiology lab for the identification of pathogens	S	1,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		Collection, handling, transport and diagnosis of clinical specimens.	5	1
	1.2	**Respiratory tract infections** Causative agents, morphology, Pathogenicity, clinical features, lab diagnosis and treatment of important Respiratory tract infections. **Bacterial**- Strep throat, Diphtheria, pneumonia (pneumococcal, Klebsiella), Pertussis, tuberculosis	5	2
	1.3	**Respiratory tract infections Viral**- Common cold- rhinovirus, influenza, Respiratory Syncytial virus infections, coronavirus (SARS)	4	2
2	2.1	**Gastrointestinal tract infection** Symptoms, Causative agents, clinical features, mode of transmission, lab diagnosis and treatment of important gastrointestinal tract infections. **Bacterial**- Gastrointestinal infection–Cholera, Shigellosis, E. coli gastroenteritis, Salmonellosis	5	3
	2.2	**Viral**- Gastrointestinal infection–Rota viral gastroenteritis, Hepatitis A, B, C. **Protozoan**- Amoebiasis	4	3
	2.3	**Urinary tract infections**- Symptoms, Causative agents, clinical features, mode of transmission and treatment of important **Urinary tract infection** -Bacterial- bacterial cystitis, Fungal- Candida	4	4
3	3.1	**Sexually transmitted diseases**- Symptoms, Causative agents, clinical features, mode of transmission, lab diagnosis and treatment of **Sexually transmitted diseases**. **Veneral- Bacterial**- Gonorrhoea, syphilis	5	4
	3.2	**Sexually transmitted diseases- Viral**- AIDS, Papilloma virus, Genital Herpes Simplex	5	4
3	3.3	**Central nervous system infections-** CNS infection- meningococcal meningitis, Botulism	4	5
	3.4	CNS infection-Viral meningitis Polio (infantile paralysis), rabies	4	5
4		**Practical**		
	4.1	Isolation and identification of bacteria from sputum sample	4	6
	4.2	Isolation and identification of bacteria from urine sample	4	6
	4.3	Isolation and identification of bacteria from skin swab	4	6
	4.4	Antibiotic sensitivity test by Kirby Bauer Disc diffusion method	4	6

	4.5	VDRL	3	6
	4.6	Widal Demonstration	4	6
	4.7	ASO	3	6
	4.8	Identification of microorganism from a clinical sample	4	6
	4.9	On the Job training (of 14 days duration) in a clinical microbiology lab		6
5		Teacher Specific Content		

Teaching and Learning Approach

Classroom Procedure (Mode of transaction)
Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Group Assignments, Library work and
Group discussion, Presentation by individual student. Laboratory sessions including demonstrations, hands on training

Assessment Types

MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks

Theory		**Practical**	
Component	Mark	Component	Marks
Test/Quiz	10	Test/Viva	5
Seminar	10	Lab involvement	2.5
Assignment	5	Activity (related to teacher-specific content)	7.5
Total	**25**	**Total**	**15***
* Adjusted to 7.5 Marks for final calculation			

End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks

Theory	**Practical**	
End Semester written examination for 50 marks	Experiments	25
	Record	5
	Viva voice	5
	Total	**35****
** Adjusted to 17.5 Marks for final calculation		

1 Credit Practical: 17.5 Marks

References
1. Sastry, A. S., & Bhat, S. (2018). *Essentials of medical microbiology*. JP Medical Ltd.
2. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.
3. Greenwood, D., Slack, R. C., Barer, M. R., & Irving, W. L. (2012). *Medical microbiology e-book: A guide to microbial infections: Pathogenesis, immunity, laboratory diagnosis and control*. Elsevier Health Sciences.

