THE MAHATMA GANDHI UNIVERSITY UNDERGRADUATE PROGRAMMES (HONOURS) SYLLABUS

MGU-UGP (Honours)

(2024 Admission Onwards)

Faculty:Science

BoS:Biotechnology (UG)

Subject: Bachelor of Science (Honours) Biotechnology

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

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Preface

We are very happy to present the new curriculum and syllabus for the **BSc (Honours) Biotechnology** Programme for favour of approval by the Faculty of Science and Academic Council of Mahatma Gandhi University, Kottayam, Kerala, India.

We are delighted to present the FYUGP syllabus for the B.Sc. Biotechnology (Honours) programme, an undergraduate programme focusing on applied biosciences. This program delves into the utilization of living organisms and their properties across various sectors such as bioprocess technology, pharmaceuticals, industries, agriculture, and food sciences, catering to a multitude of societal needs. The formulation of this syllabus is the culmination of dedicated efforts by a group of educators who meticulously crafted it, considering terms like Outcome Based Education, Academic Bank of Credit, and Skill Based Subjects.

The syllabus prioritizes skill-based education, meticulously designed to cultivate graduate attributes and learning outcomes in a systematic manner. Acknowledging the practical nature of biotechnology, substantial efforts were made to incorporate hands-on experiences. The curriculum framework is structured to provide a robust foundation, enabling students to pursue further studies and research while acquiring essential skills.

Incorporating cutting-edge technology and online resources like MOOCs has been a key focus to enhance the learning process. By emphasizing cognitive abilities and practical skills, the syllabus aims to prepare students for diverse professional careers in our rapidly evolving, knowledge-driven society. Additionally, it underscores the importance of maintaining globally competitive standards while fostering scientific curiosity, critical thinking, and ethical values among students.

The programme aims to deliver a high-quality curriculum with strong vocational elements, nurturing intellectual growth and manpower development in key areas of modern biotechnology. From molecular biology to bioinformatics, the program offers a wide range of opportunities spanning classical to applied aspects of biotechnology.

Furthermore, the syllabus aims to instil a deep understanding of the interdisciplinary nature of biotechnology and its significance in addressing global challenges. Through a combination of theoretical knowledge and practical application, students are equipped with the necessary tools to tackle real-world problems effectively.

The curriculum also emphasizes the importance of research and innovation, encouraging students to explore new ideas and contribute to advancements in the field. By fostering a spirit of inquiry and problem-solving skills, the programme prepares students to become leaders in biotechnology and allied industries.

Moreover, the syllabus is designed to promote inclusivity and diversity, ensuring that all students have equal opportunities to succeed. By creating a supportive and collaborative learning environment, the programme aims to inspire students to reach their full potential and make meaningful contributions to society.

Mahatma Gandhi University has taken tremendous effort to stay in tune with the directions from the Government and UGC for implementing the programme in time. As a part many training programmes have been conducted. The BoS of Biotechnology (UG) conducted a five-day workshop on the curriculum at CMS College, Kottayam. During this workshop, the new curricula and syllabus have been designed and representative teachers from all colleges running the B.Sc Course have participated and suggestions were taken. Dr. Jinu John, the head and Assistant Professor, Department of Biotechnology, C M S College, Kottayam was the subject expert and Dr. Shibin Mohanan, Assistant Professor in Botany, Nirmala College, Moovattupuzha was the Master Trainer.

With dedicated efforts, wholehearted support and involvement of all the members of the Board of Studies, the task of preparing the curricula and syllabi and bringing it out in the present form was made possible. I sincerely express my whole-hearted gratitude to all the fellow members of the BoS for their endless help, cooperation and encouragement showered on me for the completion of this great task. I am also thankful to all teacher representatives from Biotechnology departments of various colleges, external and internal experts for their active participation and fruitful suggestions during the syllabus design process.

I would like to express our deep sense of gratitude to Dr. Sajeshkumar, N. K, Assistant Professor and Head, Department of Biotechnology, M A College, Ramapuram, Pala, Dr. Seema Panicker, Assistant Professor and Head, Department of Biotechnology, St. Mary's College, Thiruvalla and Ms. Jyothi C Nair, Assistant Professor and Head, Department of Biotechnology, Indira Gandhi College of Arts and Science, Nellikkuzhi, Kothamangalam for their valuable inputs and help.

The objectives of the B.Sc. Biotechnology programme are to empower the students from the basics of interdisciplinary life-sciences to the recent trends in Biotechnology and its applications for the benefit of the community. The course empowers the students with conceptual and practical skills of biotechnology and introduces the students to the latest developments in biotechnology. It is fast emerging as a top course providing distinct advantages to students as it finds applications in various aspects of life sciences. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Biotechnology is intended to provide a comprehensive foundation for the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with the required skills at various stages. This course serves a plethora of opportunities in different fields right from classical to applied aspects in Biotechnology.

MGU-UGP (HONOURS)

Syllabus

Board of Studies & External Experts

Board of Studies Members

Dr.Umesh B.T- Chairman
Associate Professor and Head
Department of Biosciences
MES College, Marampally
Aluva.

Members: -

1. **Dr. Nisha Raj S**
   Associate Professor
   P.G Department of Biotechnology
   SAS SNDP Yogam College, Konni

2. **Dr. Priya Senan V**
   Associate Professor
   P.G Department of Biotechnology
   SAS SNDP Yogam College, Konni.

3. Mr. **Roshan K V Remesh**
   Assistant Professor
   Sree Narayana Arts and Science College,
   Kumarakom

4. **Dr. Indu C Nair**
   Associate Professor
   P.G Department of Biotechnology
   SAS SNDP Yogam College, Konni.

5. **Smt. Revathy Babu**
   Assistant Professor
   Department of Zoology
   Sree Sankara College, Kalady.

6. **Uma Surendran**
   Assistant Professor
   Department of Zoology
   Baselius College, Kottayam

7. **Dr. Jayesh Antony**
   Assistant Professor
   Department of Zoology
   St. Thomas College, Palai. Kottayam.

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Subject Experts

1. **Dr. Sajesh Kumar, N.K**. Assistant Professor and Head. Mar Augusthinose College Ramapuram, Pala, Kottayam.

2. **Dr. Seema Panicker**, Assistant Professor, St.Mary's College, Thiruvalla.

3. **Smt. Jyothi C Nair**, Assistant Professor, Indira Gandhi College of Arts and Science, Nellikkuzhi, Kothamangalam.

4. **Smt. Resiya Karim**, Assistant Professor, Department of Biotechnology, MES College, Marampally, Aluva.

5. **Dr. Jayesh Kuriakose**, Assistant Professor, Department of Biotechnology, The Cochin College, Cochi.

6. **Dr. Jinu John,** Assistant Professor and Head, Department of Biotechnology, CMS College (Autonomous) Kottayam.

7. **Dr. Shibin Mohan,** Assistant Professor, Department of Botany, Nirmala College, Moovattupuzha.

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Name of the Major: Biotechnology

Semester: 1

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG1DSCBTG100	Fundamentals for Biotechnology	DSC A	4	5	3	0	2	0
MG1MDCBTG100	Ecology and Environmental Science	MDC	3	4	2	0	2	0

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

Semester: 2

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCBTG100	Applied Biotechnology	DSC A	4	5	3	0	2	0
MG2MDCBTG100	Tools and Techniques in Biotechnology	MDC	3	4	2	0	2	0

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Semester: 3

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG3DSCBTG200	Biophysics and Instrumentation	DSC A	4	5	3	0	2	0
MG3DSCBTG201	Cell Biology and Genetics	DSC A	4	5	3	0	2	0
MG3DSCBTG202	Fundamentals of Molecular Biology	DSC B	4	5	3	0	2	0
MG3DSEBTG200	Developmental Biology and Assisted Reproduction Technology	DSE	4	4	4	0	0	0
MG3DSEBTG201	Plant and Animal Physiology							
MG3MDCBTG200	Nutritional Biotechnology	MDC	3	3	3	0	0	0
MG3VACBTG200	Environmental Biotechnology and Human Rights	VAC	3	3	3	0	0	0

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Semester: 4

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG4DSCBTG200	Molecular Biology	DSC A	4	5	3	0	2	0
MG4DSCBTG201	Immunology	DSC A	4	5	3	0	2	0
MG4DSEBTG200	Biosafety and Bioethics	DSE	4	4	4	0	0	0
MG4DSEBTG201	Biostatistics							
MG4DSCBTG202	Tissue Culture Techniques	DSC B	4	5	3	0	2	0
MG4SECBTG200	Quality Control in Biology	SEC	3	3	3	0	0	0
MG4VACBTG200	Human Resource Management in Biotechnology	VAC	3	3	3	0	0	0

MG4INTBTG200	INTERNSHIP	INT	2 Credits

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Semester: 5

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG5DSCBTG300	Recombinant DNA Technology	DSC A	4	5	3	0	2	0
MG5DSCBTG301	Enzyme Technology	DSC A	4	5	3	0	2	0
MG5DSEBTG300	Biotechnology and Entrepreneurship	DSE	4	4	4	0	0	0
MG5DSEBTG301	Basic Bioinformatics	DSE	4	4	4	0	0	0
MG5DSEBTG302	Bioprocess Technology	DSE	4	4	4	0	0	0
MG5DSEBTG303	Marine Biotechnology							
MG5SECBTG300	Scientific communication in research	SEC	3	3	3	0	0	0

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Semester: 6

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG6DSCBTG300	Plant and Animal Biotechnology	DSC A	4	5	3	0	2	0
MG6DSCBTG301	Cancer biology and Cell signalling	DSC A	4	4	4	0	0	0
MG6DSEBTG300	Industrial Biotechnology	DSE	4	5	3	0	2	0
MG6DSEBTG301	Food Biotechnology							
MG6DSEBTG302	Sustainable Biotechnology	DSE	4	4	4	0	0	0
MG6DSEBTG303	Intellectual Property Rights and Patenting							
MG6SECBTG300	Skills in Biotechnology	SEC	3	4	2	0	2	0
MG6VACBTG300	Biotechnology for Nourishing Health	VAC	3	3	3	0	0	0

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Semester: 7

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG7DCCBTG400	Genomics and Transcriptomics	DCC	4	4	4	0	0	0
MG7DCCBTG401	Advanced cell and Molecular Biology	DCC	4	5	3	0	2	0
MG7DCCBTG402	Research Methodology and Scientific Writing	DCC	4	4	4	0	0	0
MG7DCEBTG400	Advanced Bioinformatics	DCE	4	4	4	0	0	0
MG7DCEBTG401	Disease and Diagnostic Biotechnology	DCE	4	4	4	0	0	0
MG7DCEBTG402	Immunoengineering	DCE	4	4	4	0	0	0
MG7DSEBTG400	Agricultural Biotechnology *	DSE	4	4	4	0	0	0
MG7DSEBTG401	Proteomics*	DSE						
MG7DSEBTG402	Genetic Engineering*	DSE						

* for those who are opting Biotechnology as minor.

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Semester: 8

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG8DCCBTG400	Advanced Instrumentation technique	DCC	4	5	3	0	2	0
MG8DCCBTG401	Analytical & Molecular Techniques	DCC	4	8	0	0	8	0
MG8DCEBTG400	Molecular Mechanism of learning and Memory	DCE	4	4	4	0	0	0
MG8DCEBTG401	Biopharmaceuticals and Nanotechnology	DCE	4	4	4	0	0	0
MG8DCEBTG402	Forensic Biotechnology	DCE	4	4	4	0	0	0
MG8DCEBTG403	Stem Cell & Tissue Engineering	DCE	4	4	4	0	0	0
MG8PRJBTG400	Project	PRJ	12					

Any three DCE

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Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biotechnology**					
Course Name	**Fundamentals for Biotechnology**					
Type of Course	**DSC A**					
Course Code	**MG1DSCBTG100**					
Course Level	**100-199**					
Course Summary	Fundamentals of Biotechnology covers essential concepts related to various fields of Biotechnology. Module 1 gives basic ideas about the historical background on the field cell biology Biotechnology. Module 2 covers basics of Genetics, Immunology and Microbiology. Module 3 deals with the structure and function of biomolecule and rDNA Technology and its applications. Module 4 covers various aspects of Good laboratory practices.					
Semester	1	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	NA					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	On completion of the course students will be able to identify the scope of biotechnology, tracing its historical development from ancient to modern times.	K	2, 3, 6,10
2	Students will be able to discuss the various applications of biotechnology in medicine, agriculture, and industry.	U	1, 10
3	Students could apply their knowledge to solve problems like monohybrid and dihybrid crosses in genetics.	An	2, 5, 9,10
4	Students gain the knowledge of good laboratory practices.	U	1,2,3
***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**			

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COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs.	CO No.
1 Introduction to Biotechnology and the Cell.	1.1	**History of Biotechnology** Biotechnology - Definition, History and scope of Biotechnology, Conventional Biotechnology and Modern Biotechnology, Milestones in the development of Biotechnology. Career aspects and applications of biotechnology.	4	1, 2
	1.2	Cell theory, Cell as a tool for biotechnology. Prokaryotic and Eukaryotic cell structure.	4	1, 2
2 Overview of Genetics, Microbiology and Immunology	2.1	Introduction to Mendelian genetics; Mendelian laws; Monohybrid and Dihybrid experiments.	4	1, 2
	2.2	Introduction to Microbiology, microbial diversity – General characteristic of bacteria, fungi, virus microscopic algae and protozoa.	6	1, 2
	2.3	An overview to immunology- antigen, antibody; Cells of immune system.	6	3
3 Biomolecules-Structure and Function	3.1	General classification of Carbohydrates, Proteins, Lipids and Nucleic acids. General structure and characteristic of Carbohydrates, Proteins, Lipids and Nucleic acids.	6	1, 2
	3.2	Structure and function of nucleic acids; An outline to DNA replication, transcription and translation.	8	2
	3.3	An introduction to Recombinant DNA technology, Basic steps in rDNA technology. Applications of rDNA technology–Vaccine-Hepatitis, Covid; Hormones- Humulin, Growth hormone.	8	2
4 Practical	4.1	Overview of laboratory safety rules and regulations, Maintenance of aseptic conditions and personal hygiene.	5	4
	4.2	Introduction to the laboratory layout and equipments. Cleanliness of laboratory wares and workspace.	6	4
	4.3	Biological safety measures and maintenance of live cells, Maintenance of Sterility.	6	4
	4.4	Sources of spillage and contamination, Methods of decontamination, Waste management practices in laboratory.	8	4
	4.5	Documentation and record keeping in laboratory.	5	4
5		**Teacher specific content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks 5 hrs.	Major expt./ procedure/ case study analysis – 15 Minor expts./ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

Reference

1. Sathyanarayana U., (2020) Text book of Biotechnology, Books And Allied (P) Ltd. Kolkata.
2. Campbell, N. A., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Reece, J. B. (2017). Biology (11th ed.). Pearson.
3. Raven, P. H., Johnson, G. B., Mason, K. A., Losos, J. B., & Singer, S. S. (2017). Biology (11th ed.). McGraw-Hill Education.
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5. Solomon, E. P., Berg, L. R., Martin, D. W., & Villee, C. A. (2017). Biology (10th ed.). Cengage Learning.
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MAHATMA GANDHI UNIVERSITY · KOTTAYAM · MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Ecology and Environmental Science**
Type of Course	MDC
Course Code	**MG1MDCBTG100**
Course Level	**100-199**
Course Summary	Course enlightens with the importance of conserving and maintaining the ecosystem, appraise the impact of restoration of ecosystems around the globe

Semester	1	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome On completion of the course the student will able to	Learning Domains *	PO No
1	Identify the basic components of ecosystem	U	1,2,3
2	Evaluate the different conservation strategies and technologies.	A	2,3
3	Compare various restoration projects happened globally	A	2,3
4	Justify the restoration policies in India	E	1,2,3
5	Compare the restored ecosystem and policies	E	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 Ecosystem and Biodiversity	1.1	**Ecosystem features and significance** Definition and characteristics of ecosystems. Biotic and abiotic components. Ecosystem services and their significance. Ecosystem Processes- Food chain, Food web	4	1
	1.2	**Energy flow and Nutrient cycling.**	4	1

		Outline of Energy flow and nutrient cycling (Nitrogen and Carbon).		
	1.3	**Biodiversity** Ecosystem Dynamics and Conservation: Ecological Succession. Threats to ecosystems.	4	2
	1.4	**Biodiversity conservation.** Conservation strategies- National Park, Wildlife Sanctuaries and restoration ecology, Germplasm conservation strategies.	4	2
2 Ecosystem Restoration	2.1	**Ecosystem restoration globally:** Various ecosystem restoration projects around the globe: Arabian Oryx Reintroduction (Oman).	4	3
	2.2	**Ecosystem restoration projects-India.** Ecosystem restoration projects and strategies in India: Periyar Tiger Reserve, Nilgiri Tahr Project (2023), Sundarbans Mangrove Restoration Project, Green India Mission, National River Conservation Plan (NRCP), CAMPA (Compensatory Afforestation Fund Management and Planning Authority), Himalayan Landscape Conservation and Livelihoods Support Project.	10	3
3 Practicals	3.1	**Environmental protection Movements and mission in India.** **Case study report**:- Bishnoi movement, Chipko movement, Save Silent Valley movement, Jungle Bachao movement, Save the Western Ghats Movement, Swachh Bharat Abhiyan.	12	4
	3.2	**Ecosystem Restoration Projects.** **Case study report** : Ecological rehabilitation of the Aravalli hills, Chambal River Conservation-Madhya Pradesh and Rajasthan.	8	4
	3.3	**Field study:** Visit to any National Park or wild life sanctuary and prepare the study report.	10	2
4		**Teacher Specific Content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Class room lecture, ICT enabled classes, Discussions, Practical sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 15 marks Practical – CCA : 15 marks

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	B. End Semester Examination – 1.0 hr. Theory : 35 marks Practical : 35 marks
Pattern of questions	Total marks: 35 marks (1.0 hr.) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :3 out of 5 3x3= 9 marks Short essay (6 marks) :1 out of 2 1x6= 6 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical (35 marks) 5 hrs	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References:

1. Allison, S. K (2014). Ecological restoration and environmental change: Renewing damaged ecosystems. Routledge
2. Singh, J.S., S.P & Gupta, S.R (2006). Ecology, Environment and Resource conservation. Anamaya Publ., New Delhi
3. Chapman, J.L.& M.J. Reiss (1998). Ecology: Principles and Applications. Cambridge Univ. press. 2 nd edition.
4. Peter Stiling (2015). Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill international edition
5. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
6. Krebs, C.J. (2008). Ecology: The experimental Analysis of Distribution and Abundance (6th Edition), Benjamin Cummings Publ.
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SEMESTER-2

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Applied Biotechnology**
Type of Course	**DSC A**
Course Code	**MG2DSCBTG100**
Course Level	**100-199**
Course Summary	The course covers a broad range of topics related to the application of biological systems, organisms, or derivatives to develop or create new products or processes beneficial to the society.

Semester	2	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome After completing this course, the students will	Learning Domains *	PO No
1	Understand the past, present, and future of Biotechnology, enable to critically analyze and contribute to the field's ongoing advancements.	U	1,10
2	Ability to differentiate between the diverse domains of biotechnology.	U	1,2,3,10
3	Capable of evaluating the highlighting methods in biotechnology.	E	1,2,3,8,10
4	Able to comprehend the opportunities in various biotechnological institutes and companies.	U	1,2,5,6
5	Evaluate the recent advancements and products in biotechnology and its impacts on society	E	1,2,6,8,10
6	Able to handle laboratory wares and chemicals, prepare solutions and reagents and verify the quality of reagents.	A	1,2,3,5

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

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COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Biotechnology	1	**Scope of Biotechnology** Multidisciplinary nature of Biotechnology, Trends and emerging technologies in Biotechnology- Personalized medicine, 3D-bioprinting.	3	1
2 Applied Biotechnology	2.1	**Colours of Biotechnology** Colours of Biotechnology: Green, blue, white, red, grey, gold, dark.	3	2
	2.2	**Industrial (White)Biotechnology** Enzymes for textile industry, breweries, food supplements-SCP, Vitamins, food processing-cheese, yogurt, biodegradable plastics, biofuels.	5	2
	2.3	**Environment (Grey) Biotechnology** Waste management, Biodegradation of heavy metals, water cleaning, removing oil spills, air and soil pollution, bioremediation, biomining.	4	2
	2.4	**Medical (Red) Biotechnology** Antibiotic production, molecular diagnostics, vaccines and vaccine delivery, recombinant therapeutics, insulin, forensics.	5	5
	2.5	Overview of Recombinant DNA Technology and its applications, Human Genome Project – Objectives and Features, Ethical Legal and Social Issues (ELSI), Its implications	5	5
3 Biotechnology in Human Welfare	3.1	Genetically Modified Organisms- Methodology, Merits and Demerits. Transgenic animals: Features, merits and demerits of - Polly, Rosie the cow, Glo fish, GFP animals. Golden rice, Flavr Savr Tomato.	5	4
	3.2	Animal Vaccine production, Improvement of livestock-increased milk production, artificial insemination, poultry and fisheries.	4	4
	3.3	**Recent advances in Biotechnology** CRISPR-Cas9, Synthetic biology - Artificial Cell-Types and its applications. Bio printing, Xenografts; AI and Bio-robotics, Fundamental concepts	4	5
	3.4	**Nanobiotechnology** Nanobiotechnology- Definition, Applications in health and environment.	3	5
	4.5	**Bio-startups and Industries:** An introduction to bio-entrepreneurship and bio-startups, Marketing of biotechnology products, Major Biotechnology institutes and companies in India.	4	5
	4.1	Introduction to Solutes and Solutions: Basic concepts of measuring solutes, solvents and solutions.	4	6

4 **Practicals**	4.2	**Calculations on unit conversions:** Weight, Volume, and Concentration; Calculations on Molarity, Molality, Normality, Percentage solutions and dilution series.	7	6
	4.3	Preparation of buffer solutions of specific pH values and strength. Preparation of laboratory reagents. Accuracy, Precision and Purity.	7	6
	4.4	Preparation of standard solutions and standard curve. Verification of prepared solutions through pH measurements, titration and Colorimetry/Spectrophotometry.	6	6
	4.5	Methods for identifying and rectifying errors during solution preparation, titration and analysis. Verification of quality of reagents and chemicals.	6	6
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs. Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs.) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical- 35 marks **5 hrs.**	Major expt./ procedure/ case study analysis – 15 Minor expts./ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References:

1. Biotechnology and ethics: A blueprint for the future. (1996). North western University, Center for Biotechnology.
2. Dubey, R. C. (2022). Textbook of Biotechnology. S. Chand and Co.

3. Lodish, H. F. (2022). Molecular cell biology. Macmillan International Higher Education.
4. Nanotechnology in catalysis. (2017). Wiley-VCH Verlag GmbH & Co. KGaA.
5. Niemeyer, C. M., & Mirkin, C. A. (2007). Nanobiotechnology: Concepts, applications, and perspectives. Wiley-VCH.
6. Poole, C. P., & Owens, F. J. (2010). Introduction to nanotechnology. Wiley India.
7. Singh, B. D. (2016). Biotechnology. Kalyani Publishers.
8. Willey, J. M., Prescott, L. M., Sandman, K. M., & Wood, D. H. (2023). Prescott's microbiology. McGraw-Hill.

MAHATMA GANDHI UNIVERSITY · KOTTAYAM ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Tools and Techniques in Biotechnology**
Type of Course	**MDC**
Course Code	**MG2MDCBTG100**
Course Level	**100-199**
Course Summary	This course introduces students to the exciting world of biotechnology tools and techniques with a focus on accessibility and ease of understanding.

Semester	2	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practicum	Others	
		2	0	1	0	60
Pre-requisites, if any	NA					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome After completion of the course, the student will	Learning Domains *	PO No
1	Understand the fundamentals of molecular biology and its practical applications.	U	2,3,6
2	Explain basic gene manipulation techniques and their significance.	U	2,3
3	Describe various bioinformatics tools	U	2,3
4	Identify the concept of advanced biotechnological tools and their applications.	U	2,3,6
5	Able to isolate and quantify DNA, protein and retrieve DNA and protein sequences from databases.	S	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	Basics of DNA and RNA structure and types.	2	1

MGU-UGP (HONOURS) Syllabus

Basics of Molecular Biology:Unravelling the Secrets of DNA and RNA	1.2	Basic outline of Central dogma of molecular biology: Replication, Transcription and Translation – steps.	5	1
	1.3	Fundamentals of PCR and its types (Reverse Transcriptase PCR, Nested PCR, QPCR, RT PCR).	3	1,4
	1.4	Principle and applications of electrophoresis: AGE, PAGE.	2	3
2 **Recombinant DNA technology: The Art of Gene Manipulations**	2.1	An outline of Cloning vectors: Features and types.	2	2
	2.2	Introduction to Restriction enzymes-Properties and types.	2	2
	2.3	Basics steps of Gene cloning and expression.	2	2
	2.4	Overview of Site-directed mutagenesis.	2	3
3 Play with Proteins and Bioinformatics	3.1	Protein isolation and purification: Precipitation of proteins, Basic steps of SDS-PAGE and Western blotting.	2	3
	3.2	Introduction to Mass spectrometry-Principles and Applications	2	4
	3.3	Getting started with bioinformatics: Definition, Introduction and applications.	2	3
	3.4	Important databases: NCBI, GenBank, DDBJ, EMBL, PDB viewer.	4	3
4 Practicals	4.1	Isolation and electrophoresis of DNA	6	5
	4.2	Quantitative estimation of DNA	5	5
	4.3	Purification of protein by precipitation method	6	5
	4.4	Quantitative estimation of Protein	5	5
	4.5	Introduction to NCBI, GenBank, DDBJ, EMBL and retrieval of DNA and Protein sequence in FASTA format.	8	5
Module 5		Teacher specific content		

MGU-UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Class room lecture, ICT enabled classes, Discussions, Practical sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 15 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.0 hr. Theory : 35 marks Practical : 35 marks
Pattern of questions	Total marks: 35 marks (1.0 hr.) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :3 out of 5 3x3= 9 marks Short essay (6 marks) :1 out of 2 1x6= 6 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical- 35 marks 5 hrs.	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Molecular Biology of the Gene by James D. Watson
2. Essential Cell Biology by Bruce Alberts et al.
3. PCR (The Basics) by Tom Strachan and Andrew P. Read
4. Electrophoresis: Theory, Techniques, and Biochemical and Clinical Applications by G. Pasquali
5. Molecular Cloning: A Laboratory Manual by Michael R. Green and Joseph Sambrook
6. Recombinant DNA Technology and Molecular Cloning by Robert A. Meyers
7. Introduction to Genetic Analysis by Anthony J.F. Griffiths et al.
8. Site-Directed Mutagenesis: Methods and Protocols by Bimal D. Mepani
9. Protein Bioinformatics: An Algorithmic Approach to Sequence and Structure Analysis by Ingvar Eidhammer
10. Mass Spectrometry for the Novice by John Greaves and Andrew P. Jones

Suggested Readings

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount
2. Principles of Proteomics by Richard M. Twyman
3. CRISPR-Cas: A Laboratory Manual by Jennifer Doudna and Prashant Mali
4. Next-Generation DNA Sequencing Informatics by Stuart M. Brown
5. Microarray Technology and Its Applications by Uwe R. Müller
6. Nanobiotechnology: Concepts, Applications, and Perspectives by Christof M. Niemeyer
7. Molecular Biology Techniques: An Intensive Laboratory Course by Heather Miller
8. Introduction to Bioinformatics by Arthur M. Lesk
9. NCBI Handbook by National Center for Biotechnology Information (NCBI)
10. Biotechnology: Science for the New Millennium by Ellyn Daugherty

SEMESTER-3

MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University Kottayam

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Biophysics and Instrumentation**					
Type of Course	**DSC A**					
Course Code	**MG3DSCBTG200**					
Course Level	**200-299**					
Course Summary	The course covers the fundamentals of biophysics and various instruments used for different experiments in a laboratory					
Semester	3	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	To remember and recall fundamental principles of biophysics, including thermodynamics, biomolecular structures, and analytical techniques.	K	1,2,3
2	Demonstrate comprehension by explaining the concepts of biophysics and instrumentation.	U	2,3,10
3	Employ principles of analytical and separation instruments in medical and industrial applications	A	2,3,6
4	Analyse experimental data obtained through various techniques in biophysics.	An	1,2,10
5	Apply comprehensive experimental approaches integrating diverse biophysical and instrumentational techniques	A	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 **Introduction to biophysics**	1.1	**Thermodynamics:** Laws of thermodynamics, the concept of enthalpy, entropy, free energy and thermodynamic equilibrium.	2	1,4
	1.2	**Role of Water and its significance:** Role of water in living organisms. Basic principles and biological significance of osmosis,diffusion, adsorption and surface tension.	2	1,4
	1.3	**Principles of light:** Electromagnetic spectrum, Reflection, Refraction, Absorption, Transmittance, Scattering, Dispersion, Interference, Polarization of light.	3	1,4
2 **Protein and DNA**	2.1	**Proteins:** Proteins - primary, secondary, tertiary and quaternary structure. Peptide bond. Ramachandran plot.	4	1,2
	2.2	**DNA:** Structural DNA polymorphism – A, B, Z and other structural forms. GC content and denaturation kinetics, Melting temperature and cot curve.	5	1,2
3 **Analytical and Separation techniques**	3.1	**Radiation biology:** Radioactivity, Radioisotopes and its applications. Principle and instrumentation of GM counter and Scintillation counter. Autoradiography.	4	2,3,5
	3.2	**Microscopy and Micrometry:** Microscopy-Principle and instrumentation of Light microscope, Principle and instrumentation of Micrometry. SEM andTEM and AFM.	4	2,3,5
	3.3	**Analytical methods:** Principle (Beer-Lambert's Law) and instrumentation of Colorimetry and Spectrophotometry – UV visible and IR. Principle and instrumentation of pH meter. Principle and instrumentation of Biosensors.	6	2,3,5
	3.4	**Chromatography:** Chromatography–Principle, Instrumentation and application of paper-, column-, gel permeation-, ionexchange chromatography, TLC, HPLC & GC.	5	2,3,5
	3.5	**Centrifugation:** Principle, instrumentation and application of Centrifugation and Ultracentrifugation.	3	2,3,5
	3.6	**Dialysis:** Principle, instrumentation and application of Dialysis and Ultra filtration.	2	2,3,5
	3.7	**Electrophoresis:** Electrophoresis – Principle, instrumentation and applications of AGE, PAGE and SDS-PAGE.	5	2,3,5
4 **Practical**	4.1	Determination of pH using pH meter.	2	1,2,5
	4.1	Colorimetry – Quantitative estimation of biomolecules.	8	1,2,5
	4.3	Micrometry of plant animal and microbial cell.	6	1,2,5
	4.4	Chromatography – PC and TLC.	6	1,2,5

	4.5	Electrophoresis of DNA	4	1,2,5
	4.6	Purification of protein by dialysis.	4	1,2,5
5		Teacher Specific Content		

References

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical -35 marks 5 hrs.	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

1. Boyer, R., & Boyer, R. (2005). Modern Experimental Biochemistry. Pearson Education(Singapore) Pvt. Ltd.
2. Chatwal, G. R., & Arora, M. (2007). Biophysics. Himalaya Pub. House.Roy, R. N. (2005). *A textbook of biophysics*. New Central Book Agency.
3. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). *Biophysical Chemistry (principles andtechniques)*. Himalaya Pub. House.
4. Voet, D., & Voet, J. G. (2021). *Biochemistry*. John Wiley & Sons.
5. Wilson, K., & Walker, J. M. (2007). *Principles and techniques of Biochemistry and MolecularBiology*. Cambridge University Press.

Mahatma Gandhi University
Kottayam

Programme	BSc (Honours) Biotechnology					
Course Name	Cell biology and Genetics					
Type of Course	DSC A					
Course Code	MG3DSCBTG201					
Course Level	200-299					
Course Summary	The course covers a broad range of topics related to Cell structure, functions, cell cycle, Mendelian genetics, linkage, crossing over, sex determination, genetic disorders, gene mutation and population genetics.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practicum	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of the course the student will be able	Learning Domains *	PO No
1	Recall the salient features of living cells.	K	1,2,4
2	Explain the structure of the cell organelles	U	1,2,3
3	Identify the stages of mitosis and meiosis	U	2,3,9
4	Explain the fundamentals of Mendelian laws and Population genetics.	U	2,8,10
5	Evaluate the genetic disorder and aim to improve the genetic quality for human welfare	E	5,6,7
*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.

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1 Overview of cell	1.1	**Cell structure and Cell diversity:** Introduction to cell structure, Prokaryotic and eukaryotic cell, Cell Architecture. Plant cell structure, Animal cell structure, Microbial cell structure.	4	1
	1.2	**Cell membrane and Extra cellular matrix:** Models of Cell membrane. Fluid Mosaic Model - structure and composition. Extracellular Matrix (ECM)	3	1, 2
	1.3	**Membrane Transport:** Overview of membrane transport, Passive transport, Active transport, Types of membrane transport (Uniport, Symport and Antiport)	4	1, 2
2 Cellular world and Cell cycle	2.1	**Cell organelles:** Structure and functions - Nucleus, Endoplasmic reticulum, Golgi Apparatus, Lysosomes, Peroxisomes, Mitochondria, Chloroplast.	4	1, 2
	2.2	**Cytoskeleton:** Overview of Cytoskeleton, Structure and functions - Microtubules, microfilaments, intermediate filaments.	3	1, 2
	2.3	**Cell cycle and Cell death:** Introduction to the cell cycle, Phases of cell cycle (G, S, G2, M), Mitosis and Meiosis, Cell cycle checkpoints, Overview of cell death process, Apoptosis, Necrosis and Autophagy	4	2, 3
3 Hereditary wonders Genetic disorders and Advanced genetics	3.1	**Introduction to Genetics:** Terminology and symbols in genetics. Mendelian laws with example- Testcross, Backcross Gene interactions: Co-dominance, Incomplete dominance, Epistasis, Multiple alleles-ABO blood typing, Polygenic inheritance, Pleiotropism, Lethel genes.	4	4
	3.2	**Linkage and crossing over:** Linkage types- Complete and Incomplete, crossing over- Types and Mechanism, Factors affecting crossing over.	3	4
	3.3	**Sex determination:** Sex determination - Autosomes and sex chromosomes, Chromosomal basis of sex determination (XX-XY, XX-XO, ZZ-ZW types) Mechanism of sex-linked inheritance, Sex influenced, Sex limited gene expression, Dosage compensation (Barr bodies, drum stick).	5	4
	3.4	**Extrachromosomal inheritance** - Mitochondria and Chloroplast.	2	4, 5
	3.5	**Gene Mutation:** Types. Chromosomal aberations – structural and neumerical. Chromosomal anomalies and human disorders - Down's syndrome, Edwards syndrome, Klinefelter's syndrome, Turners syndrome, Sickle cell anemia, Phenyl ketonuria.	5	4, 5
	3.6	**Population Genetics:** Human genetics- Karyotype study, Pedigree analysis. Population genetics- Genetic variation, Hardy Weinberg principle, Factors affecting Hardy Weinberg equilibrium.	4	4
4 Practical	4.1	Identification of Cell types	4	1,2,3
	4.2	Morphological comparison of living and dead cell.	4	1,2,3
	4.3	Mitosis – Onion Root Tip	4	1,2,3
	4.4	Meiosis – Rhoeo Flower Bud	5	1,2,3
	4.5	Staining of Mitochondria Staining of Barr body and Polytene Chromosome	10	1,2,3

	4.6	ABO Blood typing	3	1,2,3
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Cell and Molecular biology by Gerlad Karp, Academic Press
2.World of the Cell, Becker, Reece, Poenie, The Benjamin /Cumming's Pub
3.Cell Biology, Lodish et al, W H Freeman and Co., NewYork.
4.Cell Biology, Thomas D Pollard and W C Earnshaw, Saunder's Publishers
5.. Principles of genetics - E J Gardner John Wiley India llp Publication
6. Genetics –M W Strick Berger, Macmillan,
7. Fundamentals of Genetics - Peter. J. Russel, Harper Collins Pub.
8.Genetics, Principles and analysis- Daniel L. Hartin and Elisabeth W. John, Jones and Bartlett Pub. US.
9. Human Genetics, - 2nd& 3rd Edn. S. D. Gangane. Elsevier/ Paras publications.
10. Essentials of Human Genetics, - 4 th Edn. S. M. Bhatnagar, M. L. Kothari and L. A. Mehta.
11.Text book of genetics, - Veer Bala Rastogi, KNRN Pub
12. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, - P. S. Verma, V.K. Agarwal., S Chand pub
13. Genetics- - P. S. Verma, S Chand pub

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Fundamentals of Molecular Biology**
Type of Course	**DSC B**
Course Code	**MG3DSCBTG202**
Course Level	**200-299**
Course Summary	Molecular biology is a multidisciplinary field that combines principles of molecular biology, genetics, biochemistry, and other related disciplines to manipulate biological systems at the molecular and cellular levels. This field has wide-ranging applications in medicine, agriculture, industry, and environmental management. A course in molecular biology typically covers a variety of topics to provide students with a comprehensive understanding of the field.

Semester	3	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

MGU-UGP (HONOURS)
Syllabus

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Able to describe fundamental molecular aspects of biology.	U	1.2.10
2	Compare the organization of DNA in viral, prokaryotic, and eukaryotic genomes.	An	1,2
3	Recall the concepts of central dogma of molecular biology.	K	2,3,10
4	Students can assess cellular functions, regulation, errors occurs during the cellular mechanisms and its repair.	U	1,3,10
5	Students can execute various molecular techniques including Isolation of genomic DNA and Plasmid, Centrifugation, Gel electrophoresis, Blotting techniques and PCR	A	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 transaction (Units)

Module	Units	Course description	Hrs	CO. No:
1 Introduction to Molecular Biology	1.1	Milestones in Molecular Biology	1	1
	1.2	Experiments demonstrating DNA and RNA as the genetic material	2	1
	1.3	Structure and types of DNA and RNA	2	1
	1.4	Organization of DNA in viral, prokaryotes and eukaryotic genome and C-value paradox	2	2
	1.5	Gene structure- Structure of prokaryotic and eukaryotic genes, Central dogma of Molecular biology.	4	2
	1.6	Transposable elements in prokaryotes- Tn elements and eukaryotes- SINEs and LINEs.	2	2
2 DNA replication and repair.	2.1	DNA replication in prokaryotic and eukaryotic nuclear genome	4	3,4
	2.2	Mutation and DNA repair mechanisms.	8	3,4
3 Protein synthesis& Gene regulation	3.1	Transcription of mRNA in prokaryotes and eukaryotes and post transcriptional modifications. Reverse transcription.	4	3,4
	3.2	Genetic code and its properties. Translation - translation of prokaryotic and eukaryotic mRNA and Post translational modifications	6	3,4
	3.3	Gene regulation in prokaryotes- Operon concept, components of operon and Positive and negative regulation	6	3,4
	3.4	Molecular details of Lac operon.	4	3,4
4 Practical Molecular Techniques	4.1	Isolation of genomic DNA	10	5
	4.2	Gel electrophoresis	6	5
	4.3	PCR-Demonstration	6	5
	4.4	Western blotting – Demonstration only	8	5
5		Teacher specific content		

MGU UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Russell, P. J. (1987). *Essential genetics*. Blackwell Scientific Publications.
2. Simmons, M. J., & Snustad, D. P. (2006). *Principles of genetics*. John Wiley & Sons. Watson, J. D. (2004). *Molecular biology of the gene*. Pearson Education India..
3. Karp, G. (2009). *Cell and molecular biology: concepts and experiments*. John Wiley & Sons.
4. Brooker, R. J. (1999). *Genetics: analysis & principles*. Reading, MA, USA:: Addison-Wesley.
5. Brown, T. A. (2020). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
6. Glick, B. R., & Patten, C. L. (2022). *Molecular biotechnology: principles and applications of recombinant DNA*. John Wiley & Sons.

Suggested Readings

1. Alberts, B. (2017). *Molecular biology of the cell*. Garland science.
2. Twyman, R. (2018). *Advanced molecular biology: a concise reference*. Garland Science.

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Developmental Biology and Assisted Reproduction Technology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG3DSEBTG200</td></tr>
<tr><td>Course Level</td><td colspan="6">200-299</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course in Developmental Biology provides a comprehensive exploration of the scope, historical perspectives, and fundamental aspects of reproductive biology, including gonadal structure, hormones, reproductive cycles, gametogenesis, and the structure of gametes. It further delves into covering fertilization, parthenogenesis, and placenta, focusing on early embryonic development, morphogenetic movements, and germ layer formation. Finally, addresses human embryonic development stages, invitro fertilization, and offers insights into enzyme engineering and future perspectives in the field.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Able to recall the anatomy of human reproductive system and its structures.	K	1,2,4
2	Gain a comprehensive understanding of early embryonic development with its stages.	U	1,2,10
3	Gain knowledge about the Assisted Reproduction Technology	U	1,2,10
4	Equipped to comprehend genetic counselling along with an exploration of the ethical and future considerations in assisted reproductive technology.	An	1,2,3,4

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Developmental Biology	1.1	Stages of embryo development	1	1,2
	1.2	Gonads- Structure of Human testis and ovary.	3	1,2
	1.3	Gonadal hormones and their functions.	2	1,2
	1.4	Female reproductive cycle (menstrual cycle).	2	1,2
	1.5	Gametogenesis -spermatogenesis, oogenesis	4	1,2
	1.6	Structure of sperm and ovum. Different types of eggs on the basis of Yolk.	3	1,2
2 Fertilization, Parthenogenesis and Placenta	2.1	Fertilization-Mechanism and Significance.	4	2,3
	2.2	Pregnancy parturition and lactation	4	2,3
	2.3	Ectopic pregnancy. Polyspermy	2	2,3
	2.4	Parthenogenesis-Types	2	2,3
	2.5	Placenta and its hormones.	3	2,3
3 Early embryonic development	3.1	Cleavage definition types and patterns	3	3
	3.2	Blastula -Mechanism of Blastulation, Gastrulation.	3	3
	3.3	Morphogenetic movements-epiboly, extension, invagination, convergence, de-lamination	4	3
	3.4	Formation of germ layers	3	3
	3.5	Fate map (chick embryo)	2	3
4 Assisted Reproduction Technology and Future Perspectives	4.1	Introduction to Genetic counselling. Eugenics, Euthenics.	3	4
	4.2	Human embryonic development (Germinal, Embryonic and foetal stages)	5	4
	4.3	In vitro fertilization, Steps in IVF.	3	4
	4.4	Prenatal diagnosis – Amniocentesis, chorionic villi sampling (CVS), Fetoscopy.	4	4
5		Teacher specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

- Berril, N..J.; and Kars, G.; 1986. Developmental biology, Mc Graw Hills
- Majumdar N. N-1985 Vetebrate embryology; Tata McGraw-Hill, New Delhi
- Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press (Int. student edition)
- Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc., U.S.; 7th Revised edition.
- Vijayakumaran Nair, K. & George, P. V. 2002. A manual of developmental biology, Continental publications, Trivandrum
- Taylor DJ, Green NPO & G W Stout. (2008) Biological Science third edition. Cambridge university press. Ref pp 748 biology 755

Suggested Readings

- Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Plant and Animal Physiology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG3DSEBTG201</td></tr>
<tr><td>Course Level</td><td colspan="6">200-299</td></tr>
<tr><td>Course Summary</td><td colspan="6">This physiology syllabus covers fundamental aspects of human and plant systems. Students study human digestion, blood components, circulatory and respiratory systems, as well as the nervous and endocrine systems. Renal physiology, diagnostic techniques, and clinical case studies are explored. In plant physiology, topics include water absorption, respiration, mineral nutrition, secondary metabolites, and plant growth regulators. Students also learn about plant movements, responses to stresses, and applications such as crop improvement and plant breeding. The syllabus emphasizes the practical applications of physiological principles in both human and plant contexts.</td></tr>
<tr><td>Semester</td><td>3</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6"></td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the importance of studying human physiology in the context of maintaining homeostasis	U	1.10
2	Analyze the factors influencing efficient digestion and absorption, considering both physiological and dietary aspects	K	2,3,6
3	Evaluate the factors influencing blood volume, such as hormones and kidney function	E	2,5,10
4	Diagnostic and treatment plans based on a deep understanding of human physiology	C	1,9,10
5	Develop new ideas for utilizing plant-associated microbes in biological control for enhanced plant health	C	4,6,10
6	Evaluate the impact of various factors on blood volume regulation and circulatory system function	E	2,5,10

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COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Human Physiology	1.1	Introduction to human physiology: Organ systems of human.	3	1,2
	1.2	Nutrition: Digestion and Absorption.	4	1,2
	1.3	Blood – Components of blood (plasma, red blood cells, white blood cells, platelets) Blood volume and its regulation.	5	1,2,3
	1.4	Circulatory system- Systemic circulation, Pulmonary circulation	4	1,2
2 Respiratory and Renal Physiology.	2.1	Respiratory system – exchange of gases, Respiratory disorders.	4	1,2
	2.2	Nervous system-Structure, Neuron structure & types, signal transduction, types of synapses and endocrine system.	5	1,2
	2.3	Renal physiology- kidney structure and function, glomerular filtration, Urine formation.	4	1,2
	2.4	Applications of human physiology: for Diagnosis and Treatment	3	1,2,6
3 Plant physiology	3.1	Introduction to plant physiology, Absorption and transport of water. Respiration in plants. Mineral nutrition in plants-Macro and Micro nutrients.	8	1,2,4
	3.2	Secondary Metabolites. Plant growth regulators-Auxins, Cytokinin, Gibberellins, Ethylene, Abscisic acid	8	2,4,5
4 Plant movement and responses.	4.1	Plant movements- trophic, tactic and nastic movements. Responses to biotic and abiotic stresses. Photoperiodism, Vernalisation.	6	4,5,6
	4.2	Applications of plant physiology-crop improvement, plant breeding. Defence mechanism in plants - plant-associated microbes for biological control of plant pathogens.	6	3,4,5
5		Teacher Specific Content		

MGU-UGP (HONOURS)

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Tortora, G. J. Principles of Human Physiology (Edition number). Wiley.
2. Widmaier, E., Raff, H., & Strang, K. Vander's Human Physiology: The Mechanism of Body Function. McGraw Hill, New York.
3. Guyton, A. C., & Hall, J. E. Textbook of Medical Physiology. Elsevier Saunders, Pennsylvania.
4. Ganong, W. F. (Year). Review of Medical Physiology.
5. Sembulingam, K., & Sembulingam, P. Essentials of Medical Physiology. Jaypee Brothers Medical Publishers, New Delhi.
6. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). Plant Physiology (6th ed.). Sinauer Associates.
7. Salisbury, F. B., & Ross, C. W. (1992). Plant Physiology. Wadsworth Publishing.
8. Hopkins, W. G., & Hüner, N. P. A. (2008). Introduction to Plant Physiology (4th ed.). John Wiley & Sons.
9. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry & Molecular Biology of Plants (2nd ed.). Wiley-Blackwell.
10. Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups (4th ed.). Springer.

MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Nutritional Biotechnology**					
Type of Course	**MDC**					
Course Code	**MG3MDCBTG200**					
Course Level	**200**					
Semester	3	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Prerequisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Student will be able to understand the role of nutrients for a healthy life.	U	1,6,8
2	Student will able to apply biotechnology for improving the nutritional quality of plants and animal foods and managing food adulterants.	A	1,6,10
3	Student is able to assess the use of bioprocess for increasing the functionality and nutraceutical properties of foods.	E	1,9,10
4	Students are able to understand the immobilization and encapsulation process.	U	1,6
5	Students are able to understand the production and use of enzymes in food processing.	U	1,10
6	Student will able to develop skills in creating well balanced and nutritious meal plans.	C	1,6
7	Students are able to assess the reason for particular lifestyle diseases.	E	1,6
8	Student will able to comprehend reasons, management and treatment of lifestyle diseases.	E	6,9,10
****Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)***			

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Nutrition and Life style	1.1	**Overview of nutrition**: Definition, importance of nutrition, nutrients-function, sources, types-macronutrients and micronutrients, principles of balanced diet.	3	1,2,3,4
	1.2	**Overview of lifestyle diseases**: Modern lifestyle and health impacts, protein energy malnutrition, RDA, diabetes, obesity, hypertension, stroke, cancer	3	1,2,3,4
2 **Food engineering**	2.1	**Food fortification**: Enriching with protein, vitamins and minerals.	2	1,2,3,4
	2.2	Organic food and GM food.	3	1,2,3,4
	2.3	Detection of food additives and pesticides.	2	1,2
	2.4	**Preservation and storage of food-** Freezing, Refrigeration, Thermal processing, Salting, Drying and irradiation, Pasteurization.	2	3
3 Food Science, Dietetics And Nutrition	3.1	**Bioprocess**: Fermentation technology, microorganism in food fermentation, antimicrobial ingredients, nutrients and Nutraceuticals production. Immobilization -basics and applications in food processing. Microencapsulation-basics and applications in food processing.	6	3
	3.2	**Enzymes in food processing:** Application of enzymes-amylases and proteases, in food industry. Enzymes for hydrolysate and bioactive peptides, maltodextrins and corn syrup solids.	5	3
	3.3	Role of enzymes in cheese making and whey processing, fruit juices, baking.	3	5
	3.4	Detection of food pathogens by plating techniques.	2	7
	3.5	**Overview of nutrition:** Definition and importance of nutrition, Nutrients and their functions, Sources of nutrients	2	1
	3.6	**Macronutrients and Micronutrients:** Understanding Macronutrients (carbohydrates, proteins, fats), Importance of micronutrients (vitamins and minerals), Balanced nutrition and dietary guidelines.	2	1

	3.7	**Nutrition in infancy:** Breast feeding vs Formula feeding, Introduction to solid foods, Nutritional needs during growth.	2	1,6
	3.8	**Nutrition in adulthood and Later years:** Age-related changes in Nutritional requirements, Common Nutritional challenges in adulthood, Healthy eating patterns for older adults.	2	1,6
	3.9	**Recommended Dietary Allowance (RDA):** Definition and purpose of RDA, Factors influencing RDA, Interpreting and applying RDA in diet planning.	2	1,6
	3.10	**Planning a healthy diet:** Principles of balanced diet, Meal planning and portion control, Dietary guidelines for different age groups.	2	1,6
	3.11	**Protein energy malnutrition:** Types and causes of protein energy malnutrition, Effects on health and development, prevention and treatment strategies.	2	7,8
4		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT enables class lecturers, Seminars
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Class tests, Assignments, Viva Total marks : 75 CCA : 25
	B. End Semester examination – 1.5 hrs. Total marks : 50
Pattern of questions	Total marks: 50 marks (1.5 hrs.) One word answer question (1mark):10 out of 10 10x1= 10 marks Short answer questions (3marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks

REFERENCES

1. Rutledge, Food and nutritional Biotechnology, Navyug publishers and distributors,2009
2. Ravishankar Rai V, Advances in Food Biotechnology, Wiley-Blackwell,2015
3. Donald Bills and Shain -Dow Kung, Biotechnology and Nutrition, Proceedings of the Third international symposium, Butterworth - Heinemann, BotsoN
4. Ferguson, L.R. (2013). Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. Boca Raton, FL: CRC Press.

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5. Bagchi, D., & Lau, F.C. (Eds.). (2010). Biotechnology in Functional Foods and Nutraceuticals. Boca Raton, FL: CRC Press.
6. Mahgoub, S.E.O. (2016). Genetically Modified Foods: Basics, Applications, and Controversy. Boca Raton, FL: CRC Press.
7. Pathak, Y.V., & Kim, S.-K. (Eds.). (2019). Handbook of Nutraceuticals Volume I: Ingredients, Formulations, and Applications. Boca Raton, FL: CRC Press
8. Jacob-Lopes, E., Maroneze, M.M., & Zepka, L.Q. (Eds.). (2020). Microalgae Biotechnology for Food, Health and High Value Products. Cham, Switzerland: Springer.

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Environmental Biotechnology and Human Rights**
Type of Course	**VAC**
Course Code	**MG3VACBTG200**
Course Level	**200-299**
Course Summary	This interdisciplinary curriculum provides a comprehensive exploration of ecological, environmental, and human rights issues, fostering a holistic understanding of the interconnectedness between the natural world and societal well-being.