SUGGESTED READINGS

1. Tille, P. (2015). *Bailey & Scott's diagnostic microbiology-E-Book*. Elsevier Health Sciences.
2. Goering, R., Dockrell, H., Zuckerman, M., Roitt, I., & Chiodini, P. L. (2012). *Mims' medical microbiology*. Elsevier Health Sciences.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Biomedical and solid Waste management**					
Type of Course	**SEC**					
Course Code	**MG4SECMBG202**					
Course Level	**200-299**					
Course Summary	Course deals all aspects of waste management activities from identification and classification of wastes to considerations guiding their safe disposal using both non-incineration or incineration strategies. Classification and segregation of health-care waste also gives a general understanding on the course.					
Semester	IV	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Outline Solid Waste Management & Disposal Methods for Solid Waste	U	1,2,6,10
2	Explain the Bioprocessing of organic wastes – Anaerobic digestion, Vermicomposting	U	1,2,3,6,10
3	Analyse the process of Composting	An	1,2,3,6,10
4	Compare different methods of biomedical waste	E	1,2,3,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Solid Waste Management** Waste management by Refuse, Reuse, Recycle, and Reduce. Generation of solid waste - Sources	5	**1**
	1.2	Disposal methods for solid waste- Open dumping, Sanitary dumping, Landfilling, Incineration, Biogas, Pyrolysis.	7	**1**
2	2.1	**Bioprocessing of organic wastes**- Anaerobic digestion- Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis . Products of anaerobic digestion - biogas, digestate and slurry. Vermicomposting- methods. Earthworm species used in vermicomposting. Factors affecting vermicomposting	6	**2**
	2.2	Composting- Types of composting: anaerobic and aerobic composting. Methods of composting. Advantages and disadvantages of composting, End product- Compost. Parameters for good compost. Demonstration of Garden Waste & Kitchen Waste Composting – Different Techniques – Bin Composting, Pit Composting, Tube Composting, In-Vessel Composting, Open Pile	6	**2**
	2.3	Types of biomedical waste, General principles of waste management, Waste treatment methods, Usage of color coded bags, BMW 2016 Rules	6	**2**
3	3.1	Environment education through 3R method in the campus	6	**3**
	3.2	Bin composting	6	
	3.3	Tube composting	6	**3**
	3.4	Vermicomposting	6	3
	3.5	Demonstration of Biomedical waste management	6	3
	3.6	Uses of plastic waste in road construction		
4		TEACHER SPECIFIC CONTENT		

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction) Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Library work and Group discussion, Presentation by individual student based on the household and community waste management practices. Field visits to the composting units and biomedical waste management unit.</td></tr>
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References

1. Atlas, Ronald M. *Microbial ecology: fundamentals and applications*. Pearson Education India, 1998.
2. Dubey, R. C., and D. K. Maheshwari. *A textbook of microbiology*. S. Chand Publishing, 2023.
3. Ananthanarayan, R. *Ananthanarayan and Paniker's textbook of microbiology*.10th edition Orient Blackswan

SUGGESTED READINGS

1. Manual on Solid Waste Management, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2000.
2. Mitchell, Ralph, and Ji-Dong Gu, eds. Environmental microbiology. John Wiley & Sons, 2010.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Sanitation microbiology**					
Type of Course	VAC					
Course Code	**MG4VACMBG202**					
Course Level	**200-299**					
Course Summary	This course provides information on sanitation and safety precautions in industrial, food processing, animal housing, hospitals and laboratories.					
Semester	IV	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	45
Prerequisites, if any						

COURSE OUTCOME

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Remember concepts of sanitation and disinfection. safety precautions in industrial, food processing, animal housing, hospitals and laboratories	R	1, 2,6,10
2	Analyse methods of air and water sampling and quantification of air and water microflora, air and water borne diseases, preventive measures and air sanitation techniques	An	1, 2,6,10
3	**E**xplain the microbiology of sewage treatment and wastewater treatment	U	1,2,6,10
4	Analyse the disposal practices	**An**	1,2,6,10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	1.1	General concept of sanitation and disinfection. Sanitation and Safety precautions in animal houses, industrial fermentation units, food processing units, hospitals and laboratories.	5	1,2
	1.2	Aeromicrobiology Airborne diseases(common cold, Influenza, Chickenpox, Mumps, Measles, Whooping cough (pertussis), Tuberculosis (TB), Diphtheria, Covid 19) and preventive measures. Methods of sampling air- I. settling under gravity, 2. centrifugal action, 3. Filtration 4. impingement and 5: electrostatic forces. Air sanitation –techniques and applications.	10	**3**
2	2.1	Water microbiology Microbiology of municipal sewage and sewage treatment. Detailed study of Wastewater treatment-Preliminary, Primary, Secondary and Tertiary treatments with special reference to aerobic and anaerobic methods. Waterborne diseases (Cholera, diarrhoea, Hepatitis A, Typhoid, Polio, Leptospirosis, Cryptosporidiasis, Otitis media)and preventive measures.	10	2
	2.2	Solid waste disposal-sanitary landfills, composting – types of composting, vermicompost. Methanogenesis and biogas production	5	3, 4
3	3.1	Isolation of microorganism from air	**7**	**4**
	3.2	Isolation of *E. coli* from water	**7**	**4**
	3.3	Enumeration of microorganisms from water	**7**	**4**
		Enumeration of microorganism from composting pit	**9**	**4**
4		Teacher Specific Content		