Semester	3	Credits		3		Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	*Need to complete 100 level courses*					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of this course in Industrial & Bioprocess Technology, participants should be able to:	Learning Domains *	PO No
1	Explain the concept, structure, components, and functions of ecosystem, energy resources, and environmental laws	K	1,2,4
2	Analyze the characteristics of wastewater and explore biodegradation processes.	An	1,2,3
3	Summarize wastewater treatment methods and solid waste management techniques	U	1,2,3
4	Gain insights into human rights, including their concept, history, and international dimensions.	U	1,2,3,6,10

5	Examine the role of the United Nations in promoting human rights and critically appraise its regime	An	1,2,3,6,10
6	Explore human rights from a national perspective, focusing on the Indian Constitution, fundamental rights, and specific issues related to women, children, minorities, and prisoners	An	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. **Ecology and Environmental Science**	1.1	Ecosystem: Concept, Structure, Components, and Function	2	1
	1.2	Biotic Components and Abiotic Components: Ecological Succession	3	1
	1.3	Food Chains, and Food Webs, Energy flow in the ecosystem, Biogeochemical cycles- Nitrogen and Carbon.	4	1
	1.4	Energy Resources: Renewable and Nonrenewable energy resources.	3	1
2. Environmental Analysis, Biodegradation, Wastewater and Solid Waste Management	2.1	Characteristics of Wastewater:	3	2
	2.2	Bacteriological Analysis of Drinking Water:	3	2
	2.3	Biodegradation of Organic Compounds:	5	2
	2.4	Wastewater Treatment.	3	3
	2.5	Biological Treatment of Wastewater:	3	3
	2.6	Solid Waste Management	3	3
	2.7	Environmental laws	3	3
3. Human Rights and International Framework	3.1	Introduction to Human Rights	4	4
	3.2	Human Rights Coordination within the UN System	3	5
	3.3	Human Rights in the Indian Constitution	3	6

4		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT enables class lecturers, Seminars
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Class tests, Assignments, Viva Total marks : 75 CCA : 25
	B. End Semester examination – 1.5 hrs. Total marks : 50
Pattern of questions	Total marks: 50 marks (1.5 hrs.) One word answer question (1mark):10 out of 10 10x1= 10 marks Short answer questions (3marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks

Reference

1. Wackett, L. P., & Hershberger, D. (1997) Biocatalysts and Biodegradation. ASM Press, Washington
2. Kumar, A. (2007). Environmental Chemistry. New Age International publishers., New Delhi
3. Atlas, R., & Bartha, R. 4th ed. (1997) (Pearson Education). Microbial Ecology: Fundamentals and Applications.
4. Moses, V., & Capes, R. E. (1991) Biotechnology: The Science and Business Harwood Academic (Medical, Reference and Social Sc,
5. Bottein, D. B., & Keller, E. A. (John Wiley Sons). Environmental Science: Earth as Living Planet.
6. Susan Barnum, S. R. 2 ed (2005). Biotechnology: An Introduction. Thomson Publishers.
7. Purohith, R., & Mathur, S. 4th ed (2010). Biotechnology: Fundamentals and Applications. Agrobotanical Publishers.
8. Sharma, R. A. (2016). Environmental Biotechnology. Pointer Publishers.
9. Dubey, R. C. 5 th ed (2014). Textbook of Biotechnology S Chand publishers.
10. Agarwal, S. K. (2015). Advanced Environmental Biotechnology, Ashish Publishing House.

Suggested Readings

1. Misra, S. P., Pande, S. N. (Ane Books Pvt. Ltd.). Essential Environmental Studies.
2. Sharma, P. D. Ecology and Environment.

SEMESTER-4

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Molecular Biology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="6">MG4DSCBTG200</td></tr>
<tr><td>Course Level</td><td colspan="6">200-299</td></tr>
<tr><td>Course Summary</td><td colspan="6">Molecular Biology covers essential concepts related to the study of biological molecules and their interactions within cells. Modules give basic ideas about the historical background, structure of nucleic acids and organization of genomes at various levels. It covers central dogma, reverse transcription, mutation and their repairing mechanisms and deals with regulation of gene expression and transposons and transposition.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 100-199 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe fundamental molecular aspects of biology.	U	1,2,10
2	Compare the organization of DNA in viral, prokaryotic, and eukaryotic genomes.	An	1,2,10
3	Illustrate the concepts of central dogma of molecular biology	U	1,2,3,10
4	Explain the cellular functions, regulation, errors occur during the cellular mechanisms and its repair.	U	1,2,3,10
5	Differentiate the role of enzymes involved in DNA replication, transcription and translation	An	1,2,3,10
6	Able to perform DNA isolation, electrophoresis of DNA and protein, estimation of DNA and RNA and restriction digestion.	A	2,3

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO. No:
1 Fundamentals of DNA, RNA and Gene	1.1	Milestones in Molecular Biology	1	1
	1.2	Experiments demonstrating DNA and RNA as the genetic material	3	1
	1.3	Structure and types of DNA and RNA	2	1
	1.4	Physico - chemical properties of DNA	2	1
	1.5	Organization of DNA in viral, prokaryotes and eukaryotic genome and C-value paradox	3	2
	1.6	Gene structure- Structure of prokaryotic and eukaryotic genes	1	2
2 DNA Replication and Repair	2.1	Central dogma of Molecular Biology	1	3,4,5
	2.2	DNA replication – Different types. Conservative, Semiconservative, Dispersive, Theta, D-loop and Rolling circle model. Meselson and Stahl experiment	3	3,4,5
	2.3	Steps involved in DNA replication. - Initiation, Elongation and Termination.	5	3,4,5
	2.4	Structure and function of enzymes involved in DNA replication	1	3,4,5
	2.5	DNA repair mechanisms- Photo reactivation, NER, BER, SOS.	3	3,4
3 Transcription and Regulation of gene Expression	3.1	Transcription of mRNA in prokaryotes and eukaryotes, reverse transcription, post transcriptional modifications	5	1,3,4,5
	3.2	Genetic code and its properties	1	1,3,4,5
	3.3	Translation - Translation of prokaryotic and eukaryotic mRNA, post translational modifications	4	1,3,4,5
	3.4	Gene regulation in prokaryotes- Operon concept, components of operon	1	1,3,4
	3.5	Positive and negative regulation, Molecular details of Lac and Trp operon	5	1,3,4
	3.6	Transposable elements in prokaryotes and eukaryotes- Types and mechanism of transposition	4	1,3,4
4 Practicals	4.1	DNA Isolation and Agarose gel electrophoresis from *E. coli* Cells and plant cells	6	6
	4.2	Isolation of plasmid DNA from *E.coli* cells	4	6
	4.3	DNA estimation	3	6
	4.4	SDS PAGE	5	6
	4.5	Protein Gel Electrophoresis	4	6
	4.6	Restriction digestion	4	6

	4.7	RNA estimation	4	6
Module 5	Teacher specific Content			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical- 35 marks **5 hrs.**	Major expt./ procedure/ case study analysis – 15 Minor expts./ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Russell, P. J. (2021). Essential genetics. Blackwell Scientific Publications.
2. Simmons, M. J., & Snustad, D. P. (2006). Principles of genetics. John Wiley & Sons. Watson, J. D. (2021). Molecular biology of the gene. Pearson Education India.
3. Karp, G. (2022). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
4. Lodish, H. F. (2022). Molecular cell biology. Macmillan.
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6. Brown, T. A. (2023). Genomes V
7. Chaitanya, K. V. (2013). Cell and Molecular Biology: a lab Manual. India: PHI Learning.
8. Sambrook, J., Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. United States: Cold Spring Harbor laboratory Press.

Suggested Readings

1. Alberts, B. (2017). *Molecular biology of the cell*. Garland science.
2. Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). Lehninger Principles of Biochemistry. Macmillan.

	Mahatma Gandhi University Kottayam

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Immunology**					
Type of Course	**DSC A**					
Course Code	**MG4DSCBTG201**					
Course Level	**200-299**					
Course Summary	Immunology delves into the history and mechanisms of the immune system, covering innate and acquired immunity, B and T cell processes, antigen-antibody reactions, and immune response types. It explores practical applications, including blood grouping, immunological techniques, and complement pathways. Immunological disorders like hypersensitivity and autoimmune diseases are discussed. The course concludes with applications in immunization, vaccine types, and antibody engineering, showcasing the practical implications of immunological insights.					
Semester	4	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre- requisites, if any	Need to complete difficulty level 100-199 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Students will be able to identify and describe the major cells and organs involved in the immune system	R	1,3,4,10
2	Students will be able to communicate effectively about advanced immunological techniques and antigen-antibody reactions, both in written reports and oral presentations	U	1,4,10
3	Identify the cells and organs of Immune System	U	1,2,3
4	Students will express effectively about advanced immunological techniques and antigen-antibody reactions	E	1,2,3,10

5	Students will describe the Type I to Type IV hypersensitivity reactions	An	1,10
6	Students will evaluate therapeutic interventions.	E	1,2,10
7	They will evaluate the immune-techniques in therapeutic applications.	Ap	2, 10
8	Students will learn the steps involved in generating and characterizing hybridomas for the production of monoclonal antibodies	U	1, 2, 8, 10
9	Students will gain practical exposure to blood cell counting, blood grouping and typing and agglutination and antigen-antibody reactions.	U	1,2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to immunology	1.1	History and scope of immunology. Types of immunity – Innate and acquired immunity	3	1,2
	1.2	Cells and organs of the immune system. B Cell and T Cell maturation, activation and differentiation.	6	1,4
	1.3	Antigen – Haptens and adjuvants. Antibody – General features, Classification of immunoglobulin.	4	1,2,4
	1.4	Immune response – Humeral and cell mediated immunity. MHC – Classes and function	4	1,3
2 Antigen antibody interactions	2.1	Features of antigen antibody reactions – affinity, avidity, cross reactivity.	3	1,3
	2.2	Agglutination reaction – Blood grouping, Coombs test, WIDAL, precipitation reactions – ODD, RID	4	1,6,8
	2.3	Immunological techniques – EIA, FIA, RIA, Immuno-electrophoresis, Western blotting. Complement proteins – pathways and complement fixation test.	5	6,8
3 Immunological Disorders and Applications of Immunology	3.1	Hypersensitivity, Tumor immunology, Transplantation immunology, immunohematology.	7	1,2,4,7,8
	3.2	Autoimmunity and autoimmune diseases. Immunodeficiency diseases.	4	1,5,8
	3.3	Immunization – passive and active. Vaccines – types and applications, Polyclonal and monoclonal antibody production – Hybridoma technology. Antibody engineering	5	3,4,6,7,8

4 Practicals	4.1	Total count and Differential count of Blood cells	6	9
	4.2	Agglutination reactions- Blood grouping, Blood typing.	5	9
	4.3	WIDAL Test- qualitative	8	9
	4.4.	RPR	6	9
	4.5	Antigen Antibody reactions- Precipitation reaction- ODD	5	9
5		Teacher specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical- 35 marks 5 hrs.	Major expt./ procedure/ case study analysis – 15 Minor expts./ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Kindt, T. J., Goldsby, R. A., & Osborne, B. A. (2007). Kuby Immunology (6th ed.). W.H. Freeman and Company
2. Illustrated Immunology. (2022). India: New India Publishing.
3. Kumar, A. (2013). Textbook of Immunology. India: Energy and Resources Institute.
4. Anil Sharma (Edited) (2019). Immunology: An Introductory Textbook. Singapore: Pan Stanford Publishing.
5. Coico, R., Sunshine, G., Benjamini, E. (2003). Immunology: A Short Course. United Kingdom: Wiley.
6. Murphy, K., Travers, P., & Walport, M. (2012). Janeway's Immunobiology (8th ed.). Garland Science.
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9. Nigam, A. (2007). Lab Manual in Biochemistry, Immunology and Biotechnology. India: McGraw-Hill Education (India) Pvt Limited.
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MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**B Sc (Honours) Biotechnology**
Course Name	**Biosafety and Bioethics**
Type of Course	**DSE**
Course Code	**MG4DSEBTG200**
Course Level	**200**
Course Summary	This course aims to provide students with a comprehensive understanding of the ethical considerations and safety measures involved in biological research, ensuring a well-rounded perspective on the responsible conduct of scientific work.

<table>
<tr><td rowspan="2">Semester</td><td rowspan="2">4</td><td colspan="4">Credits</td><td rowspan="3">Total Hours</td></tr>
<tr></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 100-199 courses</td></tr>
</table>

Syllabus

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Define Biosafety and its importance	U	1,6
2	Demonstrate good lab procedures and practices	U	1
3	Classify different Biosafety levels and justify design of containment facilities at different Biosafety levels	A, Ap	1,10
4	Assess the hazards related to Biosafety	E	1,2,6
5	Estimate Bioethical principles of animal testing	E	1

6	Justify ethical principles in animal testing	E	1,6
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 Biosafety Introduction and levels of containment	1.1	Introduction to Biosafety	2	1
	1.2	Procedures and good laboratory practices	3	2
	1.3	Standard operating procedures for research involving microbes and recombinant DNA	3	2
	1.4	Design of containment facilities, laboratories	3	4
	1.5	Levels of Biosafety containment	4	3
	1.6	National and international biosafety regulations and its importance	3	1
2 Risk Assessment and Management	2.1	Risk assessment and management	4	4
	2.2	Hazard identification and evaluation	4	4
	2.3	Personal Protective Equipment	2	3
	2.4	Biosafety cabinet	1	3
	2.5	Guidelines in biological research, Emergency response plans related to Biosafety	6	1
3 Introduction to Bioethics	3.1	Definition of Bioethics	2	5
	3.2	History of origin, scientific and legislative principles of Bioethics	4	5
	3.3	Institutional review boards and ethic committees	4	6
4 Legal aspects of Bioethics	4.1	Ethical, legal norms and requirements for conducting clinical and preclinical studies	5	5
	4.2	The rights of participants in clinical trials	5	5

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	4.3	Ethical and legal aspects of working with experimental animals and plants	4	5
5 **Teacher Specific content**	Teacher Specific content			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	D. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Singh, B. D. (2010). Biotechnology.
2. Dubey, R. C. (1993). A Textbook of Biotechnology. S. Chand Publishing.
3. Have, H. T., & Gordijn, B. (2014). Handbook of Global Bioethics. In Springer eBooks. https://doi.org/10.1007/978-94-007-2512-6
4. Lewis, M. A., Tamparo, C. D., & Tatro, B. M. (2007). Medical Law, Ethics, & Bioethics for the health professions. http://ci.nii.ac.jp/ncid/BB16082402
5. Sateesh, M. (2008). Bioethics and biosafety. https://www.amazon.com/Bioethics-Biosafety-M-K-Sateesh-ebook/dp/B01J7VZ9BM

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Biostatistics**					
Type of Course	**DSE**					
Course Code	**MG4DSEBTG201**					
Course Level	**200-299**					
Course Summary	This course provides the knowledge and skills necessary to navigate the world of biostatistics. This aspire students to conduct research, work in healthcare, or pursue further studies; the practical insights gained from this course will serve as a solid foundation for the future endeavours.					
Semester	4	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete 100 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of this course in Advanced Statistics and Data Analysis participants should be able to:	Learning Domains	PO No
1	Explain the significance, application, and limitations of statistics in life science .	U,A	2, 6
2	Apply various methods of sampling and demonstrate the application of methods for collecting and organizing primary and secondary data.	U,A	2,3
3	Apply methods of tabular, graphical, and diagrammatic data presentation and apply techniques for presenting and analyzing data.	U,A	2, 3, 10
4	Understand computer-oriented statistical techniques, and apply this for research analysis	U,A,C,S	2, 3, 10
5	Apply classification methods and data presentation techniques to real-world scenarios and utilize statistical packages for practical data analysis and interpretation.	C,A,S	2, 7, 6, 8

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Biostatistics	1.1	Introduction, definition, significance, application and limitation of statistics in life science. Statistical population and sample.	5	1
	1.2	Characteristics of sample, Methods of Sampling, Qualitative and quantitative data. Primary and Secondary data.	5	1
2 Collection and Classification of Data	2.1	Different methods of Tabular, Graphical and Diagrammatic presentation of data. Data collection methods	5	2,5
	2.2	Methods of classification of data: Geographical, Chronological, Qualitative, And Quantitative.	8	2
	3.2	Measures of Central tendency, Measures of dispersion, Correlation, Regression,	4	3
3 Presentation and Analysis of data	3.1	Different methods of Tabular, Graphical and Diagrammatic presentation of data.	7	2
	3.2	Probability theorems and distributions (Binomial, Poisson and Normal).	4	3
	3.3	Hypothesis testing, t-test, Chi square test, Basic principles of ANOVA technique.	7	3
4 Computer oriented Statistical methods	4.1	Introduction to Computer oriented statistical techniques.	4	4,5
	4.2	Introduction to MS excel software, Spread sheet and software. Statistical packages-Excel, SPSS.	5	4,5
	4.3	Frequency table of single discrete variable, Bubble sort, Computation of mean variance and Standard deviation.	6	4
5		Teacher Specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Kothari, C. R. (2004). Research Methodology: Methods and Techniques. New Age International
2. Fundamentals of Biostatistics. Veer Bala Rastogi. (2008) Ane books .
3. Arora, P. N., Malhan, P. K. (2010). Biostatistics. India: Himalaya Publishing House.
4. Levin, R. I., & Rubin, D. S. (2012). Statistics for Management. Pearson Education.
5. Introduction to Biostatistics – Sokal & Rohif(1973) Toppan Co Japan
6. Daniel, W. W., & Cross, C. L. (2018). Biostatistics: A Foundation for Analysis in the Health Sciences. John Wiley & Sons.
7. Newbold, P., Carlson, W. L., & Thorne, B. (2012). Statistics for Business and Economics. Prentice Hall
8. Daniel, W. W. (2010). Biostatistics: Basic Concepts and Methodology for the Health Sciences. John Wiley & Sons.
9. Norman,T.J. Bailey (2007) Statistical methods in biology, 3rd edition.qqqq Cambridge university press
10. Rajaraman, V. (1969). Principles of Computer Programming. India: Prentice-Hall of India Private.

Mahatma Gandhi University

Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Tissue Culture Techniques</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC C</td></tr>
<tr><td>Course Code</td><td colspan="6">MG4DSCBTG202</td></tr>
<tr><td>Course Level</td><td colspan="6">200</td></tr>
<tr><td>Course Summary</td><td colspan="6">This comprehensive course explores the fundamental principles and applications of plant and animal cell culture, delving into the historical development, essential techniques, and diverse applications of these powerful technologies. Students will gain a thorough understanding of the cultivation and manipulation of plant and animal cells in vitro, from the preparation of culture media and sterilization procedures to the manipulation of growth hormones and the exploration of totipotency and cytodifferentiation. The course also examines the ethical and societal implications of these technologies and their potential impact on various fields, including agriculture, medicine, and Biotechnology.</td></tr>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 100-199 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome** Upon completion of this course in Tissue culture techniques students should be able to:	**Learning Domains**	**PO No**

1	Recognize the historical evolution of plant biotechnology and its key contributors	K	1,6
2	Demonstrate advanced proficiency in setting up and maintaining a plant tissue culture laboratory, showcasing comprehensive knowledge of its historical context and practical applications.	A	2,3,6
3	Apply precise techniques for media preparation, sterilization, and propagation of plants through totipotency stages, showcasing a comprehensive skill set in plant tissue culture methodologies.	A	2,3,10
4	Evaluate the advantages and applications of various plant tissue cultures, including organogenesis, somatic embryogenesis, somaclonal variation, and hybridization techniques.	E	2,3
5	Trace the historical development and milestones in animal cell culture	U	2,6
6	Demonstrate knowledge of basic requirements for successful animal cell culture, including laboratory setup and equipment.	U	2,3,6
7	Analyse the composition of culture media, including natural and synthetic media.	A	2,10
8	Differentiate between primary and secondary cell cultures, and maintain established/continuous cell lines	An	2,3,8
9.	Apply animal cell culture in the production of monoclonal antibodies, vaccines, specific metabolites, and transgenic animals	A	2,6,9
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

MGU-UGP (HONOURS)
Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Plant Biotechnology Basics	1.1	Historical development and Basic requirements. Overview of the historical development of plant biotechnology Evolution from selective breeding to modern genetic engineering , Key milestones and breakthroughs	2	1, 2
	1.2	Basic requirements and lab setup in plant tissue culture Importance of sterile conditions, Essential equipment and tools, Lab layout and safety considerations	3	3

	1.3	Media preparation, sterilization techniques, and role of growth hormones, Formation of plant tissue culture media, Various sterilization techniques, Role of growth hormones in regulating plant cell growth and development	5	3
	1.4	Totipotency and cytodifferenciation, Understanding the concepts of totipotency and cyto differenciation in plant cells Practical implications in tissue culture	3	4
2 Plant Tissue Culture Techniques and Applications	2.1	Callus culture, Suspension culture, and single cell techniques, Procedure and applications of callus culture, Principles and uses of suspension culture, Isolation and utilization of single cells in plant tissue culture	4	4
	2.2	Soma clonal variation, Exploring somaclonal variation, organogenesis, embryogenesis.	3	4
	2.3	Meristem culture, Techniques and applications of organogenesis Importance of meristem culture in disease - free plant propagation	3	4
	2.4	Haploid production and applications, Haploid production of ovary, ovule, anther, and pollen culture, Techniques for inducing haploid production in various plant organs.	3	5,6
	2.5	Applications in plant breeding and genetic studies, Applications of plant cell culture, Production of specific metabolites for pharmaceutical purposes.	3	5,6
3 Animal Cell Culture	3.1	History and basic requirements of animal cell culture, Evolution of animal cell culture, Laboratory requirements and aseptic techniques	4	6,7
	3.2	Cell culture media, types, preparation, and sterilization. Formulation of media for animal cell culture. Types and significance of different media. Sterilization methods in animal cell culture	3	6,7
	3.3	Primary and secondary cell culture, anchorage dependence Techniques and applications of primary cell culture, Understanding anchorage dependence in cell culture, Transformed and continuous cell lines, commonly used animal cell lines, their origin, and applications	5	8,9
	3.4	Applications of animal cell culture Role of animal cell culture in stem cell research, Production of monoclonal antibodies, vaccines, and specific metabolites	4	8,9

MGU UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	D. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

4 Practical	4.1	Sterilization Techniques	5	1,2,3
	4.2	Plant tissue culture Media preparation	5	1,2,3
	4.3	Callus culture	5	1,2,3
	4.4	Meristem culture	5	1,2,3
	4.5	Anther culture	5	1,2,3
	4.6	Organogenesis	5	1,2,3
5. Module		Teacher Specific Content		

References

1. Bhojwani, S. S., & Razdan, M. K. (1996). Plant tissue culture: Theory and practice. Elsevier.
2. Misra, S. P. (2009). Plant tissue culture. Ane Books India.
3. Singh, B. D. (2009). Plant breeding. Kalyani Publishers
4. Narayanaswamy, S. (1994). Plant cell and tissue culture. Tata McGraw-Hill Publishing Company
5. Ignacimuthu. (2005). Plant biotechnology. Oxford & Ibh Publishing Company Pvt Limited.
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8. Raja, Florence Periera. (2006). Animal Biotechnology. New Delhi: Dominant Publishers.
9. Open University, Netherlands. (1994). In Vitro Cultivation of Animal Cells. New Delhi: Butterworth-Heinemann.
10. Vlak, J. M., de Gooijer, C. D., Tramper, J., & Miltenburger, H. G. (Eds.). (2002). Insect Cell Cultures: Fundamental and Applied Aspects. New York: Kluwer Academic Publishers
11. Masters, J. R. W. (2007). Animal Cell Culture (3rd ed.): A Practical Approach. Oxford University Press.
12. Satyanarayana, U. (2023). Biotechnology (15th ed.). Books & Allied (Publishers) Ltd.

Suggested Readings

E. Hammond, J., et al. (2012). Plant biotechnology. Springer Science & Business Media.

F. Henry, R. J. (1997). Practical application of plant molecular biology. Chapman & Hall

G. Smith, J. A. (2018). Animal Biotechnology: Models in Discovery and Translation. CRC Press.

H. Mohan, R. (2016). Introduction to Animal Biotechnology. CRC Press.

I. Mamidi, N.V.S & Ulaganathan, V. K. (Eds.). (2019). Animal Biotechnology: Emerging Trends in the 21st Century. Springer.

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Quality control in Biology**
Type of Course	**SEC**
Course Code	**MG4SECBTG200**
Course Level	**200-299**
Course Summary	This course focuses on imparting a thorough understanding of quality control principles within the biological sciences, emphasizing their application in biotechnology. The course is structured into five modules, each covering distinct aspects of quality control measures and their significance in ensuring the reliability and integrity of biological processes and products

Semester	4	Credits		3		Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Need to complete 100 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PO No
1	Understand the principle and Significance of quality control in biology.	U	1,6
2	Demonstrate Knowledge of Quality Control Measures, in molecular biology techniques.	U	1
3	Apply Quality Control Techniques in Biotechnological Processes, Implementing quality control protocol.	A	1,10
4	Comprehensive understanding of regulatory agencies (such as FDA, USDA, WHO) and Hazard Analysis and Critical Control Points (HACCP) in food processing, as well as knowledge of food safety standards and certifications (ISO 22000, FSSC 22000).	U	1,2,6
5	Evaluate GMP for biopharmaceuticals.HACCP and other standards.	E	1

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs.	CO No.
1 Introduction to Quality Control in Biotechnology	1.1	Definition and scope of quality control,Basic Principles of quality control	4	1
	1.2	Importance in ensuring research reliability. Difference between Quality Control & Quality Assurance.	3	2
	1.3	Quality Control a multidisciplinary approach.	2	2
	1.4	Documentation and record-keeping requirements.	2	2
2 Various areas in Quality Control	2.1	Role of Microbiology and Molecular Biological techniques in Quality Control.PCR, Electrophoresis, Culture Based Methods, ATP Bioluminescence.	5	4
	2.2	Sterilization methods and their validation.	2	4
	2.3	Molecular Biology tools in QC,Immunological tools in QC,Contamination control in cell culture, Quality control protocols in cell culture processes	4	3
	2.4	Importance of documentation in quality control. Preparation for regulatory audits.Statistics in quality control, Control charts for data analysis	5	3
	2.5	Analytical and Software tools in Quality Control	2	3
3 Introduction to Regulatory framework in Food industry and Medicine	3.1	Historical perspective and evolution of regulations in food and bioprocessing. Overview of regulatory agencies Codex Standards.(FDA,USDA,WHO,etc.).Food Saftey Modernisation Act (FMSA).	5	5
	3.2	Regulatory frameworks in biotechnology. Regulatory Requirements in Food Processing: Good Manufacturing Practices (GMP) in food industry.	3	5
	3.3	Hazard Analysis and Critical Control Points (HACCP). Food safety standards and certifications (ISO 22000, FSSC 22000).	3	5
	3.4	Current Good Manufacturing Practice (Cgmp) for biopharmaceuticals. Good Laboratory Practice (GLP) International Council for Harmonization (ICH) Guidelines	5	3
4		Teacher Specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT enables class lecturers, Seminars
Assessment types	**MODE OF ASSESSMENT** 1. **Continuous Comprehensive Assessment (CCA)** MCQ, Class tests, Assignments, Viva Total marks : 75 CCA : 25 2. **End Semester examination – 1.5 hrs.** Total marks : 50
Pattern of questions	Total marks: 50 marks (1.5 hrs.) One word answer question (1mark):10 out of 10 10x1= 10 marks Short answer questions (3marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks

References

1. Van Lenteren, J. C. (Ed.). (2003). Quality control and production of biological control agents: Theory and testing procedure.

2. Oates, J. E. (n.d.). Quality control in the biological sciences.

3. Satyanarayana, U. (2005). Textbook of biotechnology.

4. Weinberg, S. (1995). Good laboratory practice regulations (2nd ed.). Marcel Dekker Series.

5. Singh, B. D. (2014). Biotechnology (4th ed.). ISBN-13: 978-9327222982 ISBN-10: 9327222989.

6. Vasconcellos, J. A. (2004). Quality assurance for the food industry. CRC Press.

7. Geigert, J. (2002). Quality assurance and quality control for biopharmaceutical products: Development and manufacture of protein pharmaceuticals (Vol. 14). ISBN: 978-1-4613-5127-6

8. Jack O'Grady, Austin Community College,Copyright Year: 2019, Quality Assurance & Regulatory Affairs for the Biosciences,Publisher: Austin Community College

9. Ralph Early,Guide to Quality Management Systems for the Food Industry By Springer Science Business Media.

Suggested reading

3. Bioprocess Engineering Principles (1995) by Pauline M. Doran

4. Introduction to Statistical Quality Control" by Douglas C. Montgomery. WELEY Publications.

5. Relevant research articles and case studies from reputable journals and regulatory agencies.

MGU UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

Programme	
Course Name	**Human Resource Management in Biotechnology**
Type of Course	**VAC**
Course Code	**MG4VACBTG200**
Course Level	**200-299**
Course Summary	This course is designed to equip students with the essential leadership and teamwork skills necessary for success in scientific research and collaborative projects.

Semester	4	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Need to complete difficulty level 100-199 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the characteristics and roles of leadership, management and team-building in research institutions	U	1,5,7,8
2	Apply leadership theories or approaches to professional scenarios and case studies	A	5,6,7,8
3	Comprehend clear oral and written communication that engages the audience, team and consumers	U	2,4,6
4	Apply effective team building skills by outlining the different groups	A	3,4,6,7
5	Employ the qualities of a mentor to work in good team	A	4,5,6,7
6	Choose a team which manages the work more efficiently	E	1,4, 5, 9
****Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)***			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Leadership and communication skills	1.1	Overview of Leadership in Scientific Settings: Understanding the unique challenges and opportunities for leadership in scientific research, Introduction to various leadership styles and their applicability in scientific contexts	4	1
	1.2	Case study 1: Examples of successful leaders in science, Leading researcher in Biotechnology, Case study 2: Self-assessment of leadership style	4	1
	1.3	Importance of teamwork in scientific research.: Building and managing effective research teams,	4	2
	1.4	Communication skills for scientists. Clear scientific writing and presentation techniques.	3	3
2 Team Dynamics and mentorship	2.1	Conflict, Resolution and Decision Making- Identifying and addressing conflicts in research teams. Strategies for fostering a positive and collaborative team culture,	4	3
	2.2	Techniques for effective decision-making in scientific projects, Balancing individual and team perspectives	3	4
	2.3	Importance of mentorship in scientific careers and teams, Developing mentoring skills for both mentors and mentees	3	5
	2.4	Career Development in Science: Navigating career paths in academia, industry, and beyond. Networking and professional development in the scientific community	5	5
3 Team Management in Science Projects	3.1	Ethical Leadership in Science: Ethical considerations in scientific research, Responsible conduct of research and leadership	3	1
	3.2	Project Planning and Execution: Developing project plans and timelines.	3	6
	3.3	Monitoring progress and adapting to changes in scientific projects.	3	6
	3.4	Resource Management: Managing laboratory resources efficiently	3	6
	3.5	Budgeting and grant management in scientific research	3	6
4	Teacher specific content			

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
ICT enables class lecturers, Seminars</td></tr>
<tr><td rowspan="2">Assessment types</td><td>MODE OF ASSESSMENT
6. Continuous Comprehensive Assessment (CCA)
MCQ, Class tests, Assignments, Viva
Total marks : 75
CCA : 25</td></tr>
<tr><td>7. End Semester examination – 1.5 hrs.
Total marks : 50</td></tr>
<tr><td>Pattern of questions</td><td>Total marks: 50 marks (1.5 hrs.)
One word answer question (1mark):10 out of 10 10x1= 10 marks
Short answer questions (3marks) :4 out of 6 4x3= 12 marks
Short essay (6 marks) :3 out of 5 3x6= 18 marks
Essay (10 marks) :1 out of 2 1x10= 10 marks</td></tr>
</table>

References:

1. Chopra, R. (2021). Leading Science Teams: The Basics of Collaboration and Team Leadership in Research. New Delhi: Academic Press.

2. Joshi, M. (2019). Teamwork and Innovation in Scientific Research. Mumbai: Springer.

3. Rai, S. K. (2022). Leadership in Scientific Inquiry: Strategies for Success. Chennai: Oxford University Press.

4. Sengupta, S. (2021). Effective Team Management in Research Organizations. Kolkata: Sage Publications.

Suggested Readings:

8. Pavitt, C. & Curtis, E. (2001). Small group discussion: A theoretical approach (3rd ed.). Retrieved from

http://www.uky.edu/~drlane/teams/77avitt

2. Poole, M.S., & Hollingshead, A.B. (2004). Theories of small groups: Interdisciplinary perspectives. Thousand Oaks, CA: Sage**.**

3. Hackman, J. R., & Johnson, C. E. (2013). Leading Teams: Setting the Stage for Great Performances (2nd ed.). Harvard Business Review Press.

4. Katzenbach, J. R., & Smith, D. K. (2015). The Wisdom of Teams: Creating the High-Performance Organization (2nd ed.). Harvard Business Review Press

5. Gardner, H. (2008). Five Minds for the Future. Harvard Business Review Press.

SEMESTER-5

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University

Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Recombinant DNA Technology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="6">MG5DSCBTG300</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course delves into the principles, methodologies, and applications of recombinant DNA technology. Students will get a thorough understanding of the tools used to manipulate DNA, gene cloning processes, and the various applications of genetic engineering.</td></tr>
<tr><td>Semester</td><td>5</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the common tools used in genetic engineering, such as restriction enzymes and vectors.	U	1, 2,3
2	Read the role of cloning vectors to introduce recombinant DNA into host cells	K	1, 2,4
3	Evaluate the advantages and disadvantages of various expression systems	E	1, 2,3
4	Design and plan a gene cloning experiment, considering variables and controls	C	1, 2,9
5	Propose innovative applications of genetic engineering in emerging fields	C	1, 2,9
6	Able to perform isolation of DNA and plasmid, restriction digestion, transformation and PCR.	A	1,2,3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction and Tools in Rdna technology	1.1	Introduction. History. Enzymes for in vitro modification of nucleic acids– Kinases, Phosphatases, Exonucleases, Endonucleases, Restriction Endonucleases, Ligases and Terminal Transferases.	2	1
	1.2	Modification of Ends – Adapters, Linkers, Homopolymer Tailing.	1	1
	1.3	Cloning Vectors – Plasmids and their desirable properties, E coli based vectors – Pbr, Psc, Puc, Pgem3Z. M13 based vectors. Bacteriophages λ EMBL Cosmids, Phasmid. Phagemids with special reference to pBluescript, Plitmus.	3	2
	1.4	In vitro packaging, phage display. Gateway Cloning, TA cloning. Shuttle Vectors -Pcambia, Vectors for Yeast (YEP, YIP, YRP, YCP, YAC) Artificial Chromosomes- BAC, MAC, PAC	4	2
	1.5	Viral and virus derived vectors for animal cells- SV40, Adenovirus vectors, Baculovirus. Plant vectors – geminivirus, Ti plasmid	3	2
2 Gene Transfer Techniques, Screening and Advanced technology in Rdna (17 Hours)	2.1	Gene Transfer Methods: CaCl2 mediated, Microinjection, Electroporation, Lipofection, Particle Bombardment, Gene Gun, Agrobacterium mediated	5	2
	2.2	Genetic markers in plants – Kanamycin, neomycin, Hygromycin B, Bromoxynil, Methotrexate, chloramphenicol. Genetic markers in animals-Neomycin/Geneticin Resistance, Hygromycin, Puromycin Resistance, GFP. Screening methods: Blue white assay, Insertional inactivation, colony hybridization.	3	3
	2.3	Expression vectors- Elements for expression- Protein tags, Promoters- Introduction and elements for expression.	4	3
	2.4	Fusion tagged expression system, affinity tag. Protein selection methods – hybrid arrest and hybrid release translations, immunochemical methods. Nuclear transfer technology,	2	3
	2.5	Inducible expression system and control of transgene expression through naturally inducible promoters – lac and tet. Steroid hormones as heterologous Inducers.	3	3
3 Bio	3.1	PCR types and applications. DNA foot printing, fingerprinting, gel shift analysis, DNA microarray,	3	4
	3.2	Advanced molecular markers: RFLP, RAPD, AFLP, STS, SNP, SSR, EST. chromosome walking, jumping.	4	4

instrumentation and application in Rdna	3.3	Next generation sequencing (NGS) – Illumina sequencing ABI/SOLID, Ion Torrent (Thermo Fisher), 454 Sequencing (Roche) Site directed Mutagenesis.	4	4
	3.4	Applications of recombinant DNA technology- Production and purification of recombinant proteins- insulin and somatostatin. Gene therapy. Metabolite engineering. Imparting new agronomic traits to plants to improve quality and quantity.	4	5
4 **Practicals**	4.1	Isolation of Genomic DNA	5	2
	4.2	Isolation of plasmid DNA	5	2
	4.3	Restriction digestion of DNA	5	2
	4.4	Bacterial Transformation	5	2
	4.5	Polymerase Chain Reaction	5	2
	4.6	RAPD/RFLP/SNP	5	2
5		**Teacher Specific content**		

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Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

MGU-UGP (HONOURS) Syllabus

Reference:

1. Brown, T. A. (2007). *Genomes 3*. Garland Science.
2. Brown, T. A. (2016). *Gene cloning and DNA analysis: An Introduction*. John Wiley & Sons.
3. Karp, G., Iwasa, J., & Marshall, W. (2018). *Karp's Cell Biology*. John Wiley & Sons.
4. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2017). *Lewin's GENES XII*. Jones & Bartlett Learning.
5. Primrose, S. B., & Twyman, R. (2013). *Principles of gene Manipulation and Genomics*. John Wiley & Sons.
6. Purohit, S. S., & Mathur, S. (2002). *Biotechnology: Fundamentals and Applications*.

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MAHATMA GANDHI UNIVERSITY · KOTTAYAM ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University

Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Enzyme Technology**
Type of Course	**DSC A**
Course Code	**MG5DSCBTG301**
Course Level	**300-399**
Course Summary	The curriculum provides a comprehensive exploration of enzymology. It begins with an introduction covering the basics of enzymes, their structure, function, nomenclature, and classification. The study of enzyme kinetics, including Michaelis-Menten kinetics and factors influencing enzyme activity, is included. The next segment delves into enzyme regulation, considering allosteric regulation and covalent modification. The following part focuses on enzyme immobilization and engineering, detailing principles, techniques, applications, and methods for enhancing enzyme properties. The final provides the practical experience in determining enzyme activity, factors affecting enzyme activity and enzyme immobilization.. The curriculum aims to provide students with a comprehensive understanding of enzymology and its diverse applications.

Semester	5	Credits			4	Total hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Need to complete difficulty level 200-299 level courses					

MGU-UGP (HONOURS) Syllabus

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of this course in Industrial & Bioprocess Technology, participants should be able to:	Learning Domains *	PO No
1	Explain biological importance of enzymes	U	1,2,3
2	Describe enzyme structure and its correlation with function.	U	1,2,3
3	Classify enzymes using the EC numbering system	U	1,2,3
4	Describe enzyme kinetics, including Michaelis- Menten dynamics and influencing factors.	U	1,2,3
5	Explain enzyme regulation, including allosteric control and feedback inhibition.	U	1,2,3
6	Discuss the applications of enzymes in diverse fields and discuss future trends in enzymology.	U	1,2,3
7	Evaluate the role of enzymes in various fields, such as biotechnology, medicine, and environmental science.	E	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 Introduction to Enzymology	1.1	Basics of Enzymes: Definition and characteristics of enzymes. Importance of enzymes in living organisms	2	1
	1.2	Enzyme Structure and Function: Molecular structure of enzymes. The relationship between structure and function. Active site and substrate specificity..	3	2
	1.3	Enzyme Nomenclature and Classification: Enzyme Commission (EC) numbering system. Classification based on catalytic activity. Examples of enzyme names and classifications.	4	3
	1.4	Cofactors and Coenzymes: Types of cofactors (metal ions) and coenzymes (vitamins)..	5	5
	1.5	Role of cofactors: Role of cofactors in enzyme catalysis. Overview of prosthetic groups.	3	5
2 Enzyme Kinetics, Regulation and Enzyme engineering	2.1	Enzyme Kinetics: Understanding enzyme kinetics. Michaelis-Menten kinetics and its parameters. Factors influencing enzyme activity. Enzyme inhibition and types	6	4
	2.2	Regulation of Enzyme Activity: Allosteric regulation. Covalent modification and feedback inhibition. Regulation in metabolic pathways	5	5
	2.3	Enzyme Immobilization and Applications: Principles and techniques of enzyme immobilization. Applications of Immobilized enzymes	3	6
	2.4	Enzyme Engineering: Introduction to enzyme engineering. Methods for enhancing enzyme activity and stability. Applications of engineered enzymes	5	6
3 Enzyme Applications and Future Perspectives	3.1	Application of enzymes: Clinical, Environmental and industrial.	3	7
	3.2	Future Perspectives in Enzymology: Emerging trends and advancements in enzyme technology	3	6
	3.3	Synthetic enzymes and Abzymes	3	6
4 Practical	4.1	Determination of enzyme activity- amylase assay	5	4
	4.2	Factors affecting Enzyme activity Effect of pH on enzyme activity Effect of temperature on enzyme activity Effect of metal ion on enzyme activity Effect of inhibitors on enzyme activity	20	5
	4.3	Immobilization of enzyme and perform its activity	5	5
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

- Price, N. C., & Stevens, L. (1999). Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins. Oxford University Press, USA.
- Taylor, K. B.(2008). Enzyme Kinetics and Mechanisms. Springer.
- Voet, D., & Voet, J. G, (2004). Biochemistry. John Wiley & Sons
- Shivraj Kumar, P.K.(2007) Enzyme Mechanism. RBSA Publishers
- Horton, R. H., Moran, L. A., & Scrimgeour, K. G.(2006). Principles of Biochemistry (4th ed.). Pearson

MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Biotechnology and Entrepreneurship**					
Type of Course	**DSE**					
Course Code	**MG5DSEBTG300**					
Course Level	**300-399**					
Course Summary	The course is a detailed exploration of various aspects of .Starting off with the basic methodology, the course further delves into practical understanding of the subject matter. It also provides an insight into the various legal and market perspectives along with awareness about gathering opportunities around the globe. The curriculum means to provide students with a comprehensive understanding of Bio entrepreneurship and equips them with the necessary skills related to the topic.					
Semester	**5**	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete 200 level courses.					

MGU-UGP (HONOURS)
Syllabus

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1.	Express the historical development of bio entrepreneurship, showcasing its scope and significance in the modern business landscape.	C	1,2,9
2. 7	Analyze the connection between biotechnology and entrepreneurship, assessing how entrepreneurship contributes to economic growth and innovation.	A	2,3
3. 8	Apply key entrepreneurial characteristics to real-world situations, creating a framework for resilience, adaptability, and successful small-scale product development.	A	2,3

4.	Critically evaluate the legal and ethical implications of intellectual property rights in entrepreneurship, and assess the effectiveness of market research and branding strategies in the biotechnology sector.	E	1,2,3
5.	Apply government policies, funding opportunities, and global collaborations to craft a comprehensive entrepreneurship business plan, demonstrating practical application.	A	2,3
6.	Assess the ethical implications and societal impacts of entrepreneurship in agricultural, medical, and environmental biotechnology.	E	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 Fundamentals of Bioentrepreneurship -Characteristics and Development	1.1	Introduction to Bioentrepreneurship; Definition and Scope of Bioentrepreneurship; Historical Perspective of Bioentrepreneurship	3	1
	1.2	Importance in the Modern Business Landscape; Significance of Bioentrepreneurship	3	1
	1.3	Link between Biotechnology and Entrepreneurship; Contributions to Economic Growth and Innovation	3	1
	1.4	Essential Bioentrepreneurial Characteristics; Traits of Successful Bioentrepreneurs	3	2
	1.5	Developing Resilience and Adaptability; Small-Scale Development of Product	3	2
	1.6	Ideation and Conceptualization; Research and Development in Bioentrepreneurship.	3	2
2 Legal and Market Perspectives.	2.1	Intellectual Property Rights; Understanding Patents, Trademarks, and Copyrights	3	3
	2.2	Legal and Ethical Implications	2	3
	2.3	Bioentrepreneurship Market Development; Market Research in Biotechnology	4	3

	2.4	Branding and Marketing Strategies	4	3
3 **Government and Global Influences**	3.1	The Role of the Indian Government in Bioentrepreneurship	3	4
	3.2	Policies and Initiatives Supporting Bioentrepreneurs; Funding Opportunities and Grants	4	4
	3.3	Foreign Investors in Bioentrepreneurship in India; Attracting Foreign Investment in Biotechnology	4	5
	3.4	Global Partnerships and Collaborations.	4	5
4 **Specialized Biotechnologies and Global Outlook**	4.1	Starting, Managing, and Leading Innovative Technologies; Entrepreneurship in Agricultural Biotechnology	3	6
	4.2	Bioentrepreneurship in Medical Biotechnology	3	6
	4.3	Entrepreneurship in Industrial Biotechnology	3	6
	4.4	Bioentrepreneurship in Environmental Biotechnology	3	6
	4.5	Bioentrepreneurship Globally.	2	6
5		**Teacher Specific Content**		

MGU-UGP (HONOURS)
Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

Reference:

1. Swati Agarwal, Sonu Kumari, Suphiya Khan; (2021) Bioentrepreneurship and Transferring Technology Into Product Development; IGI Global ISBN13: 9781799874119, ISBN10: 1799874117 EISBN13: 9781799874133.

2. Holger Patzelt, Thomas Brenner, (2008) Handbook of Bioentrepreneurship. Springer DOI: 10.1007/978-0-387-48345-0; ISBN: 978-0-387-48343-6,eISBN: 978-0-387-48345-0

3. Craig Shimasaki; (2020) Biotechnology Entrepreneurship. Academic Press Inc. ISBN: 978-0-12-404730-3

4. Audretsch, D. B., & Link, A. N. (2019). Entrepreneurship and innovation policy: Essential elements of an entrepreneurial ecosystem. Oxford University Press.

5. Lerner, J. (2009). Boulevard of broken dreams: Why public efforts to boost entrepreneurship and venture capital have failed—and what to do about it. Princeton University Press.

6. Chesbrough, H. W. (2003). Open innovation: The new imperative for creating and profiting from technology. Harvard Business Press.

7. Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. Academy of Management Review, 25(1), 217-226.

8. Santoro, M. D., & Bierly, P. E. (2006). Innovation and entrepreneurship in biotechnology, an international perspective: Concepts, theories and cases. Edward Elgar Publishing.

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MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University

Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Basic Bioinformatics**
Type of Course	**DSE**
Course Code	**MG5DSEBTG301**
Course Level	**300-399**
Course Summary	**Overall, bioinformatics courses aim to equip students with the knowledge and skills needed to analyse and interpret biological data, fostering an understanding of the computational methods used in modern biological research. The field is dynamic, and courses may be updated to reflect advancements in both biology and computational techniques.**

Semester	5	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		40	5	30	0	75
Pre-requisites, if any	Need to complete difficulty level 200-299 level courses.					

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COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1.	Understand the basics, career paths and significance of Bioinformatics.	U	1,2,3
2.	Apply the practical experience in data interpretation and analysis by utilizing bioinformatics databases.	A	2,3
3.	Develop basic skills in using bioinformatics tools for data analysis and scientific research.	S	1,2,10
4.	Outline the use and importance of genomic data in modern biological research.	An	1,2,3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to bioinformatics	1.1	Introduction to bioinformatics-	2	1
	1.2	Careers and Scope in Bioinformatics. Key milestones in Bioinformatics. **Activity:-**Literature mining using PubMed and Medline.	2	1
	1.3	Human Genome Project. Next-Generation Sequencing (NGS): Principles of NGS technologies.	3	1
2 Overview of Biological Databases	2.1	Overview of NCBI, EMBL, DDBJ, Genbank, PDB, Swissprot.	2	2
	2.2	Biological Databases-Sequence databases and structural databases.	2	2
	2.3	Sequence analysis tools (FASTA, BLAST). Bioinformatics Structure prediction tools (Swiss model, MODELLER). **Activity:** Retrieve information from biological databases like NCBI or UniProt/ Swissprot, PDB.	2	3
	2.4	Genomic databases (GenBank, Ensembl) Protein databases (UniProt, PDB). **Activity:**- Translating an unknown DNA sequence	2	2
3 Sequence alignments	3.1	Sequence alignments- global alignment, local alignment. Dot matrix analysis. **Activity**:- Perform a basic sequence alignment using tools like BLAST-Nucleotide BLAST (BLASTn). Protein BLAST (Blastp). Translated BLAST (Blastx).	3	3
	3.2	Multiple sequence alignment- CLUSTAL W or T-Coffee. **Activity:** Finding out open reading frames (ORF) through NCBI ORF finder	2	3
	3.3	Phylogenetic analysis-Phylip. Homology 92odelling. Tivixe Activity:-Construct a phylogenetic tree using a small set of protein or DNA sequences.	5	3
	3.4	General overview of Map Viewer. ORF Finder. Locus- Link. SPDBV, Pymol, Jmol, Rasmol **Activity:-**. Visualize the 3D structure of a protein using tools like Pymol or Jmol or Rasmol.	5	3
4 Applications of Bioinformatics	4.1	Applications of Bioinformatics: Basic research, Geoinformatics. Personalized Medicine.	3	4
	4.2	Pharmacogenomics- Structure-based drug design-ADME, Classical SAR and QSAR studies. Pharmacophore identification and novel drug design.	3	4
	4.3	Structure based drug design and computer aided drug design. Legal and ethical considerations.	4	4
	4.4	Molecular Docking – Identification of ligands, active site prediction, docking and evaluation. Molecular Docking software	5	4

		– AutoDock.		
5		**Teacher Specific Content.**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis* Cold Spring Harbour Lab Press, New York.
2. Baxevanis, A. D., & Ouellette, B. F. F. (2004). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience*
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7. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (n.d.). *Biochemistry*
8. Klipp, E., Liebermeister, W., Wierling, C., Kowald, A., Lehrach, H., & Herwig, R. (n.d.). *Systems Biology: A Textbook.*
9. Brown, T. A. (n.d.). *Genomes.*
10. Xiong, J. (n.d.). *Essential Bioinformatics.*

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Bioprocess Technology**
Type of Course	**DSE**
Course Code	**MG5DSEBTG302**
Course Level	**300-399**
Course Summary	This course provides a comprehensive overview of bioprocess technology, covering key concepts from fermentation and microorganism screening to bioreactor design and downstream processing in the production of various valuable products.

Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete difficulty level 200-299 level courses.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
	Upon completion of this course in Bioprocess Technology, participants should be able to:		
1	Define and explain the fundamental concepts of industrial biotechnology.	U	1,10
2	Differentiate and understand various fermentation processes.	An	2.3
3	Perform isolation and screening of industrially important microorganisms.	A	1.2
4	Formulate fermentation media and explain the principles of bioreactor design.	C	2,6,10
5	Employ the proper downstream processing techniques to recover and purify products from fermentation processes.	A	1,6

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 Fundamentals of Fermentation and Bioprocessing.	1.1	Fermentation and its role in bioprocessing.	2	1
	1.2	Types of fermentation: Submerged and Solid State Fermentation: Differentiation between submerged and solid-state fermentation.	4	2
	1.3	Mode of Microbial Culture: Batch, continuous, and fed-batch culture.	3	2
	1.4	Applications of Bioprocess Technology: Overview of the diverse applications of bioprocess technology.	4	2
2 Isolation, Screening and Strain improvement	2.1	Isolation and Screening of Industrially Important Microorganisms: Techniques for isolating and screening microorganisms. **Activity**: Isolation and screening of Amylase producing bacteria.	6	3
	2.2	Primary and Secondary Screening: Processes involved in primary and secondary screening of microorganisms.	4	3
	2.3	Strain improvement techniques- Mutation, Hybridization and rDNA technology.	5	3
3 Fermentation media and Bioreactor design.	3.1	Role of Fermentation Media: Defined and undefined media.	3	4
	3.2	Components of Fermentation Medium: Carbon and nitrogen sources, precursors, inducers, inhibitors, and antifoam agents. **Activity:** Media preparation.	6	4
	3.3	Media Formulation and Sterilization: Techniques for formulating and sterilizing fermentation media.	4	4
	3.4	Bioreactor Design: Design considerations for a typical bioreactor. Criteria for designing a bioreactor. Types of bioreactors.	6	4
4 Downstream Processing and Fermentative production	4.1	Introduction to Downstream Processing	3	5
	4.2	Various stages of downstream processing. **Activity**:Enzyme purification: Amylase by Ammonium sulphate precipitation.	5	5
	4.3	Fermentative production of enzyme (amylase), antibiotics (Penicillin) **Activity:** Enzyme immobilization: Amylase	5	5
5		**Teacher Specific Content**		

MGU-UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks **B. End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

- Stanbury, P. F., Whitaker, A., & Hall, S. J. (2008). Principles of Fermentation Technology. Elsevier.
- Kalichelvan, P. T., & Arul Pandi, I. (2009). Bioprocess Technology. MJP Publishers, Chennai.
- Shuler, M., & Kargi, F. (2002). Bioprocess Engineering. Prentice Hall (I) Ltd., New Delhi.
- Moser, A., & Manor, P. (1998). Bioprocess Technology: Kinetics and Reactors. Springer.
- Mansi, E. M. T., Bryce, C. F. A., Dmain, A. L., & Alliman, A. R. (2009). Fermentation Microbiology and Biotechnology. Taylor and Francis.
- Cassida, L. E. (1968). Industrial Microbiology. John Wiley and Sons Publishers.
- Vazhacharickal, P. J Mathew, J. J. & Kumaran Nair S. N. (2018). Industrial Biotechnology: An Introduction. Independently Published.