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References

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2. Daniel, Joseph C. "Environmental Aspects of Microbiology." (1996)
3. McKane, Larry. "Microbiology: essentials applications." *Microbiology: essentials applications*. 1986.

Suggested readings

1. Ramesh, K. Vijaya. *Environmental microbiology*. MJP Publisher, 2019.
2. Cheesbrough, Monica. *Medical laboratory manual for tropical countries*. Vol. 1. M. Cheesbrough, 14 Bevills Close, Doddington, Cambridgeshire, PE15 OTT., 1981.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Microbiology**					
Course Name	**Bio entrepreneurship development**					
Type of Course	**SEC**					
Course Code	**MG5SECMBG301**					
Course Level	**300**					
Course Summary	Bio entrepreneurship development in provides foundations for developing entrepreneurship skills, ventures and innovations in the field of microbiology. It also provides a platform to interact with the bioentrepreneurs in the medical and biology field and also to develop entrepreneurship skills in students.					
Semester	V	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		45	-	-	-	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Will get an insight into the concept of entrepreneurship, Idea generation, Feasibility Study and opportunity assessment and Business Plan	U	3
2	Will understand the role of Entrepreneurs In Problem Solving and the role of technology in Entrepreneurship	U	1
3	Will get an idea about the difference between start-ups and MSMEs and different agencies supporting entrepreneurship.	U	1,10
4	Will be able to have direct exposure to an enterprise project.	A	1,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Entrepreneurship: Concept and Functions -Why Entrepreneurship for You, Myths about Entrepreneurship, Advantages and Limitations of Entrepreneurship. An Entrepreneur: Types of Entrepreneurs, Competencies and Characteristics, Entrepreneurial Values, Attitudes and Motivation, Intrapreneur: Meaning and Importance	10	1
	1.2	Entrepreneurship Journey -Idea generation, Feasibility Study and opportunity assessment, Business Plan: meaning, purpose and elements, Execution of Business Plan. Design thinking.	10	2
2	2.1	Entrepreneurship as Innovation and Problem Solving -Entrepreneurs as problem solvers, Innovations and Entrepreneurial Ventures – Global and Indian, Role of Technology – E-commerce and Social Media, Social Entrepreneurship - Concept	15	3
3	3.1	Difference between startups and MSMEs.NISP(NATIONAL INNOVATION AND STARTUP POLICY), Brief Insight into National Innovation Foundation (NIF), MoES Innovation Council (MIC), Kerala start-up mission, IEDC.	10	4,5
	3.2	Conduct a case study of any entrepreneurial venture in the field of Microbiology in your nearby area OR Interaction with a successful entrepreneur.	5	4,5
4		Teacher Specific content		

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Reference:

1. Mohanty, Sangram Keshari. *Fundamentals of entrepreneurship*. PHI Learning Pvt. Ltd., 2005.
2. Kumar, S. Anil. *Entrepreneurship development*. New Age International, 2008.

SUGGESTED READINGS

1. https://www.biotech.co.in/sites/default/files/2020-01/Bioentrepreneurship-Development.pdf
2. Jayaraman, Selvaraj, et al. "Microbiology-Based Entrepreneurship." *Industrial Microbiology Based Entrepreneurship: Making Money from Microbes*. Singapore: Springer Nature Singapore, 2022. 1-9.
3. Amaresan, Natarajan, Dhanasekaran Dharumadurai, and Diana R. Cundell. *Industrial Microbiology Based Entrepreneurship: Making Money from Microbes*. Springer, 2022.
4. Amaresan, Natarajan, Dhanasekaran Dharumadurai, and Olubukola Oluranti Babalola. "Agricultural Microbiology Based Entrepreneurship."