Suggested Readings

- Purohith, Trevan, Mathur, Agrobotanical Publishers. (2018). Biotechnology: Fundamentals and Applications.
- Barnum, S. R. (2005). Biotechnology: An Introduction. Thomsun.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Marine Biotechnology**
Type of Course	**DSE**
Course Code	**MG5DSEBTG303**
Course Level	**300-399**
Course Summary	Marine biotechnology applies biological principles to marine organisms for diverse purposes, spanning from basic concepts in marine biology and genetic diversity exploration to the utilization of marine microorganisms in biotechnological applications like biofuel production and enzyme synthesis. Techniques such as oceanographic sampling and molecular methods like Polymerase Chain Reaction (PCR) are crucial for data analysis. The field extends to the production of bioproducts and pharmaceuticals from marine sources, addressing challenges in drug discovery. Moreover, marine biotechnology plays a role in mitigating marine pollution through bioremediation, underscoring the importance of conservation for sustainable marine ecosystems.

Semester	5	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre- requisites, if any	Need to complete 200 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe key Marine Organisms	K	1, 2, 4
2	Explain the applications in Biotechnology, such as biofuel production and enzyme production	U	1, 2 ,3
3	Differentiate various Molecular Techniques	An	1, 2, 3
4	They can discuss the challenges and opportunities in Marine-derived Drugs and Therapeutics.	U	1, 2, 3

5	Able to design strategies for the sustainable production of Marine bioproducts.	C	1, 2, 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 Introduction to Marine Biotechnology	1.1	Definition and Scope of Marine Biotechnology. Basic Concepts in Marine Biology - Identification of Key Marine Organism.	5	1
	1.2	Fundamentals of Genetic Diversity in Marine Organisms	3	1
2 Marine Organisms and Their Applications	2.1	Marine Microorganisms - Bacteria, Archaea, Viruses and Algae in Marine Environments.	6	1
	2.2	Marine Microbial Diversity.	3	1
	2.3	Applications in Biotechnology – Biofuel production from micro algae, enzyme production from marine bacteria.	4	2
3 Tools and Techniques in Marine Biotechnology	3.1	Techniques in Marine Sampling and Analysis, Oceanographic Sampling Methods **Activity:** Visit to a marine ecosystem; collection and morphological identification of marine microorganism and preparation of study report	8	3
	3.2	Analytical Techniques in Marine Biology **Activity:** Visit to a marine biology laboratory and preparation of study report.	8	3
	3.3	Molecular Techniques in Marine Biotechnology, Polymerase Chain Reaction (PCR), DNA Sequencing **Activity**: Molecular identification of isolated marine microorganism and preparation of study report.	8	3
4 Applications of Marine Biotechnology	4.1	Marine Bioproducts and Pharmaceuticals. Marine-derived Drugs and Therapeutics	7	4
	4.2	Challenges and Opportunities. Marine Pollution and Bioremediation. Conservation Strategies	8	5
5		**Teacher Specific Content**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.	
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks	
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.	
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks	

References

1. Levinton, J. S. (2017). Marine Biology: Function, Biodiversity, Ecology. Oxford University Press..
2. Speight, M. R., & Henderson, P. A. (2010). Marine Ecology: Concepts and Applications. Wiley-Blackwell.
3. Glazer, A. N., & Nikaido, H. (2007). Microbial Biotechnology: Fundamentals of Applied Microbiology. Cambridge University Press.
4. Borowitzka, M. A., & Moheimani, N. R. (2014). Algae for Biofuels and Energy. Springer
5. Libes, S. (2009). Introduction to Marine Biogeochemistry. Academic Press.
6. Saito, K. (2019). PCR (Polymerase Chain Reaction): Techniques, Applications and Troubleshooting. Intech Open.
7. Kim, S.-K. (2014). Marine Biotechnology I. Springer

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University

Kottayam

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Scientific Communication in Research**					
Type of Course	**SEC**					
Course Code	**MG5SECBTG300**					
Course Level	**300-399**					
Course Summary	The Scientific Communication in Research Course provides an introduction to various aspects of communicating scientific works. It deals with the structure, indexing , evaluation- selection , citation as well as ethical considerations both theoretically and practically.					
Semester	**5**	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Need to complete 200 level courses.					

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COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1.	Recall fundamental principles in professional scientific communication, including hypothesis components and the distinction between inductive and deductive reasoning.	K	1,2,4
2.	Understand the significance of creativity in scientific research and explore diverse sources and methods for generating research ideas.	U	1,2,3
3.	Apply skills in hypothesis formulation, reasoning, and testing to construct and assess research hypotheses	A	2,3
4.	Analyze the structure of scientific reports, recognizing the significance of each section and understanding the rationale behind visual elements.	An	1,2,3
5.	Synthesize knowledge to prepare a synopsis, comprehend various forms of scientific writing, and apply ethical considerations in biomedical research. Additionally, evaluate the peer review process and demonstrate ethical decision-making through practical exercises and real-world case studies	E	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 Introduction, Structure and Processes of Scientific report	1.1	Introduction to Professional Scientific Communication.	2	1
	1.2	Discussion of creativity, research ideas and where to find them.	2	1
	1.3	Inductive reasoning versus deductive reasoning.	2	1
	1.4	Hypothesis, reasoning and testing-specify the hypothesis.	2	1
	1.5	Structure of a scientific report, Synopsis preparation.	3	2
	1.6	Structure of a Research article: Title, abstract, methods, results, and discussion, Schematic diagrams, figures, tables and flow charts -rationale and usage	4	2
	1.7	Peer review process, Different forms of writing: scientific report, proposal, and reviews.	4	5
	1.8	Presentations-thumb rules and good practice. Ethics in research	3	5
2 Overview of Major Indexing Databases	2.1	Understand the Importance of Scientific Publication Indexing: Explore the role of indexing databases in scholarly communication.	2	3
	2.2	Recognize the impact of indexing on visibility, credibility, and dissemination of research.	2	3
	2.3	Introduction to Major Indexing Databases: Overview of prominent scientific publication indexing databases (e.g., PubMed, Scopus, Web of Science, UGC care list, etc).	3	3
	2.4	Evaluating and Selecting Journals: Understand the criteria for selecting reputable journals for publication. Explore the use of journal metrics and impact factors.	3	4
	2.5	Citation Analysis and Metrics: Introduction to citation analysis as a measure of research impact. Interpretation of citation metrics and their significance.	3	4
	2.6	Open Access Databases and Repositories: Explore open access indexing databases and repositories. Understand the benefits and challenges of open access publishing.	3	5
3 Ethical Considerations	3.1	Ethical Considerations in Publication: Discuss ethical issues related to scientific publishing. Understand plagiarism, authorship, and publication ethics.	2	5

in Publications	3.2	Practical Exercises and Case Studies: Hands-on sessions to navigate and search in popular indexing databases. Analyze real-world case studies related to publication and database usage.	5	5
4		Teacher specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT enables class lecturers, Seminars
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Class tests, Assignments, Viva Total marks : 75 CCA : 25
	B. End Semester examination – 1.5 hrs. Total marks : 50
Pattern of questions	Total marks: 50 marks (1.5 hrs.) One word answer question (1mark):10 out of 10 10x1= 10 marks Short answer questions (3marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks

References:

1. C.R. Kothari , Gaurav Garg (2019) Research Methodology, New Age International (P) Ltd. ISBN-10 : 9386649225 ISBN-13 : 978-9386649225
2. Martha Davis, Kaaron J Davis, Marion M Dunagan, (2013) Scientific Papers and Presentations, Third Edition.
3. Christina Hanganu- Bresch and Kelleen Flaherty (2020) Effective scientific Communication- The Other Half of Sience
4. Day, R. A., & Gastel, B. (2016). How to Write and Publish a Scientific Paper. Cambridge University Press.
5. Booth, V., Colomb, G. G., & Williams, J. M. (2008). The Craft of Research. University of Chicago Press.
6. Rudestam, K. E., & Newton, R. R. (2014). Surviving Your Dissertation: A Comprehensive Guide to Content and Process. SAGE Publications.
7. Hart, C. (2001). Doing a Literature Review: Releasing the Social Science Research Imagination. SAGE Publications.
8. Day, R. A. (2011). Scientific English: A Guide for Scientists and Other Professionals. ABC-CLIO.
9. Zeiger, M. (1999). Essentials of Writing Biomedical Research Papers. McGraw-Hill Education.
10. Masic, I. (2012). How to Search, Write, Prepare and Publish the Scientific Papers in the Biomedical Journals. Avicena.
11. Council of Science Editors. (2014). Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers. Council of Science Editors.

SEMESTER-6

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Plant and Animal Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="6">MG6DSCBTG300</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">The coursework covers plant tissue culture, including principles, techniques like micropropagation, and applications such as somatic hybridization. It also delves into animal cell culture, covering laboratory prerequisites, media types, and applications like stem cell utilization, providing students with a comprehensive understanding of tissue culture principles and applications.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
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<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete 200 level courses</td></tr>
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COURSE OUTCOMES (CO)

<table>
<tr><td rowspan="2">CO No.</td><td>Expected Course Outcome</td><td rowspan="2">Learning Domains *</td><td rowspan="2">PO No</td></tr>
<tr><td>Upon completion of this course in Plant biotechnology, students should be able to:</td></tr>
<tr><td>1</td><td>Recognize the historical evolution of plant biotechnology</td><td>K</td><td>1, 2, 4</td></tr>
<tr><td>2</td><td>Apply precise techniques for media preparation, sterilization, and propagation of plants through various plant tissue cultures techniques.</td><td>A</td><td>2, 3</td></tr>
<tr><td>3</td><td>Understand the principles and significance of germplasm conservation.</td><td>U</td><td>1, 2, 3,</td></tr>
<tr><td>4</td><td>Describe the historical development and milestones in animal cell culture, demonstrate knowledge of basic requirements for successful animal cell culture, including laboratory setup and equipment</td><td>K</td><td>1, 2, 4</td></tr>
<tr><td>5</td><td>Analyse the composition of culture media, Maintenance of established/continuous cell lines and apply advanced cell culture techniques</td><td>An</td><td>1, 2, 3</td></tr>
<tr><td>6</td><td>Apply animal cell culture techniques in stem cell and cancer research</td><td>A</td><td>2, 3</td></tr>
<tr><td colspan="4">*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)</td></tr>
</table>

MGU UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to plant tissue culture	1.1	Historical development of plant Biotechnology	2	1
	1.2	Basic requirements and setting up of a plant tissue culture.	3	2
	1.3	Media preparation, Sterilization technique in plant tissue culture	3	3
	1.4	Totipotency, Stages of Micropropagation	2	3
	1.5	Regeneration of plantlets-organogenesis and somatic embryogenesis	3	4
2 Types of plant tissue culture, and Transgenic plants	2.1	Types of culture-Callus, Suspension and Single cell culture,	2	4
	2.2	Meristem culture. Haploid production- Ovary, Ovule, Anther and Pollen culture.	3	4
	2.3	Artificial seeds. Somaclonal variation	3	4
	2.4	Plant protoplast–isolation, culture and Somatic hybridization- Hybrids &Cybrids	4	6
	2.5	Maintenance and storage of plant cell, Applications of plant cell culture ,Transgenic Plants	5	6
3 Introduction to animal cell culture	3.1	History, Laboratory prerequisites for aseptic animal cell culture, Types of culture media: natural and synthetic, , Preparation and sterilization of media	5	6
	3.2	Culture Types: Anchorage-dependent and anchorage-independent cells	2	6
	3.3	Transformed Animal Cells, Established/ Continuous cell lines, Common Cell lines and maintenance	2	6
	3.4	Basic Techniques of mammalian cell culture	3	6
	3.4	Stem cells and their applications	3	5
4 Practicals	4.1	Preparation of MS media for plant tissue culture.	5	1
	4.2	Surface sterilization of explants	5	3
	4.3	Callus culture, Meristem culture.	8	4
	4.4	Embryo rescue technique, Invitro germination of recalcitrant seeds (Orchid)	7	4
	4.5	Composition of animal tissue culture media, Preparation serum containing media, Preparation of serum free media. – Demo (Virtual lab) Submission of report.	5	5

5		Teacher specific content

References

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

1. Bhojwani, S. S., &Razdan, M. K. (1996). Plant tissue culture: Theory and practice. Elsevier.
2. Misra, S. P. (2009). Plant tissue culture. Ane Books India.
3. Singh, B. D. (2009). Plant breeding.Kalyani Publishers
4. Narayanaswamy, S. (1994). Plant cell and tissue culture. Tata McGraw-Hill Publishing Company
5. Ignacimuthu. (2005). Plant biotechnology. Oxford &Ibh Publishing Company Pvt Limited.
6. Masters, J. R. W. (2007). Animal Cell Culture (3rd ed.): A Practical Approach. Oxford University Press.
7. R. Ian Freshney (2016). Culture of Animal Cells: A Manual of Basic Technique. Edition,7, Illustrated, reprint. Publisher, A.R. Liss, 1983.
8. Sasidhara, R. (2019). Animal Biotechnology.MJP Publisher.
9. Raja, Florence Periera. (2006). Animal Biotechnology. New Delhi: Dominant Publishers.
10. Open University, Netherlands. (1994). In Vitro Cultivation of Animal Cells. New Delhi: Butterworth-Heinemann.

MGU UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Cancer Biology and Cell signaling</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="6">MG6DSCBTG301</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">The course provides a comprehensive overview of the fundamental principles underlying cancer development, as well as the latest advancements in research and treatment strategies.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="2">Credits</td><td colspan="2">4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the basic principles of cancer biology	K	1,6
2	Summarise the different types of laboratory tests used to diagnose cancer	U	1,2,6,8
3	Explain the principles of molecular diagnostics	K	1,2
4	Apply molecular diagnostic techniques for the diagnosis of various cancer	A	1,2,6
5	Evaluate molecular diagnostic results	E	1,2,3,6,8
6	Criticise different cancer therapy methods	C	1,2,8,6,8
7	Evaluate the cell signalling	E	1,2

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Cancer Biology	1.1	Overview of cancer as uncontrolled cell growth	3	1
	1.2	Different forms of cancers	3	1
	1.3	Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.	4	2,4, 5
2 Principles of carcinogenesis and metastasis	2.1	Theory of Carcinogenesis, Chemical and physical carcinogenesis	3	1
	2.2	X-ray radiation-mechanisms of radiation carcinogenesis	3	1
	2.3	Clinical significance of invasion, Metastatic cascade, Basement membrane disruption, proteinase and tumor cell invasion	4	4 3
3 Molecular cell biology of cancer and signaling pathway	3.1	Signal targets and cancer, activation of kinases;	3	7
	3.2	Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/proto-oncogene activity	4	1
	3.3	Growth factors related to transformation, Telomerases. Tumor suppressor genes, modulation of cell cycle in cancer.	5	1
	3.4	Intracellular signalling mechanisms Receptor tyrosine kinases and G protein-coupled receptors, Signal transduction cascades	8	7
4 Methods for cancer therapy	4.1	Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection.	10	2,5
	4.2	Different forms of therapy, chemotherapy, radiation therapy,	5	2,5
	4.3	Use of signal targets towards therapy of cancer; Gene therapy.	5	7
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. B. Alberts et. al.; (2014) Molecular biology of the cell; Taylor & Francis Publishers,.; 6th edition.
2. H. Lodish, A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore and J. Darnell; (2007) Molecular Cell Biology; W. H. Freeman & Comp.,; 6th edition
3. G. M. Cooper and R. E. Hausman; (2009) The cell: A molecular approach; ASM Press,; 5th edition.
4. F Bunz; (2008) Principles of Cancer Genetics; Springer;

Suggested Readings

1. Hanahan, D., & Weinberg, R. A. (2011). Hallmarks of Cancer: The next generation. *Cell*, *144*(5), 646–674. https://doi.org/10.1016/j.cell.2011.02.013
2. Gonzalez, F. J., & Shah, Y. M. (2008). PPARalpha: mechanism of species differences and hepatocarcinogenesis of peroxisome proliferators. *Toxicology*, *246*(1), 2–8. https://doi.org/10.1016/j.tox.2007.09.030

Mahatma Gandhi University
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<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Industrial Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG6DSEBTG300</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides a comprehensive overview of Industrial Biotechnology, covering key concepts from fermentation and microorganism screening to bioreactor design and downstream processing in the production of various valuable products.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of this course in Industrial & Bioprocess Technology, participants should be able to:	Learning Domains *	PO No
1	Define and explain the fundamental concepts of industrial biotechnology	K	1,2,4
2	Summarize various fermentation processes.	U	1,2,3
3	Demonstrate the ability to isolate and screen industrially important microorganisms.	A	2,3
4	Illustrate primary and secondary screening methods for the selection of microorganisms	An	1,2,3
5	Judge the merits of different methods of strain improvement	E	1,2,3
6	Design and analyse fermentation media and understand the principles of bioreactor design	C	1,2,9
7	Apply downstream processing techniques to recover and purify products from fermentation processes.	A	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 Fundamentals of Fermentation and Bioprocessing, Fermentation Media	1.1	Define fermentation and its role in bioprocessing, Applications of bioprocess technology	3	1
	1.2	Submerged and solid-state fermentation	4	2
	1.3	Role of Fermentation Media. Defined and undefined media, Components of fermentation medium: carbon and nitrogen sources, precursors, inducers, inhibitors, and antifoam agents	4	2
	1.4	Media formulation and sterilization .	3	2
2 Isolation, Screening, and Strain Improvement	2.1	Mode of microbial culture.	3	3
	2.2	Isolation and screening of industrially important microorganisms Primary and secondary screening	4	4
	2.3	Strain improvement, Methods of strain improvement	6	5
3 Bioreactor Design, Downstream Processing and Fermentative Production	3.1	Bioreactor: design of a typical bioreactor, criteria for the designing of a bioreactor	3	6
	3.2	Types of Bioreactors: STR, Airlift, Packed Bed, Fluidized Bed, Tower Fermenters	3	6
	3.3	Introduction to Downstream Processing	2	7
	3.4	Various stages of downstream processing	5	7
	3.5	Fermentative production of enzyme (amylase), antibiotics (Penicillin) Amino Acid (Glutamic acid), organic acids (citric acid).	5	7
4 Practical	4.1	Determine the potability of the provided water sample by MPN technique.	5	1
	4.2	Fermentative Production of Microbial Metabolites: Submerged	5	7
	4.3	Isolation of Industrially Important Organisms	5	3
	4.4	Secondary Screening of Industrial Important Microorganisms	5	5
	4.5	Screening of the amylase-producing isolates from soil.	5	5
	4.6	Immobilization Of Bacteria for Metabolite Production	5	7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks 10 hrs.	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

5		**Teacher Specific Content** .

References

1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2008). Principles of Fermentation Technology. Elsevier.
2. Kalichelvan, P. T., & Arul Pandi, I. (2009). Bioprocess Technology. MJP Publishers, Chennai.
3. Shuler, M., & Kargi, F. (2002). Bioprocess Engineering. Prentice Hall (I) Ltd., New Delhi.
4. Moser, A., & Manor, P. (1998). Bioprocess Technology: Kinetics and Reactors. Springer.
5. Mansi, E. M. T., Bryce, C. F. A., Dmain, A. L., & Alliman, A. R. (2009). Fermentation Microbiology and Biotechnology. Taylor and Francis.
6. Cassida, L. E. (1968). Industrial Microbiology. John Wiley and Sons Publishers.
7. Vazhacharickal, P. J Mathew, J. J. & Kumarannair S. N.. (2018). Industrial Biotechnology: An Introduction. Independently Published.

Suggested Readings

1. Susan Barnum, S. R. 2 ed (2005). Biotechnology: An Introduction. Thomson Publishers.
2. Purohith, R., & Mathur, S. 4th ed (2010). Biotechnology: Fundamentals and Applications. Agrobotanical Publishers

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<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Food Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG6DSEBTG301</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides an in-depth exploration of food biotechnology, covering its historical development, ethical considerations, and various applications such as microbial processes, enzyme usage, transgenic organisms, and food preservation methods. Students will learn about the role of microorganisms, enzymes, genetic modification, safety measures, and regulatory frameworks in shaping the modern food industry.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Summarize the significance of microorganisms in food processes.	U	1,2,3
2	Identify starter cultures and various types of cheese.	K	1,2,4
3	Evaluate the diverse applications of enzymes in food processing.	E	1,2,3
4	Explore applications of bovine somatotropin, transgenic plants, and transgenic fish production.	An	1,2,3
5	Assess various methods of food preservation.	E	1,2,3
6	Appraise the importance of food safety and government regulatory agencies.	E	1,2,3
7	Able to perform chemical and microbial analysis of food and detection of food adulterants.	A	1,2,3

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Food Biotechnology	1.1	Overview of Food Biotechnology, Historical development and significance in the food industry	2	1
	1.2	Ethical considerations and societal impact of Food Biotechnology	2	1
	1.3	Emerging trends in food biotechnology	3	6
2 Microorganisms and Biotechnological applications in Food Production	2.1	Role of microorganisms in food processes, Starter cultures and their applications	4	1
	2.2	Types of cheese and their production processes, Fermented dairy products and beverages	4	2
	2.3	Basics of enzymes and their importance, Applications of enzymes in food processing	6	3
	2.4	Applications of Bovine somatotropin, Chymosin, Transgenic plants, Transgenic fish in food production.	6	3
3 Food Preservation, Food Safety and Regulatory Aspects	3.1	Causes and prevention of contamination	2	5
	3.2	Preservation methods: low temperature, freezing, heat, drying, concentration, fermentation, canning, radiation, and chemical preservatives	2	5
	3.3	Microbial contamination and spoilage of food, Significance of food safety assessments and surveillance.	4	5
	3.4	Government regulatory agencies: FDA, CDC, EPA. Hazard Analysis and Critical Control Points (HACCP) concepts, Risk assessment in food production	6	6
	3.5	Labelling of GM foods	2	6
	3.6	Ethical considerations and societal impacts	2	6
4 Practicals	4.1	Analysis of food samples: Determination of protein, Fat, Carbohydrates, Moisture content.	6	7
	4.2	Determination of chemical constituents: Total sugar, Total phenolic compounds.	8	7
	4.3	Microbial Analysis of food: Microbiological examination of milk(MBRT), Microbiological examination of fruits and vegetables.	8	7
	4.4	Test for adulterants in food items -Any five. Detect the presence of adulterants in sugar, oil and butter, chilli, powder, turmeric powder, dyes in fats etc.	8	7
5		Teacher Specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks 10 hrs.	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

Reference

1. Green, J. 1 st Ed.. (1991). Biotechnological Innovations in Food Processing. Butterworth-Heinmann.
2. Manay, N. S., & Shadakshara Swamy, M. (2020). Food-Facts and Principles (4 th). New Age International.
3. Kalichelvan, P. T., & Arul Pandi, I. (2009). Bioprocess Technology. MJP Publishers, Chennai.
4. George, J. B. (1987). Basic Food Microbiology. CBS Publishers & Distributors.
5. Roger, A., Gorden, B., & John T. (1989). Food Biotechnology. Cambridge University Press
6. Susan Barnum, S. R. 2 ed (2005). Biotechnology: An Introduction. Thomson Publishers.
7. Purohith, R., & Mathur, S. 4th ed (2010). Biotechnology: Fundamentals and Applications. Agrobotanical Publishers

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<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Sustainable Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG6DSEBTG302</td></tr>
<tr><td>Course Level</td><td colspan="6">300-399</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course delves into the sustainable utilization of natural waste materials through biotechnology, the preparation of cost-effective substrates for industrial applications such as mushroom cultivation, solid waste management via biogas production, the production of green bioproducts including biofertilizers, biopesticides, biofilters, biopolymers, and biosurfactants, exploration of green fuel technology encompassing bioconversion of biomass into first, second, and third-generation biofuels with considerations of limitations, potential, and prospects, and the methods and types of bioremediation, covering microbial, phytoremediation, mycoremediation, biostimulation, bioaugmentation, and bioventing, with a focus on environmental and economic aspects.</td></tr>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome Upon completion of this course in Sustainable biotechnology, participants should be able to:	Learning Domains *	PO No
1	Explain the processes involved in the preparation of nutritive and cost-effective substrates for industrial applications.	U	1,6,7
2	Critically assess the advantages and disadvantages of utilizing biofertilizers, biopesticides, biofilters, biopolymers, and biosurfactants, taking into account their economic and environmental implications.	E	1,2,3,6,7
3	Design innovative approaches for enhancing the efficiency and sustainability of biofuel production.	C	2,3,6,7
4	Demonstrate of in-situ and ex-situ bioremediation methods,	A	2,3,6,7

*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 Waste to Energy	1.1	Exploitation of natural waste materials through biotechnology	5	1
	1.2	Preparation of nutritive and cost-effective substrates for industrial application: Mushroom Cultivation	5	1
	1.3	Waste to energy- Solid waste management through Biogas production.	5	1
2 Green bioproducts	2.1	Biofertilizers- types, applications and advantages. **Activity:** Visit to a biofertilizer production facility and prepare the study report. **Case study**: Effect of biofertilizers on growth of plants. Preparation of report.	8	2
	2.2	Biopesticides- types and applications. Biofilters, biopolymers, biosurfactants.	7	2
3 Green fuel technology	3.1	Bioconversion of biomass into biofuels- First-generation, Second-generation and Third-generation biofuels.	6	3
	3.2	Limitations, potential and future prospects of Biofuels	4	3
	3.3	Environmental and economic considerations of biofuels.	5	3
4 Bioremediation	4.1	Bioremediation : Methods- in-situ and ex-situ	6	4
	4.2	Types of bioremediation- Microbial Bioremediation, Phytoremediation, Mycoremediation, Biostimulation, Bioaugmentation, Bioventing. **Case study** of anyone type and report preparation.	9	4
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** 1. **Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	2. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.

Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. Susan Barnum, S. R. 2ed. (2005). Biotechnology: An Introduction. Thomson Publishers.
2. Purohith, R., & Mathur, S. 4th ed (2010). Biotechnology: Fundamentals and Applications. Agrobotanical Publishers.
3. Zoological Society of India. . Applied Zoology.
4. Sobti, R. C., & Pachauri, S. S. (2009). Essentials of Biotechnology. Ane Books Pvt Ltd.
5. Sharma, R. A. (2016). Environmental Biotechnology. Pointer Publishers.
6. Dubey, R. C. 5 th ed (2014). Textbook of Biotechnology S Chand publishers.
7. Agarwal, S. K. (2015). Advanced Environmental Biotechnology, Ashish Publishing House.
8. Young, M. M. (Ed.). (2011). Comprehensive Biotechnology (2nd ed.). Elsevier.

Suggested readings

1. Smith, J. K., & Brown, A. L. Sustainable Biotechnology: Principles and Applications.
2. Greenfield, P. F., & Johnson, M. S. Advances in Sustainable Biotechnology.

MAHATMA GANDHI UNIVERSITY KOTTAYAM
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Biotechnology**					
Course Name	**Intellectual Property Rights and Patenting**					
Type of Course	**DSE**					
Course Code	**MG6DSEBTG303**					
Course Level	**300-399**					
Course Summary	This course provides a comprehensive understanding of Intellectual Property Rights (IPR), specifically focusing on patents. Students will explore the legal frameworks, processes, and ethical considerations for protecting intellectual creations. The course aims to equip participants with the knowledge and skills needed to navigate the complexities of patent law, fostering an appreciation for the role of intellectual property in innovation and economic development.					
Semester	6	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	*Need to complete difficulty level 200-299 level courses.*					

MGU-UGP (HONOURS)
Syllabus

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Students will summarise different types of intellectual property rights	K	2, 3, 6
2	Students will be able to explain the step-by-step process of obtaining a patent.	U	2
3	Students will be able to relate the importance of patent infringement and associated legal implications	An	1, 6
4	Students will create and propose amendments to existing patent claims to enhance protection or address legal issues.	C	1, 2, 6, 7
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 **Introduction to IPR**	1.1	IPR - Introduction	2	1
	1.2	Types of IPR- Patents, Copyright, Trade mark, Trade secrets	4	2
	1.3	Design, Geographical indication,	1	1
	1.4	Advantages of IP protection	3	1
	1.5	Ethical and Legal Issues in IP	2	1
2 Patent act documents and procedures	2.1	Patents - History of Indian patent act 1970, Recent amendments	2	1
	2.2	Sections in Indian Patent act	2	1
	2.3	Conditions for patentability, Types of patent - process, product	2	1
	2.4	Patenting-Required documents and procedures	3	3
	2.5	Non patentable inventions -examples for patentable biotech products and process	3	3
	2.6	Patents in an international perspective	3	3
	2.8	Rights of patentee.	1	2
	2.9	Challenges in IP protection	2	2
	2.10	Case study - Basmati rice, Turmeric and Neem patent issues.	2	2
3 International institutions and conventions	3.1	Budapest treaty, Paris convention for protection of industrial property.	4	3
	3.2	Bern convention, Trips agreement, GATT agreement	3	2
	3.3	International institutions related to IPR	3	2
	3.4	Process of deposition of materials to IDA	3	3
	3.5	Geographical indication -advantages and examples for GI tagged products	5	1
4 Agencies of IPR	4.1	Agencies involved in IPR-Indian and international	3	3
	4.2	Civil, criminal and administrative remedies for IP infringement	3	3
	4.3	Plant breeders' rights and farmers rights	2	4
	4.4	Trademark registration	2	3
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. End Semester Examination – 2.0 hrs. Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Singh, B. D. (2010). Biotechnology.
2. Dubey, R. C. (1993). A Textbook of Biotechnology. S. Chand Publishing.
3. Narayanan, P. (2001). Intellectual Property Laws. Eastern Law House.
4. Paul, M. (2009). Intellectual Property Laws. Allahabad Law Agency.
5. Universal Law Publication Company. (2020). Intellectual Property Law containing Acts and Rules.
6. Smith, J. E. (2002). Biotechnology (3rd ed.). Cambridge University Press.
7. Glick, B. R., & Pasternak, J. J. 4th Ed (2010). Molecular Biotechnology.
8. Brown, T. A.8th Ed (2020). Gene Cloning and DNA Analysis: An Introduction. Chapman and Hall.
9. Old, R. W., & Primrose, S. B. 3rd Ed (2003). Principles of Gene Manipulation. Blackwell Scientific Publishers.

Suggested Readings

http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/
http://www.cbd.int/biosafety/background.shtml
http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm
http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html
https://www.wipo.int/treaties/en/registration/budapest/

MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Skills in Biotechnology**
Type of Course	**SEC**
Course Code	**MG6SECBTG300**
Course Level	**300-399**
Course Summary	This course delves into the practical skills essential for a career in biotechnology, emphasizing both theoretical understanding and hands-on application. Divided into three modules, the course covers key aspects of food technology, agricultural biotechnology, and molecular techniques. The course cultivates a well-rounded skill set, preparing students for diverse roles in biotechnology with an emphasis on real-world application and critical thinking.

<table>
<tr><td>Semester</td><td>6</td><td colspan="3">Credits</td><td>3</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>2</td><td>0</td><td>1</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 200-299 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the historical context, principles, and scope of food processing, including key developments that have shaped the industry.	U	1, 6
2	Apply practical knowledge in the production of fermented foods and the cultivation of mushrooms, demonstrating proficiency in relevant techniques and processes.	A	1
3	Generate innovative solutions to challenges in food processing and preservation, showcasing creativity and adaptability in application.	Ap	1, 10
4	Evaluate the significance, advantages, and constraints of different types of fertilizers, considering their impact on agriculture and the environment.	E	I, 2, 6
5	Analyze microbial species and their roles in biofertilizer production, demonstrating critical understanding and the ability to assess their suitability for agricultural applications.	An	1

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Food Technology	1.1	Food technology: Scope of food processing; historical developments; principles of food processing and preservation.	3	1
	1.2	Methods of Food Preservation: Physical, Chemical and Biological methods.	3	2
	1.3	Fermentation a method of food preservation: Fermentation principles, Types Production of Fermented foods: Dairy Fermented products.	4	2
	1.4	Mushroom cultivation: Introduction,Types,Steps in Mushroom cultivation, processing and preservation - Processing of Mushroom: mushroom recipes.	5	4
2 Biofertilizers	2.1	Biofertilizer technology: An introduction to fertilizers- inorganic fertilizers, organic fertilizers, bio-fertilizers. importance, advantages and constraints.	4	4
	2.2	Importance, advantages and constraints of Biofertilizers.	4	4
	2.3	Identification of microbial species – Rhizobium, Azospirillum Azotobacters, blue green algae and phosphate solubilizers.	4	6
	2.4	Production of Biofertilizers.	3	6
3 Practicals	3.1	Molecular techniques: Isolation of Nucleic acids- DNA, RNA, Polymerase chain Reaction, Electrophoresis.	10	5
	3.2	Preparation of fermented food products, Biofertilizers and Biopesticides.	10	5
	3.3	Bioinformatics tools: Retrieving nucleotide sequences and similarity search and phlogeny studies.	5	6
	3.4	Problem solving and critical reasoning: Preparing Statement of Purpose, Case study report, Resume, Communication skills.	5	10
4		Teacher Specific Content.		

MGU-UGP (HONOURS)

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Class room lecture, ICT enabled classes, Discussions, Practical sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 15 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.0 hr. Theory : 35 marks Practical : 35 marks
Pattern of questions	Total marks: 35 marks (1.0 hr.) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :3 out of 5 3x3= 9 marks Short essay (6 marks) :1 out of 2 1x6= 6 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks **5 hrs.**	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References:

6. Singh, B. D. (2015). Biotechnology. Kalyani Publishers.
7. Dubey, R. C. (2007). A Textbook of Biotechnology. S. Chand Publishing..
8. Have, H. T., & Gordijn, B. (2013). Handbook of Global Bioethics. Springer eBooks.
9. Lewis, M. A., & Tamparo, C. D. (2007). Medical Law, Ethics, and Bioethics for the Health Professions (6th ed.). F.A. Davis Company.
10. Sateesh, M. K. (2020). Bioethics and Biosafety. Dreamtech Press.

MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University

Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Biotechnology for Nourishing Health**
Type of Course	**VAC**
Course Code	**MG6VACBTG300**
Course Level	**200**
Course Summary	This course equips learners with a holistic understanding of biotechnology's evolution, its role in food production and medicine, and its contributions to human welfare while navigating ethical considerations in this rapidly advancing field.

Semester	3	Credits			3	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Curiosity to know the applications of Biotechnology					

MGU-UGP (HONOURS) Syllabus

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	To identify and define the scope and concepts of Biotechnology.	K	3,10
2	To understand the Basic Concepts and tools in Biotechnology.	U	3,10
3	To explain the principle of BT crops and GM foods and analyse the benefits of Biofortification in foods.	An	1,2,6
4	To understand the importance of Probiotics in gut health.	U	2,3,10
5	To apply the knowledge gained about the GM products and probiotics in improving health	A	1,2,10
6	To compare GM foods from Normal Foods based on its properties.	An	1,3,10

7	To compare the GM foods with normal foods and it's health benefits.	E	4,6,10
8	To understand the importance Environmental Biotechnology and define the role of Biofuels in sustainable development.	U	2,10
9	Understand and Apply Ethical and Legal aspects of Biotechnology.	A	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Overview of Biotechnology	1.1	Biotechnology: History and milestones	3	1
	1.2	Scope of Biotechnology	3	1,2
	1.3	Tools in Biotechnology: Overview	4	5
2 Biotechnology and Food	2.1	Basics of rDNA technology	4	1,2
	2.2	GM Crops: Merits and Demerits.	3	3,7
	2.3	Biofortification of foods and it's Benefits. Fermented foods Probiotics and Gut Health,	6	3
3 Applications of Biotechnology	3.1	Importance of Biotechnology in Medicine:	3	1
	3.2	Production of Medicine by Biotechnology An overview. Gene Therapy, Stem cell Technology.	4	2
	3.3	Introduction to Gene Editing, Personalized Medicine. Molecular Diagnostics.	6	2
	3.4	Environmental Biotechnology for healthy planet. Biofuel and its advantages.	5	8
	3.5	Biotech Trends in Health & Medicine: Synthetic Biology & 3D printing.	2	6
	3.6	Ethical & Legal aspects of Biotechnology	2	9
4		Teacher Specific Content		

MGU-UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT enables class lecturers, Seminars
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Class tests, Assignments, Viva Total marks : 75 CCA : 25
	B. End Semester examination – 1.5 hrs. Total marks : 50
Pattern of questions	Total marks: 50 marks (1.5 hrs.) One word answer question (1mark):10 out of 10 10x1= 10 marks Short answer questions (3marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks

References

1. B.D. Singh. 20. Kalyani Biotechnology Expanding Horizons Fifth Edition. Kalyani Biotechnology. ISBN: 9789393168085.
2. Dr. U. Satyanarayana & Dr. U. Chakrapani Biotechnology First Published: 2005 Reprints: 15: ISBN: 81-87134-90-9 –.
3. Sandy B. Primrose and 1 more Principles of Gene Manipulation and Genomics 7th Edition7th Edition ISBN-13: 978-1405135443.
4. Reinhard Renneberg, Viola Berkling Vanya Loroch Biotechnology for Beginners, Second Edition, ISBN: 978-0-12-801224-6 Academic Press.
5. Industrial Biotechnology: Products and Processes Editor(s):Christoph Wittmann, James C. Liao First published:25 November 2016 Print ISBN:9783527341818

Suggested Readings

1. Fundamentals of Food Biotechnology Author(s):Byong H. Lee First published:12 December 2014 Print ISBN:9781118384954
2. S. C. Bhatia Food Biotechnology 1st Edition: WPI Publishing eBook ISBN9781315156491.

SEMESTER-7

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Genomics and Transcriptomics**
Type of Course	**DCC**
Course Code	**MG7DCCBTG400**
Course Level	**400-499**
Course Summary	The course comprises the *in vivo* and *in silico* tools used to analyze the genome of eukaryotes and prokaryotes, which enlightens them to interpret the novel genome identified and use it for novel approaches.

<table>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the concept of genomes.	U	1,2,8
2	Analyze the role of different techniques used for genomic and metagenomic study.	An	1,2,3,4
3	Appraise the Insilco tools used for genomic study.	E	2,3,5
4	Discuss the importance of RNA sequence analysis in genomic study	U	1,2,3
5	Explain the transcriptome and applications of genomic study	U	1,2,3,5
6	The syllabus objective is to develop a comprehensive understanding of molecular biology techniques, bioinformatics principles, and data analysis methods, including gene prediction, sequence databases, RNA-Seq retrieval, quality check using Galaxy,	U, A	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 Introduction to genomics	1.1	Definition, scope of Genomics and Transcriptomics: Understanding Gene Expression. Historical perspective, Ethical issues related to genomic studies.	4	1
	1.2	Applications in various fields: evolutionary studies, clinical, pharmacogenomics, and environmental studies.	4	1
	1.3	Comparative genome study of eukaryotes and prokaryotes. Gene families- Globin superfamily. theories of gene evolution.	4	2
	1.4	Genome sequencing techniques and methods. **Activity:** Familiarise Sequence Data bases: GenBank, EMBL, DDBJ; Uniprot-KB: SWISS-PROT, TrEMBL, UniParc.	4	4
2 Basic techniques used for genomic and metagenomic study	2.1	Genome sequencing studies, Expression system studies: DNA Barcoding and meta barcoding, 16sr RNA, Cytochrome c oxidase.	5	4
	2.2	Molecular Finger printing techniques: RFLP, t RFLP, DGGE.	4	6
	2.3	FISH, Differential expression analysis.	2	6
	2.4	NGS Platforms: Illumina, Nano pore sequencing, **Activity:** Repositories for high throughput genomic sequences: EST, STS, GSS.	5	6
3 Analysis of genomic and metagenomic data	3.1	Standard Genomic Data analysis pipelines **Activity:** Familiarise Genome Databases at NCBI, EBI, TIGR, SANGER.	3	2
	3.2	Servers involved: Galaxy, RAST. Meta data analysis.	3	3
	3.3	Gene identification and gene annotation, metabolic pathway analysis. **Activity:** Case studies demonstrating Gene prediction and annotation as internship/workshop	3	3
	3.4	Databases: Integrated microbial genome and microbiomes, Green genes, Gene Mark, AUGUTUS. **Activity**: Gene prediction using GeneMark, AUGUSTUS.	4	3
4 RNA sequence analysis for genomic study and applications	4.1	Library preparation from total RNA, SAGE Analysis, CAGE.	3	4
	4.2	Processing, Alignment, quality control checkpoints, Expression quantification methods. **Activity:** Quality Score check of the Sequence using Galaxy.	4	4
	4.3	Tools used: Single-cell RNA sequencing, poly (A) RNA sequencing, Global Run On Sequencing (Gro- seq), Gene ontology Knowledge database	4	5

		Activity: RNA-Seq Data Retrieval		
	4.4	Databases for transcriptome analysis, NCBI - Gene expression omnibus, EBI -Array express. Applications of genomics: Biomarker discovery, Disease profiling.	4	5
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. T.A. Brown: Brown, T. A. (2007). *Genomes*. Garland Science.
2. Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics. Wiley.
3. D.W.Mount, Bioinformatics: sequence and genome analysis- CSH lab press.
4. Lesk AM (2017). Introduction to Genomics. Oxford University press. Oxford, UK.
5. Green MR & Sambrook J (2014). Molecular Cloning, A Laboratory Manual. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, USA.

Suggested Readings

1. Bioinformatics concepts, skills and applications- S.C.Rastogi, N,Mendirattar and Y.Rastogi, CBS Publishers, New Delhi.
2. Bioinformatics- Westhead, Parish and Twynan, Bio Scientific Publishers, Oxford.
3. Introduction to Bioinformatics: A theoretical and practical approaches- S.A. Krawetzt, D.D. Womble, Human Press.
4. Bioinformatics: sequence and genome analysis- D.W.Mount, CSH lab press.
5. Internet for the molecular biologist- S.R. Swindell, R.R.Miller, G.S.A. Meyers, Horizon Scientific Press.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Advanced Cell and Molecular Biology**
Type of Course	**DSC**
Course Code	**MG7DCCBTG401**
Course Level	**400-499**
Course Summary	This course integrates molecular and cellular approaches, covering topics such as cytoskeleton dynamics, cellular membranes and signaling, cell-cell communication, cell cycle regulation, apoptosis, cell differentiation, developmental signaling pathways, DNA topology, replication machinery, transcriptional regulation, epigenetic modifications, mRNA splicing, ribosome structure, and post-translational modifications. Emphasizing environmental factors in epigenetic inheritance, the course also explores DNA-protein interactions and molecular evolution theories. Practical skills include whole genome isolation, agarose gel visualization of DNA, and PCR amplification of bacterial 16S rRNA genes from diverse strains. Students gain a holistic understanding of cellular processes, molecular mechanisms, and hands-on laboratory techniques.

Semester	7	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		3	0	1	0	**75**
Pre-requisites, if any	Need to complete difficulty level 300-399 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the Integration of Molecular and Cellular Approaches	U	1,2,9
2	Comment about of Cell-Cell Communication	E	2,9,10
3	Comprehend Cell Cycle Regulation and Differentiation	An	2,9,10
4	Explain the Central Dogma of Biology - Gene Expression	U	1,2,3,4
5	Analyze Epigenetic modifications,RNA Processing and Translation	An	2,9,10
6	Apply molecular biology techniques, including whole-genome isolation from bacteria, visualization of DNA on agarose gel, and PCR amplification of 16S rRNA gene	A	1,3,10

MGU-UGP (HONOURS) Syllabus

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 Introduction to Integrative Cell Biology	1.1	Integrating molecular and cellular approaches, cross-talk of pathways,	2	1
	1.2	**Cytoskeleton dynamics**: Muscle contraction, Spindle fibre. **Cellular Membranes and Signaling**: Mechanism of membrane Transport- pumps, carrier and channel proteins, Signal transduction pathways, Receptor-ligand interaction, Intracellular signaling cascades.	5	1
	1.3	**Cellular Membranes and Signaling**: Mechanism of membrane Transport- pumps, carrier and channel proteins, Signal transduction pathways, Receptor-ligand interaction, Intracellular signaling cascades. **Cell-Cell Communication:** Intercellular junctions: Gap junctions, Tight junctions, Desmosomes, Adherens junctions, Plasmadesmata, Hemidesmosomes, Cell adhesion molecules and adapter proteins	4	1
	1.4	**Cell cycle phases, regulation and checkpoints**: Cyclins, cyclin-dependent kinases (CDKs), and check points and cell cycle regulation. Cell cycle inhibitors and DNA repair control points P53, p16, RB, ATM, ATR. Apoptosis and necrosis.	5	2
	1.5	**Cell Differentiation and Development:** Stem cells and their role in differentiation, Cellular fate determination. **Developmental signaling pathways**: wnt and hedgehog pathway, auxin, and cytokinin signaling pathways	4	2
2 Central Dogma of Biology - Gene Expression	2.1	DNA topology and supercoiling, Replication machinery, and fidelity.	3	3
	2.2	Transcriptional Regulation: Transcription factors and regulatory elements. Chromatin structure and gene expression.	3	3
	2.3	DNA methylation, Histone modifications (acetylation, methylation, phosphorylation, etc.)	3	4
	2.4	Non-coding RNAs (microRNAs, long non-coding RNAs) in epigenetic regulation.	3	4
	2.5	Role of epigenetic modifications in gene activation, repression, and its mechanisms. Environmental factors influencing epigenetic inheritance	3	4
3 RNA Processing and Translation	3.1	mRNA splicing and alternative splicing, Regulation of mRNA stability,	3	5
	3.2	Ribosome structure and function. DNA-protein interactions,.	2	5

	3.3	Post-translational modifications, Protein sorting. Molecular evolution and phylogenetics:	3	5
	3.4	Theories of new protein evolution: Gene Duplication and divergence, Exon Shuffling, Horizontal Gene transfer, De novo protein evolution, Neofunctionalization, Gene Fusion.	2	5
4 Practical	4.1	Whole genome isolation from bacteria	10	6
	4.2	Visualize the extracted DNA on an agarose gel or use a spectrophotometer to quantify the yield	5	6
	4.3	PCR amplification of 16srRNA gene from E.coli, Klebsiella, Pseudomonas, Steptococcus, Staphylococcus, Bacillus (From any of three bacterial strains	15	6
5		Teacher Specific Content.		

MGU-UGP (HONOURS)
Syllabus

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
Lecture, ICT enabled classes, Seminars, Practical.</td></tr>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT
A. Continuous Comprehensive Assessment (CCA)
MCQ, Test papers, Viva, Assignments, Practicals, Exercises.
Evaluation:
Theory – CCA : 25 marks
Practical – CCA : 15 marks</td></tr>
<tr><td>B. End Semester Examination – 1.5 hrs
Theory : 50 marks
Practical : 35 marks</td></tr>
<tr><td>Pattern of questions</td><td>Total marks : 50 marks (1.5 hrs)

One word answer question (1 mark):10 out of 10 10x1= 10 marks
Short answer questions (3 marks) :4 out of 6 4x3= 12 marks
Short essay (6 marks) :3 out of 5 3x6= 18 marks
Essay (10 marks) :1 out of 2 1x10= 10 marks</td></tr>
<tr><td>Practical-35 marks.
5 hrs.</td><td>Major expt/ procedure/ case study analysis – 15

Minor expts/ Spotters – 10

Viva – 5

Record/case study report/field visit report – 5</td></tr>
</table>

MGU-UGP (HONOURS)
Syllabus

References:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular biology of the cell. New York: Garland Science.
2. De Robertis, E. D. P., & De Robertis, E. M. F. (2006). Cell and molecular biology (8th ed.). New York: Lippincott William & Wilkins.
3. Cooper, G. M., & Hausman, R. E. (2009). The cell: A molecular approach (5th ed.). Washington, D.C., Sunderland, Mass.: ASM Press; Sinauer Associates.
4. Tymoczko, J. L., Berg, J. M., & Stryer, L. (2012). Biochemistry: A short course (2nd ed.). W.H. Freeman and Company.
5. Karp, G. (2010). Cell and molecular biology: Concepts and experiments (6th ed.). Hoboken, NJ: John Wiley.
6. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., Amon, A., & Martin, K. C. (2016). Molecular cell biology (8th ed.). New York: W.H. Freeman and Company.

MAHATMA GANDHI UNIVERSITY · KOTTAYAM ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	BSc (Honours) Biotechnology					
Course Name	Research Methodology & Scientific Writing					
Type of Course	DCC					
Course Code	MG7DCCBTG402					
Course Level	400-499					
Course Summary	This course covers the fundamental aspects of research methodology, including sampling methods, data collection, tabulation, and graphical presentation. It delves into statistical analysis techniques such as measures of central tendency, dispersion, correlation, regression, and significance testing, including hypothesis testing and chi-square tests. Additionally, it explores various research designs, experimental setups, scientific writing conventions, and ethical considerations in research, including plagiarism prevention and proper citation practices.					
Semester	7	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4	0	0	0	**60**
Pre-requisites, if any	Need to complete difficulty level 300-399 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the role of Biostatistics in research.	U	1,2,8
2	Identify the proper resource design.	U	1,2,8
3	Prepare experimental designs and apply them effectively in research.	C	1,2,3,5,9
4	Interpret research results meaningfully, employing various techniques.	A	1,2,3
5	Proficiency in scientific writing, report steps, types, integrity, and plagiarism checks for accurate, clear communication.	A	1,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Biostatistics in Research	1.1	Methods of sampling; Collection, classification, tabulation and presentation- graphical and diagrammatic- of data.	5	1
	1.2	Analysis of data- Measures of central tendency Measures of dispersion-Range, Quartile deviation, Probability and probability distributions, Correlation and Regression.	6	1
	1.3	Test of significance. Basic idea of significance test- hypothesis testing, levels of significance, Chi-square test and goodness of fit; ANOVA.	5	1
2 Research Methodology	2.1	An Introduction; Defining the Research Problem; Design of Sample Surveys.	5	2
	2.2	Research Design - Meaning, Needs and Features; Different research designs.	6	2
3 Principles of experimental designs and Interpretation of results	3.1	Important experimental designs. Before-and-After Without Control Design; After-Only with Control Design; Before-and-After with Control Design	5	3
	3.2	Completely Randomized Design (C.R. Design); Randomized Block Design (R.B. Design); Latin Square Design (L.S. Design)	5	3,4
	3.3	Factorial Designs; Meaning, Techniques of interpretation; Precautions in result interpretation.	4	3,4
4 Scientific Writing	4.1	Introduction to Scientific Writing , Report writing- significance, steps, layout. Types of reports, Mechanics of writing reports and precautions while writing reports.	4	5
	4.2	Writing an Abstract, Title for a Research Paper, Title and Keywords, Mileposts for the Article Writing, Writing the Methods Section, Writing the Results Section, How to Prepare Figures , How to Prepare Schematics.	5	5
	4.3	How to write Introduction and Discussion Sections,Finalizing the Manuscript and Ethics in Research, Writing a Research Proposal and Preparing for a Presentation.	5	5
	4.4	Plagiarism: Prevention and Cure , Definition of Plagiarism, Acknowledge Sources , Paraphrasing ,Direct and Indirect Quotations , Summarizing , Evaluation of Text , Plagiarism Checking .	5	5
5.		Teacher Specific Content.		

MGU-UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. C.R. Kothari, Gaurav Garg Research Methodology, New Age International (P) Ltd. ISBN-10: 9386649225 ISBN-13: 978-9386649225
2. C George Thomas, Research Methodology and Scientific writing, Ane Books Pvt Ltd. ISBN 978-3-030-64864-0 ISBN 978-3-030-64865-7
3. Dawson, Catherine, (2002) Practical Research Methods, New Delhi, UBS Publishers' Distributors
4. Kumar, Ranjit, (2005) Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed.), Singapore, Pearson Education.
5. Matthews J.R and Matthews R.W, (2007) Successful Scientific Writing - A step-by-step guide for the biological and medical sciences, Cambridge University Press.
6. Alley, Michael, (1997) The Craft of Scientific Writing, Springer. ISBN 978-0-387-94766-2.

MGU UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Biotechnology**
Course Name	**Advanced Bioinformatics**
Type of Course	**DCE**
Course Code	**MG7DCEBTG400**
Course Level	**400**
Course Summary	This advanced bioinformatics course delves into sophisticated computational techniques and their integration with experimental approaches to address complex questions in biological research. Students will explore advanced algorithms, high-throughput data analysis, systems biology, and emerging technologies shaping the forefront of bioinformatics.

Semester	7	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete difficulty level 300-399 level courses.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Discuss the significance of computational biology in modern biological research.	U	1,2,3,6,8,
2.	Explain the foundational principles of molecular and cell biology relevant to computational applications.	U	1,2,3,5
3.	Apply algorithmic thinking to solve practical biological problems.	A	1,2,3,4,5,7
4.	Utilize bioinformatics tools for comparing and aligning biological sequences. Evaluate the methods for predicting and analyzing protein structures.	E	1,2,3,4,5
5.	Critically assess the impact of computational methods on understanding gene regulatory elements	E	1,2,3,4,6
6	Design and implement applications of computational methods in drug discovery.	C	1,2,3,4

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 Introduction to Computational Biology	1.1	Overview of computational biology and its applications in biology and medicine, Historical development and key milestones, Introduction to relevant programming languages.	5	CO1
	1.2	Biological Fundamentals: Molecular biology basics (DNA, RNA, proteins).	5	CO1
	1.3	Central dogma of molecular biology, Cell biology concepts relevant to computational analysis.	5	CO1
2 Algorithms and Data Structures	2.1	Basic algorithms and data structures used in computational biology.	2	CO2
	2.2	Algorithmic complexity and efficiency.	3	CO2
	2.3	Sequence Analysis-Pairwise and multiple sequence alignment, Hidden Markov Models (HMMs).	5	CO2
	2.4	Phylogenetic tree construction and analysis.	5	CO2
3 Structural Bioinformatics	3.1	Protein structure prediction. Molecular dynamics simulations.	2	CO3
	3.2	Genome assembly and annotation. Comparative genomics, Structural Genomics, Functional Genomics.	3	CO3
	3.3	Metagenomics. Pharmacogenomics.	5	CO3
	3.4	Human Genome Project, Next Generation Sequencing methods. SNPs.	5	CO3
4 Drug Designing	4.1	Structure-based drug design-ADME, Classical SAR and QSAR studies.	3	CO4
	4.2	Pharmacophore identification and novel drug design, Structure based drug design and computer aided drug design, Molecular Docking – Identification of ligands, active site prediction, docking and evaluation. Molecular Docking software – AutoDock.	4	CO4

	4.3	Personalized Medicine. Application of computational methods to a real-world biological problem. Legal and ethical considerations.	3	CO5
	4.4	Data analysis and interpretation. Presentation of findings.	5	CO6
5		Teacher specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. Mount, D. W.(2005). *Bioinformatics: Sequence and Genome Analysis* Cold Spring Harbour Lab Press, New York.
2. Baxevanis, A. D., & Ouellette, B. F. F. (2004) *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.*
3. Higgs, P. G., & Attwood, T. K. (2013) *Bioinformatics and Molecular Evaluation.* Blackwell Publishers.
4. Misener, S., & Krawetz, S. A. (2000) *Bioinformatics Methods and Protocols.* Humana Press.
5. Rastogi, S. C., Mendiratta, N., & Rastogi, P. (2022) *Bioinformatics Methods and Applications.*
6. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002) *Molecular Biology of the Cell.*
7. Xiong, J. (2007) *Essential Bioinformatics.*

Suggested Readings

1. *Compeau, P., & Pevzner, P.*. Bioinformatics Algorithms: An Active Learning Approach
2. *Sedgewick, R., & Wayne, K.*. Algorithms.
3. *Branden, C., & Tooze, J.*. Introduction to Protein Structure
4. *Fridman, R. H. B.*. Bioinformatics: Sequence and Structure.

5. *Wünschiers, R.*. Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R.

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Disease and Diagnostic Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DCEBTG401</td></tr>
<tr><td>Course Level</td><td colspan="6">400-499</td></tr>
<tr><td>Course Summary</td><td colspan="6">Disease and molecular diagnostics covers the molecular basis of diseases and the use of diagnostic techniques to identify and understand these conditions. The course equips students with a comprehensive understanding of the molecular mechanisms underlying diseases and the practical skills needed for molecular diagnostic applications in healthcare.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td><td>60</td></tr>
<tr><td>Pre- equisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 courses.</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the molecular and pathophysiological basis of major infectious diseases, its mode of transmission.	U	1,2,3,5,6
2	List out preventive measures and potential therapeutic interventions for these diseases.	K	1,2,3,5,6
3	Describe the principles behind immunological assays, microarray technology, and molecular techniques.	U	1,2,10
4	Assess the ethical considerations involved in regulatory decisions, such as balancing innovation with patient safety and ensuring equitable access.	E	1,2,3,5,8
5	Developing practical skills in handling and analyzing Genomics and advanced Molecular Biology.	An	1,9,10

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO. No:
1 Infectious and Genetic diseases.	1.1	Classification of diseases- By etiology, body system or organ affected, pathophysiological mechanisms, age group, life-style related, organism affected, Epidemiology and public health.	5	1,2
	1.2	Overview of major infectious diseases and its mode of transmission in infection Microbes and parasites- Bacteria, Fungi, Viruses, Protozoans, Helminthes and Arthropods, Prions.	5	1,2
	1.3	Genetic Disorders-Heamoglobinopathies- Sickle cell aneamia, Beta Thalassemia, cystic fibrosis and Alzheimers disease. Muscular disordrers- Duchenne's Muscular dystrophy. Triplet disorders-Fragile X syndrome, Huntington's disease, Myotonic dystrophy. Chromosomal disorders-autosomal and sex chromosomal.	5	1,2
2 Molecular Diagnostic methods	2.1	Principle and applications of:- Immunological assays- ELISA, western blotting, immunofluorescence assay, RIA, ICA and multiplex assays.	4	3
	2.2	Microarray technology- gene expression profiling, DNA microarrays, protein microarrays, MiRNA microarrays, autoimmune disease profiling.	4	3
	2.3	Molecular Techniques- Polymerase Chain Reaction (PCR), DNA sequencing, Gene expression analysis, Next-generation sequencing (NGS).	4	3
	2.4	Molecular Markers for Disease- Biomarkers and their significance – Genetic, proteomic and metabolomic markers in disease diagnosis.	3	3
3 Molecular diagnosis of Cancer, Viral and Genetic diseases	3.1	Cancer diagnostics- PCR, FISH, NGS, IHC, liquid biopsy, microarray, dPCR, Mass spectrometry, CTCs and epigenetic analysis, Molecular testing of BRCA1 and BRCA2	5	5
	3.2	Viral disease diagnostics-HIV, Avian Flu, Chikungunya, Swine fever, SARS and Covid	5	5
	3.3	Molecular diagnostic tools for Genetic disorders- Sickle cell anemia, Huntington's disease, Myotonic dystrophy, cystic fibrosis, Alzheimers disease and Down syndrome	5	5
4 Ethical and regulatory framework of molecular diagnosis.	4.1	Ethical issues in molecular diagnosis. Genetic testing and informed consent. Personalized medicine and access, Bio banking.	5	4
	4.2	Regulatory framework and compliance.	3	4
	4.3	Genetic privacy and data security. Privacy concerns in genomic data sharing, Challenges in maintaining in genetic privacy.	3	4
	4.4	Case study on ethical issues in molecular diagnostics. HeLa cell case/ BabySeq project.	4	4
Module 5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. Greenwood, D., Slack, R., & Peutherer, J. (Eds.). (1997). *Medical Microbiology*. ELST Publishers.
2. Forbes, B. A., Sahm, D. F., Weissefeld, A. S., & Trevino, E. A. (2002). *Bailey and Scott's Diagnostic Microbiology*.. C.V. Mosby.
3. Knudsen, S. (2006). *Cancer diagnostics with DNA microarrays*. John Wiley & Sons.
4. Mooi, J. (2009). Lange: 2008 Current Medical Diagnosis & Treatment. *Australian Journal of General Practice*, *38*(3), 151.
5. Lashley, F. R., & Durham, J. D. (Eds.). (2007). *Emerging infectious diseases: trends and issues*. Springer Publishing Company.
6. Russell, P. J. (1987). *Essential genetics*. Blackwell Scientific Publications.

Suggested Readings

MGU-UGP (HONOURS)

1. Kumar, V., Abbas, A. K., Fausto, N., & Aster, J. C. (2014). *Robbins and Cotran pathologic basis of disease, professional edition e-book*. Elsevier health sciences.
2. Kasper, D., Fauci, A., Hauser, S., Longo, D., Jameson, J., & Loscalzo, J. (2015). *Harrison's principles of internal medicine, 19e* (Vol. 1, No. 2). New York, NY, USA:: Mcgraw-hill.
3. Alberts, B. (2017). *Molecular biology of the cell*. Garland science.

Mahatma Gandhi University Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Immunoengineering**
Type of Course	**DCE**
Course Code	**MG7DCEBTG402**
Course Level	**400-499**
Course Summary	The Immunoengineering course for Biotechnology students is designed to provide a comprehensive understanding of the intersection between immunology and engineering principles. This course explores the applications of engineering techniques to manipulate and enhance the immune system for various biotechnological purposes. Students will delve into the principles of immunology and learn how to apply engineering strategies to modulate immune responses, design immunotherapies, and develop novel biotechnological solutions.

Semester	7	Credits		4		Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre- requisites, if any	Need to complete difficulty level 300-399 courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Recall the fundamental principles of immunology and identify key components of the immune system and their functions.	K	1,10
2	Summarize the interactions between immune cells with biomaterials and Describe the engineering techniques used for immunomodulation.	U	1,2,10
3	Apply engineering strategies to modulate specific immune responses and Utilize bioinformatics tools for the analysis of immunological data.	A	1,2,9,10
4	Analyze the challenges and opportunities in immunoengineering.	An	2,4,9
5	Evaluate the regulatory considerations in developing immunotherapies and vaccines.	E	1,2,6,8
6	Design a comprehensive immunoengineering strategy for a specific biomedical problem and create a research proposal for a new immunoengineering project.	C	1,2,4,6,8

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Immunoengineering	1.1	Fundamentals of Engineering in Immunology	2	1
	1.2	Introduction to immunoengineering concepts	2	1
	1.3	Interdisciplinary approaches in immunology and engineering	2	3
	1.4	Antibody engineering.	2	3
2 Biomaterials in Immunoengineering	2.1	Overview of biomaterials in immunoengineering.	3	4
	2.2	Properties and classifications of biomaterials	4	5
	2.3	Immunomodulatory Biomaterials	4	3
	2.4	Design principles for biomaterials that interact with the immune system, modulating immune responses using biomaterials	4	4
3 Cellular Engineering, Immunomodulation and Drug Delivery	3.1	Cell-based Therapies - Overview of cell-based immunotherapies. Engineering immune cells for therapeutic applications.	5	4
	3.2	Synthetic Biology in Immunology - Introduction to synthetic biology principles	5	3
	3.3	Engineering of synthetic immune cells	4	2
	3.4	Immunomodulatory Strategies - Techniques for modulating immune responses.	5	3
	3.5	Immunomodulatory drugs and their applications. Drug Delivery Systems- Engineering approaches for targeted drug deliver,	5	4
	3.6	Nanotechnologyin immunomodulation. Challenges and Opportunities in Drug Delivery	5	4
4 Applications of Immunoengineering	4.1	Immunotherapy,Vaccine Development,	3	5
	4.2	Biofabrication and tissue engineering, Drug delivery systems	3	6
	4.3	Diagnostic tools and Regenerative medicines	2	6
5		Teacher Specific Content		

<table>
<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.</td></tr>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT
A. Continuous Comprehensive Assessment (CCA)
Assignment, Oral Presentations, Quiz, Group Discussions
Evaluation:
CCA : 30 marks</td></tr>
<tr><td>B. End Semester Examination – 2.0 hrs.
Total marks: 70 marks.</td></tr>
<tr><td>Pattern of questions</td><td>Total marks : 70 marks (2.0 hrs)
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Essay (15 marks) :1 out of 2 1x15= 15 marks</td></tr>
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Reference

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). Cellular and Molecular Immunology. Publisher.

2. Prendergast, G. C., & Jaffee, E. M. (2013) Cancer Immunotherapy: Immune Suppression and Tumour Growth. Publisher.

3. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. (2012) Biomaterials Science: An Introduction to Materials in Medicine. Publisher.

4. Harlow, E., Lane, D., & Lane, D. J. (1988). Antibodies: A Laboratory Manual. Publisher.

5. Enderle, J., Bronzino, J., & Blanchard, S. (2005). Introduction to Biomedical Engineering. Publisher.

विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Agricultural Biotechnology**
Type of Course	**DCE**
Course Code	**MG7DSEBTG400**
Course Level	**400-499**
Course Summary	The course covers Agricultural Biotechnology, spanning from its introduction and significance in modern farming to historical perspectives and milestones. Ethical considerations and regulatory frameworks are explored alongside an introduction to plant genetic engineering and genetically modified techniques in crops. Transgenic plants and genome editing technologies like CRISPR/Cas9 are discussed. Microbial Biotechnology's role in soil health, biofertilizers, and plant-microbe interactions for improved crop yield are examined. The course also addresses plant stress, crop management applications, and strategies for increased crop yield through modern agronomic practices and biotechnology-enhanced breeding techniques.

Semester	7	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete difficulty level 300-399 courses					

MGU-UGP (HONOURS)
Syllabus

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the impact of biotic and abiotic factors on agricultural practices.	U	1, 2, 3, 6
2	Evaluate ethical considerations associated with agricultural biotechnology.	E	1, 2, 3, 7
3	Analyse the applications and implication of transgenic plant.	An	1, 2, 3, 9
4	Understand the fundamentals of Genome editing in agriculture.	U	1, 2, 9, 10
5	Formulate bio fertilizers.	C	1, 2, 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 Introduction to Agriculture Biotechnology	1.1	Overview Of Agricultural Biotechnology: Introduction to agricultural biotechnology and it's significance in modern farming. Key concepts, principles and techniques in agricultural biotechnology. Application of biotechnology in crop improvement, pest control and disease resistant	4	1
	1.2	Historical Perspectives And Milestones: Evaluation of agriculture Biotechnology from traditional breeding to modern technological approaches. Land mark achievement and discoveries in the field. Contributions of notable scientists and researchers.	4	2
	1.3	Ethical Considerations: Exploration of ethical issues, impact of biotechnological interventions, ethical consideration in genetic modification and gene editing in crops.	4	3
	1.4	Regulatory Framework: Overview of national and international regulation, role of governmental and non-governmental organizations in biotechnological practices	3	4
2 Plant Genetic Engineering	2.1	Introduction To Plant Genetic Engineering: Overview of genetic engineering principles, historical development, importance of genetic modification in agriculture	4	3,4
	2.2	Genetically Modified Techniques In Crops: Various methods of genetic modification in crops, comparison of traditional breeding and genetic engineering, regulatory framework governing GM crops.	4	3,4
	2.3	Transgenic Plants: Concepts And Development: Definition and characteristics of transgenic plants, techniques for introducing foreign genes into the plants Examples of successful transgenic crops.	4	3,4
	2.4	Genome Editing Technology In Agriculture (Crisper/Cas9): Introduction to genome editing and crisper cas9, mechanism and composition of crisper cas9 system.	3	3,4
3 Microbial Biotechnogy in Agriculture	3.1	Introduction To Microbial Biotechnology: Definition and scope, historical context and development of microbial application in farming, significance of microorganisms in sustainable agriculture.	3	5
	3.2	Role Of Microorganism In Soil : Importance of soil microorganisms for nutrient cycling, microbial diversity in soil ecosystems, impact of microorganism on soil structure and fertility	3	5
	3.3	Biofertilizers And Their Applications: Definition and types of bio fertilizers, microorganisms used in biofertilizer production, benefits and challenges of using biofertilizers in agriculture.	3	5

	3.4	Plant - Microbe Interaction For Improved Crop Yield: Mutualistic relationship between plant and beneficial microbes, mechanisms of plant growth – promoting Rhizobacteria (PGPR), enhanced nutrient uptake and disease resistance through microbial interactions.	3	2
	3.5	Applications In Crop Management: Microbial solutions for pest and disease control, bioremediation using microorganisms.	3	2
4 Advanced Crop Improvement Techniques	4.1	Introduction To Plant Stress: Biotic stress and abiotic stress in plants, impact on plant growth and development, physiological responses to biotic and abiotic stress.	5	1
	4.2	Strategies For Increased Crop Yield: Factors influencing crop yield, modern agronomic practices - sustainable farming techniques, precision agriculture and its impact on yield, molecular tools in crop breeding. Marker-assisted breeding its principles and applications, genomic selection in crop improvement.	5	3
	4.3	Biotechnology For Crop Enhancement: Transgenic crops for pest and disease resistant, genetic modification for enhanced nutritional content.	5	3
5.		Teacher Specific Content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Doe, J. (1987) Principles of Agricultural Biotechnology. National Research Council
2. Smith, J. et al.(1996). Genetic Engineering of Crops. Nature biotechnology,
3. Johnson, R. et al. (2004) Microbial Applications in Agriculture. Springer
4. Chawala, H. S. (2011) Biotechnology in Crop Improvement. CRC Press.
5. Gupta, P. K. (2010) Elements of Biotechnology. Rasthogi Publications

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Proteomics</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DSEBTG401</td></tr>
<tr><td>Course Level</td><td colspan="6">400-499</td></tr>
<tr><td>Course Summary</td><td colspan="6">The Proteomics course covers diverse protein analysis techniques and applications. It explores protein isolation, structure analysis, and methods like 2-DE gels, MALDI-TOF mass spectrometry, and NMR spectroscopy. Students learn protein identification strategies such as sequencing, peptide mass fingerprinting, and quantification through isotope labeling and MS. Post-translational modifications analysis and protein interaction assessment methods are also discussed. The course emphasizes proteome databases like UniProt, NCBI Protein, and STRING, alongside proteomic analysis software and quantitative techniques such as i-TRAQ and SILAC. Through case studies and insights from the Human Proteome Atlas, students understand proteomics' significance in clinical research, drug discovery, biomarker identification, and agriculture.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the concept of proteomics	U	1,2,10
2	Apply the methods available for the identification of unknown gene expression products in a high-through-put manner	E	2,3
3	Evaluate the use of the protein structural analytical tools	E	1,2,4
4	Formulate a stepwise workflow for identifying novel protein using Insilco studies	C	1,2
5	Explain the applications in Biomedical research, agricultural research, environmental studies.	U	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Proteomics	1.1	Introduction and scope of proteomics; Types of proteomics-quantitative proteomics; functional proteomics, structural proteomics.	4	1
	1.2	Protein isolation & structure analysis: detection and quantitation of proteins, Preprocessing, Protein Identification and Quantification, Interpretation and Visualization	4	1
	1.3	Analysis of proteomes: Sample Preparation, Solubilization, Reduction, Resolution	2	2
	1.4	Reproducibility of 2-DE Gels Two-dimensional polyacrylamide gel electrophoresis.	3	2
	1.5	Isoelectric focusing (IEF), protein microarrays, MALDI-TOF mass spectrometry, NMR spectroscopy, x-ray crystallography	5	2
2 Strategies for protein identification	2.1	Protein sequencing, peptide mass fingerprinting.	4	3
	2.2	Protein quantification based on isotope labeling and MS. Analysis of post-translational modifications.	4	3
	2.3	Analysis of protein interactions using affinity chromatography; DNA-Protein interaction: EMSA, Chromatin Immunoprecipitation (ChIP)	3	3
	2.4	Protein - Protein interaction: Chemically induced dimerization, Y2H methodology and protein microarrays.	4	3
3 Proteome databases and Servers	3.1	Proteome database: Chip-seq,	3	4
	3.2	Amino acid sequencing Protein Databases: UniProt, NCBI Protein Protein Data Bank (PDB), InterPro, STRING, PhosphoSitePlus, PRIDE	4	4
	3.3	Proteomic analysis software (protein pilot, Mascot)	4	4
	3.4	Introduction to quantitative proteomics and techniques. (i-TRAQ and SILAC).	4	4
4 Potentials of proteomics in biotechnology	4.1	Case studies related to Clinical and biomedical application of proteomics; drug discovery and personalized medicine,	3	5
	4.2	Target identification and validation, Biomarker discovery in drug development, Stem Cell Research, Protein Engineering,	4	5
	4.3	Monitoring Agricultural Contaminants, Bio indication and Biotic Response	3	5
	4.4	Metaproteomics. Human Proteome Atlas	2	5
5.		Teacher Specific Content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Twyman R (2013). Principles of Proteomics. Garland Science, Taylor & Francis Group, LLC, New York, USA.
2. Liebler DC (2002). Introduction to Proteomics- Humana Press, New York, USA.
3. Keith Wilson & John Walker, (2010), Principles and Techniques of Biochemistry and Molecular Biology, ed., Cambridge Univ. Press
4. Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.
5. R. D. Appel and D.F. Hochstrasser, Proteome Research: New Frontiers in Functional Genomics,Springer, 1997.

Suggested Readings

MGU-UGP (HONOURS)

1. Reiner Westermeier, Tom Naven, Proteomics in Practice, Wiley-VCH, May 2002.
2. D. Hochstrasser, Concepts in Proteomics
3. Wilkins, M. R., Williams, K. L., & Appel, R. D. (Eds.). (1997). Proteome Research: New Frontiers in Functional Genomics (2nd ed.). Springer.
4. Kussmann, M., & Roepstorff, P. (2005). Mass Spectrometry in Systems Biology: An Introduction. Wiley-VCH.
5. Palsson, B. (2006). Systems Biology: Properties of Reconstructed Networks. Cambridge University Press.

Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Genetic Engineering</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DSEBTG402</td></tr>
<tr><td>Course Level</td><td colspan="6">400-499</td></tr>
<tr><td>Course Summary</td><td colspan="6">The course provides a comprehensive understanding of the tools used to manipulate DNA, the methods of gene cloning, and the practical applications of rDNA technology.</td></tr>
<tr><td>Semester</td><td>7</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Understand the fundamental principles and history of genetic engineering	U	1,2, 3
2.	Apply various techniques and tools used in gene cloning and manipulation	A	2,3,8
3.	Analyze the role of genetic engineering in medicine, agriculture, and industry	An	1, 2, 3, 8
4.	Evaluate the ethical, legal, and social implications of genetic engineering	E	1, 2, 3, 6, 8
5.	Create innovative solutions to biological problems using advanced genetic engineering techniques.	C	1, 2, 3, 6, 8,9

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to genetic engineering	1.1	Introduction to genetic engineering. History and Scope of Genetic Engineering, Birth of rDNA Technology: Paul Berg's development of DNA techniques.	3	2
	1.2	Isolation of genetic material:DNA,RNA,Plasmid. Gene Libraries: Genomic and cDNA Libraries.	3	5
	1.3	PCR and Its Applications. Gene Cloning Strategies: Restriction Enzyme, Gateway, TOPO, Gibson assembly, Type IIS , Ligation Independent Cloning, Oligo Stitching **Activity**: DNA sequencing - Sanger or Maxam Gilbert (Demo)	5	3
	1.4	Steps in genetic engineering: Isolating the DNA, Cutting the DNA at specific site, Preparing the suitable vector, Ligation, Transformation, Screening and Selection, Harvesting and Analyzing. Adapters, Linkers, Homopolymer tail.	4	3
2 Tools and techniques of Genetic engineering	2.1	Enzymes in genetic engineering: DNA Ligases, Polymerase enzymes -DNA polymerase, Klenow fragment, Taq polymerase, Reverse transcriptase; Nucleases - exonucleases: Bal31, exonucleases III, lambda exonuclease, S1 nucleases, RNase H; Restriction endonucleases; Alkaline Phosphatase, Polynucleotide Kinase, Terminal transferase;	5	5
	2.2	Vectors in Genetic engineering: Classification of Vectors: Plasmids - pSC 101, pBR322, pUC; Bacteriophage vectors: M13, and Lambda; Cosmids, Phasmid, Shuttle vectors: YACs, & BACs. Plant and Animal vectors.	5	5
	2,3	Techniques of Gene Transfer: CaCl2 mediated Transformation, Transfection, Electroporation, Lipofection, Microinjection, and Biolistic method. Agrobacterium mediated gene transfer. **Activity**: Cloning and transformation of gene.	5	
3 Screening methods and applications of Genetic engineering	3.1	Screening methods: Blue White screening, Insertional inactivation, Marker genes, reporter genes, colony hybridization. Molecular Techniques: RFLP, RAPD.	5	5
	3.2	Blotting Techniques: Southern, Western, Northern **Activity**: Production of recombinant protein/enzyme.(Demo)	5	5
	3.3	Application of genetic engineering: Production of GMOs: Transgenic plants, animals; Protection of recombinant Insulin, vaccines, antibiotics, Superbugs, Gene therapy, Biofuels, Molecular pharming; Risk of GMOs	5	4
4 Cutting-Edge	4.1	Genome Editing Technologies: CRISPR-Cas9, TALENs, and ZFNs	3	6

Techniques and Future Perspectives	4.2	Synthetic Biology: Design and Construction of Novel Biological Pathways and Organisms	3	6
	4,3	RNA Technologies: RNA Interference, RNAi Therapeutics, and Gene Silencing	3	6
	4.4	High-Throughput Sequencing Technologies and Applications in Functional Genomics	3	6
	4.5	Future Directions and Challenges in Genetic Engineering.	3	6
5		Teacher Specific Content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
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Reference:

1. Brown, T. A. (2007). Genomes 3. Garland Science.
2. Brown, T. A. (2016). Gene cloning and DNA analysis: An Introduction. John Wiley & Sons.
3. Karp, G., Iwasa, J., & Marshall, W. (2018). Karp's Cell Biology. John Wiley & Sons.
4. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2017). Lewin's GENES XII. Jones & Bartlett Learning.
5. Primrose, S. B., & Twyman, R. (2013). Principles of gene Manipulation and Genomics. John Wiley & Sons.
6. Purohit, S. S., & Mathur, S. (2002). Biotechnology: Fundamentals and Applications.
7. Watson, J. D., Myers, R. M., Myers, U. R. M., Caudy, A. A., & Witkowski, J. A. (2007). Recombinant DNA: Genes and genomes: A Short Course. Macmillan.
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11. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
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SEMESTER-8

MAHATMA GANDHI UNIVERSITY · KOTTAYAM ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

Programme	BSc (Honours) Biotechnology					
Course Name	**Advanced Instrumentation Techniques**					
Type of Course	**DCC**					
Course Code	**MG8DCCBTG400**					
Course Level	**400-499**					
Course Summary	This course describes different advanced techniques in proteomics, imaging techniques and genomics					
Semester	8	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	**75**
Pre-requisites, if any	Need to complete difficulty level 300-399 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Students will be able to recall the working principles of advanced techniques used biological research	K	1, 10
2	Students will be able to classify the techniques required for specific application	An	1,2,3
3	Students will be able to implement different techniques used in biological research	A	1, 2,9
4	Students will be able to evaluate biological samples for the detection of specific proteins	E	I, 2, 10
5	Students will be able to select suitable tools for applying various techniques.	E	1,2.9

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

MGU-UGP (HONOURS)
Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Techniques in proteomics	1.1	Protein purification- An overview,	4	1
	1.2	Techniques in protein purification- Cell lysis Methods, Precipitation Techniques, Dialysis, Chromatographic techniques (Ion exchange, Size exclusion, Affinity chromatography).	6	1,2
	1.3	Techniques used in protein analysis and characterization: SDS PAGE, Western Blotting, HPLC, NMR Spectroscopy- Proton NMR, C13 NMR, 2D NMR, MALDI - ToF Spectroscopy, Peptide Mass Fingerprinting, GC-MS.	5	1,2
2 Advanced Imaging Techniques	2.1	Microscopic Techniques:- Phase Contrast Microscopy, Fluorescent Microscopy, Confocal Microscopy, Flow cytometry.	5	1,2
	2.2	Electron Microscopy:- Scanning Electron Microscopy, Transmission Electron Microscopy, Cryo Electron Microscopy.	5	1,2
3. Techniques in genomics	3.1	Sequencing Techniques:- Next Generation Sequencing Techniques - Illumina, Nanopore Sequencing.	7	1,2
	3.2	Sequence analysis tools	7	1,2
	3.3	Gene expression analysis: Relative gene expression Analysis using qPCR, DNA microarrays, Biosensors	6	1,2
4 Practicals	4.1	Protein purification	4	1,2,
	4.2	Ion exchange / Affinity chromatography	8	1,2
	4.3	SDS PAGE	8	1,2
	4.4	Western Blotting	6	1,2
	4.5	DNA sequencing (Demo)	4	1,2
5.		Teacher Specific Content.		

MGU-UGP (HONOURS) Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, ICT enabled classes, Seminars, Practical.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** MCQ, Test papers, Viva, Assignments, Practicals, Exercises. **Evaluation:** Theory – CCA : 25 marks Practical – CCA : 15 marks
	B. End Semester Examination – 1.5 hrs Theory – : 50 marks Practical : 35 marks
Pattern of questions	Total marks : 50 marks (1.5 hrs) One word answer question (1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :4 out of 6 4x3= 12 marks Short essay (6 marks) :3 out of 5 3x6= 18 marks Essay (10 marks) :1 out of 2 1x10= 10 marks
Practical-35 marks. 10 hrs.	Major expt/ procedure/ case study analysis – 15 Minor expts/ Spotters – 10 Viva – 5 Record/case study report/field visit report – 5

References

1. Wilson, K., & Walker, J. (Eds.). (2000). Practical Biochemistry. Cambridge University Press.
2. Boyer, R. (2000). Modern Experimental Biochemistry. Pearson Education.
3. Upadhyay, A., Upadhyay, K., & Nath, N. (2009). Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House.
4. Thompson, J. D., Ueffing, M., & Schaeffer-Reiss, C. (Eds.). (2008). Functional Proteomics. Springer Nature.
5. McNair, H. M., Miller, J. M., & Snow, N. H. (2019). Basic Gas Chromatography. Wiley.
6. Head, S. R., Ordoukhanian, P., & Salomon, D. R. (Eds.). (2018). Next Generation Sequencing: Methods and Protocols. Springer Nature.

MGU-UGP (HONOURS) Syllabus

Mahatma Gandhi University
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<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Analytical and Molecular Techniques</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCC</td></tr>
<tr><td>Course Code</td><td colspan="6">MG8DCCBTG401</td></tr>
<tr><td>Course Level</td><td colspan="6">400-499</td></tr>
<tr><td>Course Summary</td><td colspan="6">This practical course covers the the various technologies in the fields of advanced imaging genomics</td></tr>
<tr><td>Semester</td><td>8</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>100</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 level courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate a foundational understanding of various microscopic techniques, including phase contrast microscopy, fluorescent microscopy, confocal microscopy, and flow cytometry through video presentations and research lab visits.	U	1, 2,
2	Gain proficiency in scanning electron microscopy and transmission electron microscopy, having been exposed to practical applications through video presentations and research lab visits.	A	1, 3, 9
3	Develop competence in next-generation sequencing techniques, specifically Illumina and Nanopore sequencing, through practical demonstrations via video presentations or research lab visits.	S	1,10
4	Acquire skills in relative gene expression analysis using qPCR and DNA microarray, along with an understanding of biosensors (e.g., glucose biosensors), demonstrated through live demonstrations.	S	1, 2, 3
5	Demonstrate proficiency in protein purification techniques, including cell lysis, protein precipitation, and chromatographic techniques such as ion exchange, size exclusion, and affinity chromatography, through live demo sessions.	A	9, 10
6	Gain advanced skills in protein analysis and characterization techniques, including SDS-PAGE, Western blotting, HPLC, NMR spectroscopy (MALDI-ToF), and GC-MS. This knowledge will be imparted through video presentations or research lab visits.	S	1, 2, 3

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

MGU UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Advanced Imaging Techniques (30 hrs)	1.1	Microscopic Techniques, Phase Contrast Microscopy, Fluorescent Microscopy, Confocal Microscopy, Flow Cytometry. (These practicals to be conducted through demonstration by video presentation or research lab visit/attending workshops)	20	1
	1.2	Electron Microscopy Scanning Electron Microscopy, Transmission Electron Microscopy. (These practicals to be conducted through demonstration by video presentation or research lab visit/attending workshops)	10	2
2. Techniques in Next Generation sequencing (30 hrs)	2.1	Sequencing Techniques :Next Generation Sequencing Techniques: Illumina, Nanopore Sequencing. (These practicals to be conducted through demonstration by video presentation or research lab visit/attending workshops)	20	3,4
3 Gene expression analysis	3.1	Gene Expression Analysis, Relative Gene Expression Analysis using qPCR (Quantitative Polymerase Chain Reaction),	15	3,4
4 Screening of Gene expression	4.1	DNA Microarray (These practicals to be conducted through demonstration by video presentation or research lab visit/attending workshops), Biosensor (Glucose biosensor) (Live demo)	10	3,4
5.		Teacher Specific Content.		

विद्या अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Practicals, Demonstrations, Workshops, Research lab visits, Trainings
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Practical result/record submission **Evaluation:** CCA : 30 marks **B. End Semester Examination - 2 Hour** Total marks: 70 marks.
Pattern of questions Total marks : 70 marks 10 hrs.	Major expt/ Presentation/ demonstration – 25 Minor/spotters/ - 10 Procedure writing - 15 Viva – 10 Record -10

References:

1. Jerome Mertz,(2010) Introduction to Light Microscopy , Cambridge University Press
2. David L. Glaser, (2004), Phase Contrast Microscopy, Imperial College Press
3. Ulrich Kubitscheck,(2005), Fluorescence Microscopy: From Principles to Biological Applications, Wiley-VCH
4. James B. Pawley, (2006),: Handbook of Biological Confocal Microscopy, Springer
5. Alice Longobardi Givan, (2015) Flow Cytometry: Principles and Applications CRC Press.
6. John J. Bozzola and Lonnie D. Russell,: (1998),: Electron Microscopy: Principles and Techniques for Biologists, Jones & Bartlett Learning
7. Authors: Joseph Goldstein, Dale E. Newbury, et al. (2003), Scanning Electron Microscopy and X-Ray Microanalysis, Springer
8. David B. Williams and C. Barry Carter,(2009),: Transmission Electron Microscopy: A Textbook for Materials Science, Springer
9. Stuart M. Brown,: (2016), Next-Generation DNA Sequencing Informatics ,Cold Spring Harbor Laboratory Press,
10. Tim Mohlere, (2019): Illumina Sequencing: Methods and Protocols: Humana
11. Susanna-Assunta Sansone, et al., (2007),Gene Expression: General and Specialized Methods, Horizon Scientific Press
12. Roberto Biassoni and Alessandro Raso, (2014), Quantitative Real-Time PCR: Methods and Protocols, Springer
13. Jorg Hoheisel, (2006),DNA Microarrays: Methods and Protocols, Humana Press

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Molecular Mechanisms of Learning and Memory**
Type of Course	**DCE**
Course Code	**MG8DCEBTG400**
Course Level	**400-499**
Course Summary	This course explores neurobiology's role in learning and memory, beginning with historical context and advancing through synaptic transmission, synaptic plasticity mechanisms like LTP and LTD, and intracellular signaling pathways. It examines neurotransmitter-receptor dynamics, immediate early genes, and epigenetic modifications such as DNA methylation and histone modification in memory formation. Environmental influences on epigenetics and the molecular basis of neurodegenerative diseases like Alzheimer's and Parkinson's are scrutinized. Therapeutic approaches for these disorders are also discussed. By integrating theory with practical applications, students gain a deep understanding of neurobiology's impact on cognitive processes and neurological health, fostering insight into potential interventions and future research directions.

Semester	8	**Credits**			3	**Total Hours**
Course Details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4	0	0	0	**60**
Pre-requisites, if any	Need to complete difficulty level 300-399 courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Students will understand the fundamental principles of neurobiology.	U	1, 2,
2	Students will gain the knowledge of neuronal structure and function	K	1, 9
3	Students will critically analyze intracellular signaling pathways.	An	3, 4
4	Evaluate the impact of epigenetic modifications on memory.	E	9, 10
5	Demonstrate the ability to analyze and solve problems related to disorders of learning and memory.	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 transaction (Units)

Module	Unit	Course Content	Hrs	CO No.
1 Introduction to Molecular Basis of Learning and Memory	1	Introduction to the field of neurobiology and its relevance to learning and memory.	3	1
	2	Historical perspective on the study of molecular mechanisms in neuroscience.	3	1
2 Neuronal Signaling and Synaptic Plasticity	1	Neuronal structure and function. Synaptic transmission and its role in learning and memory.	6	2
	2	Long-term potentiation (LTP) and long-term depression (LTD) as synaptic plasticity mechanisms.	5	2
3 Molecular and Epigenetic mechanisms of Memory formation	1	Intracellular signaling pathways involved in memory formation.	5	3
	2	Role of neurotransmitters and receptors in learning and memory.	5	3
	3	Study of immediate early genes in memory consolidation.	5	3
	4	Epigenetic modifications and their impact on memory.	5	4
	5	DNA methylation, histone modification, and their role in synaptic plasticity.	6	4
	6	Environmental influences on epigenetic mechanisms in memory.	5	4
4 Disorders of Learning and Memory	1	Neurological disorders affecting learning and memory.	5	5
	2	Molecular basis of neurodegenerative diseases (e.g., Alzheimer's, Parkinson's diseases).	4	5
	3	Therapeutic approaches and potential interventions.	3	5
5		Teacher Specific content		

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Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S. A., & Hudspeth, A. J. (2012). Principles of Neural Science. McGraw-Hill Education.
2. Bear, M. F., Connors, B. W., & Paradiso, M. A. (2015). Neuroscience: Exploring the Brain. Wolters Kluwer.
3. Nestler, E. J., Hyman, S. E., & Malenka, R. C. (2015). Molecular Neuropharmacology: A Foundation for Clinical Neuroscience. McGraw-Hill Education.
4. Squire, L. R., & Kandel, E. R. (2009). Memory: From Mind to Molecules. Roberts and Company Publishers.
5. Sweatt, J. D., Meaney, M. J., & Nestler, E. J. (2012). Epigenetics in the Nervous System. Cold Spring Harbor Laboratory Press.
6. Kesner, R. P., & Martinez Jr., J. L. (2007). Neurobiology of Learning and Memory. Academic Press.

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Biopharmaceuticals and Nanotechnology**
Type of Course	**DCE**
Course Code	**MG8DCEBTG401**
Course Level	**400-499**
Course Summary	This course aims to provide a comprehensive understanding of various principles and process of Biotechnology and its integration to pharmaceutical studies. This course also aims to discuss the science of nanotechnology and its application in medicine.

Semester	8	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Need to complete difficulty level 300-399 courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Able to define and explain Biopharmaceuticals .	K	1, 2
2.	Summarise the context and evolution of biopharmaceuticals.	U	3, 10
3.	Understand therapeutic applications and classifications of biopharmaceuticals.	U	1, 2
4.	Apply knowledge of Immunology and rDNA technology in production of Biopharmaceuticals.	A	1, 10
5.	Analyse preclinical and clinical trials and study the regulatory framework for pharmaceuticals.	An	6, 8
6.	Understand the nanomaterials and it's application on medicine,	U	1, 3
7.	Compare the difference between Nano based medicine from conventional medicine by using case study models.	An	1, 4, 10
8.	Design Biopharmaceuticals based on the knowledge gained about extraction of compounds.	C	2,3,4

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 Fundamentals of Biopharmaceuticals	1.1	Definition and scope of biopharmaceuticals	2	1, 2
	1.2	Historical context and evolution of biopharmaceuticals.	3	1, 2
	1.3	Basic techniques in Biopharmaceutical production – Overview Difference between Biopharmaceuticals and pharmaceuticals.	5	2, 3
2 Biopharmaceuticals : A Revolution in Medicine	2.1	Immunology & Biopharmaceuticals: Hybridoma Technology and purification of Monoclonal antibodies.	5	4, 5
	2.2	Recombinant Proteins and Vaccines : Insulin, Recombinant vaccines, Biopharming, Overview of metabolic Engineering	5	3, 4
	2.3	Gene therapy, Personalized Medicine,3D printing.	3	2, 4
	2.4	Purification and Downstream processing of Biopharmaceuticals.	3	4, 10
3 Drug Development Pipeline	3.1	Stages in Drug development: Target Identification and Validation, Assay Development, Lead optimization.	5	2, 6
	3.2	Preclinical testing and clinical trials.	3	4, 6
	3.3	Regulatory affairs: CDSCO, CPCSEA guidelines, ICMR Guidelines.	4	4, 6
4 Basics of Nanotechnology	4.1	Nanotechnology an Introduction – Properties of Nanoparticles	2	7
	4.2	Classification of Nanomaterials: Carbon based, Metal based,Dendrimers and composites. Magnetic and metallic nanoparticles. Preparation and characterization. Quantum dots: Properties.	4	7,8
	4.3	Application of Nanotechnology in Medicine: Nano drug delivery systems, Nano based tissue engineering materials, Cancer Therapy using Nanomaterials, Cosmetics and Nanotechnology. Benefits of Nano- based treatments a comparative study. **Case study** : Drug delivery using Nanomaterials for Targeted Cancer Therapy.	8	7,8
	4.4	Extraction of Nanoparticles from bio sources. An Outline for Developing Biopharmaceuticals based start-ups. **Case study**: A study on successful Biopharmaceuticals company and it's products.	8	9,10
5.		Teacher Specific Content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References:

1. Cromwellian, D. J. A., & Sindelar, D. R. (2007). Pharmaceutical Biotechnology: Fundamentals and Applications (3rd ed.). CRC Press.
2. Kulkarni, S. K. (2015) Nanotechnology Principles and Practices.
3. Murthy, B. S., et al.(2013) Textbook of Nanoscience And Nanotechnology. Universities Press (India) Private Limited.
4. Niemeyer, C. M., & Mirkin, C. A. (2004) Nanobiotechnology: Concepts, Applications and Perspectives.
5. Primrose, S. B., & 1 more. (2003). Principles of Gene Manipulation and Genomics (7th ed.). ISBN-13: 978-1405135443.
6. Satyanarayana, U., & Chakrapani, U. (2005). Biotechnology (15th ed.). ISBN: 81-87134-90-9.
7. Singh, B. D. (2000). Kalyani Biotechnology Expanding Horizons (5th ed.). Kalyani Biotechnology. ISBN: 9789393168085.
8. Stranford, S. A., Owen, J. A., Punt, J., & Janus, P. P. Kuby☹2013)Textbook of Immunology. ISBN: 9781464137846.
9. Walsh, G. (2003) Biopharmaceuticals: Biochemistry and Biotechnology.
10. Yeh, M. K., & Chen, Y. C. (2018). Biopharmaceuticals. British Library. ISBN: 978-1-78923-718-4.

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Honours) Biotechnology</td></tr>
<tr><td>Course Name</td><td colspan="6">Forensic Biotechnology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG8DCEBTG402</td></tr>
<tr><td>Course Level</td><td colspan="6">400-499</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course offers an in-depth exploration of forensic principles, including Locard's Exchange principle, crime scene preservation, evidence identification, and chain of custody. It covers ethical considerations and interdisciplinary collaboration. Biotechnology's role in forensic sample collection, preservation, DNA processing, and analysis techniques such as spectrophotometry and PCR are discussed. Emphasis is placed on DNA profiling, sequencing methods, bioinformatics, and applications like NGS and metagenomics. Fingerprint and counterfeit analysis, epigenetics, and environmental forensics are also addressed. Students engage with ethical and social concerns in forensic science, fostering comprehensive understanding and critical analysis within the field.</td></tr>
<tr><td>Semester</td><td>8</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Need to complete difficulty level 300-399 courses</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Comprehend the concept of Forensic Biotechnology principles.	U	1,2,10
2	To apply the ethical principles in forensics	E	2,3
3	To Understand and Apply the knowledge gained about sample collection in forensics.	U,A	3,5,9
4	To understand various methods for collection and preservation of forensics samples.	U,A	1,2,3
5	To identify the use of instruments in forensic biotechnology.	A	6,9,10
6	To analyse the importance of molecular techniques in forensics	An	2,3,6

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

MGU-UGP (HONOURS) Syllabus

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Forensic Science	1.1	Definition; Basic Principles of Forensics-Locard's Exchange Principle; Preservation of Crime Scene; Identification, Individualization & Classification; Chain of Custody and Chronological History of Evidence; Reconstruction; Reliability & Validity; Expert Testimony; Transparency and Objectivity; Cross-Disciplinary Collaboration	7	1,2,
	1.2	Ethical principles, Legal, and Social Implications.	3	2,4
	1.3	Scope of Biotechnology in Forensics, Forensic Disciplines.	5	1,
2. Sample Collection and processing	2.1	Sample Collection: (Hair, Blood, Body Fluids); Collection of Touch DNA. Sample Collection Techniques: DNA Collection Kits,Buccal Swabs,Filter Paper Technology, Absorption Matrices, Flinder Technology Cards, Lateral Flow Device, Microfluidics, DNA Vacuum Pump	6	1,3
	2.2	Preservation & transport. Processing & Isolation of Nucleic acids.	4	1,4
	2.3	Quantitative and Qualitative analysis: Spectrophotometry, Chromatography, Spectroscopy techniques-overview modifications.	5	4,5
3. Advanced Molecular Techniques in Forensics	3.1	Amplification techniques- PCR, qPCR. Forensic related markers- STR Analysis, DNA profiling,VNTR-DNA Fingerprinting, indicators for sex determination-Mitochondrial DNA analysis, Y-Chromosome Analysis-Amelogenin, SRY, and DYS14.	5	1,5
	3.2	Sequencing Methods -DNA Sequencing (Overview). DNA methylation Analysis.	5	1,4
	3.3	Bioinformatics in forensics: DNA Databases (Forensic).	5	4,5
4. Applications, Scope and Future trends	4.1	Advances in Forensic Genomics and phenotyping, Applications of forensic Biotechnology -NGS.	5	1,3,
	4.2	Fingerprint Analysis, Counterfeit Analysis, Metagenomics - Environmental forensics- Epigenetics.	5	3, 5
	4.3	Development of New Biomarkers for Forensic Use, Forensic Biotechnology in Mass Disasters and Missing Persons Cases, Ethical, Legal, and Social Implications of New Forensic Technologies.	5	2,5
5.		Teacher Specific Content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks
	B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

1. Tobe, S. S. (2016). Forensic DNA Analysis: Current Practices and Emerging Technologies. CRC Press.
2. Sandy B. Primrose et al. (2013) Principles of Gene Manipulation and Genomics 7th Edition7th Edition ISBN-13: 978-1405135443.
3. Elsa Lee et al (2015) Forensic Science: The Basics, Third Edition 3rd Edition ISBN-13: 978-1482223330 ISBN-10: 9781482223330
4. Vivan Varma, Schutte (2010) Fundamentals of Forensic Science Second Edition Belle Library. ISBN: 978-0-12- 374989-5
5. David Holding (2020) Forensic Science Basics: Every Contact Leaves a Trace
6. Butler, J. M. (2015). Advanced Topics in Forensic DNA Typing: Interpretation. Academic Press.
7. Lee, H. C., & Ladd, C. (2001). DNA Typing in Forensic Science. Elsevier.
8. Jamieson, A., & Moenssens, A. (2016). Wiley Encyclopedia of Forensic Science. Wiley.
9. Goodwin, W., Linacre, A., & Hadi, S. (2011). An Introduction to Forensic Genetics. Wiley-Blackwell.

Suggested readings

1. Max M. Houck and Jay A. Siegel Fundamentals of Forensic Science, Academic Press Second Edition,978-0-12-374989-5
2. Evgeny Katz; Jan Halámek Forensic Science: A multidisciplinary approach by ISBN: 9783527338948 2016
3. Stuart James & Jon Nordby Forensic Science, An Introduction to Scientific and Investigative Techniques, ISBN9781315170336
4. Houck, M. M. (2018). Forensic Biology. Elsevier.
5. Li, R. (2008). Forensic Biology. CRC Press.
6. An, J. H., & Shin, K. J. (2012). Forensic DNA Typing Protocols. Humana Press.
7. Magalhães, T., & Santos, M. A. (2015). Forensic DNA Applications: An Interdisciplinary Perspective. CRC Press.
8. Kobilinsky, L. (2005). DNA: Forensic and Legal Applications. Wiley-Liss.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Biotechnology**
Course Name	**Stem Cells and Tissue Engineering**
Type of Course	**DCE**
Course Code	**MG8DCEBTG403**
Course Level	**400-499**
Course Summary	This course enlightens the students with the trends and techniques in stem cells and tissue engineering.

Semester	8	Credits			4	Total Hours
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	O	60
Pre-requisites, if any	Need to complete difficulty level 300-399 level courses					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Students will be able to define stem cells and describe their characteristics	K	1,2
2	Applying the principles of tissue engineering.	E	2,6,8
3	Students will analyze the sources of stem cells.	An	3,6,8,
4	Through an in-depth understanding of tissue development in vitro and in vivo, students will evaluate parameters used in tissue engineering.	E	,8,10
5	Students will engage in critical thinking by addressing challenges and opportunities in the integration of stem cells and tissue engineering.	E	2,6,8
6	Explore advanced technologies in tissue engineering.	A	3,6,8,

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

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COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to stem cells and tissue engineering	1.1	Introduction to stem cells and tissue engineering	5	1
	1.2	Cell differentiation and principlesof stem cells	5	1
	1.3	Types of tissue engineering and application of bio-materials	5	1
2 Cell behavior andadvanced techniques	2.1	Stem cell type and sources.	5	2
	2.2	Stem cell behavior and advancedtechniques.	5	2
	2.3	Plant stem cells and its types	5	
3 Tissue engineering. and health	3.1	Tissue development in in vitro andin vivo cultures	8	3
	3.2	Tissue regeneration and advancedhealth care techniques	7	3
4 Tissue Engineering, Challenges and Opportunities	4.1	Donating or harvesting stem cells	5	4
	4.2	Tissue Engineering, challengesand opportunities	5	4
	4.3	Bio fabrication and 3D printing,	5	4
5		Teacher specific content		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Discussion.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Assignment, Oral Presentations, Quiz, Group Discussions **Evaluation:** CCA : 30 marks B. **End Semester Examination – 2.0 hrs.** Total marks: 70 marks.
Pattern of questions:	Total marks : 70 marks (2.0 hrs) One word answer question(1 mark):10 out of 10 10x1= 10 marks Short answer questions (3 marks) :5 out of 7 5x3= 15 marks Short essay (6 marks) :5 out of 7 5x6= 30 marks Essay (15 marks) :1 out of 2 1x15= 15 marks

References

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2. Bhatt SM, (2011) Animal Cell Culture - Concept and Application-Narosa publishing house,2011,ISBN 10:8173199264

3. Bikramjith Basu, (2022) Biomaterials science and Tissue Engineering; Principles And Methods-IIS press.2022. ISBN 13:9781108415156.ISBN 10:1108415156

4. Robert Lanza (2011), Essentials of Stem Cell Biology, Academic press

5. Bruce M Carlson (2014) Human Embryology and Developmental Biology Elsevier.

6. Mark Saltsman W, (2014) Tissue Engineering : Principles and Practice.

7. Darwin J. Prockop (2008) Cells Handbook, Springer

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<table>
<tr><th colspan="4">MODE OF ASSESSMENT - INTERNSHIP</th></tr>
<tr><td rowspan="10">Assessment Types</td><td colspan="3">A. Continuous Comprehensive Assessment (CCA)</td></tr>
<tr><td rowspan="3">Internship</td><td>Performance Appraisal from the Industry/Units:
1. Technical skills,
2.Work quality,
3.Problem solving skills,
4.Communication and team work and
5. Time management.</td><td>Marks
10</td></tr>
<tr><td>Knowledge acquisition, Growth and Improvement</td><td>5</td></tr>
<tr><td>Total</td><td>15</td></tr>
<tr><td colspan="3">B. Final Evaluation</td></tr>
<tr><td colspan="2">Exam Components</td><td>Marks</td></tr>
<tr><td colspan="2">Internship Report</td><td>20</td></tr>
<tr><td colspan="2">Presentation of work done</td><td>5</td></tr>
<tr><td colspan="2">Viva-Voce</td><td>10</td></tr>
<tr><td colspan="2">Total</td><td>35</td></tr>
</table>

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MODE OF ASSESSMENT – PROJECT Course code: MG8PRJBTG400	
Course code: MG8PRJBTG400	**Course Name : Project**
A. Continuous Comprehensive Assessment (CCA)	
Relevance of Topic	**10**
Depth of Research	**20**
Punctuality	**10**
Final report	20
Total	**60**
B. Final Assessment	
Evaluation components	**Distribution of mark**
Preparation of Thesis	
Certificates of guide, HOD, Declaration of student	3
Abstract, key words	2
Introduction	5
Review	5
Materials and Methods	10
Result & Discussion	10
Conclusion & Bibliography	5
Placement of Table/, Fig)	5
Neat layout	5
Total	**50**
Presentation of work	
Timing	5
Display of slides (relevant data)	10
Presentation of methodology	10
Preparation of result	10
Interpretation and analysis	10
Conclusion	5
Total	**50**
Viva	
Response to the questions	10
Knowledge and concept of objective and methodology	10
Justification of Result/Significance of hypothesis	10
Understanding on future work, its practicality and feasibility	10
Total	**40**
Grand Total	**140**
Final mark (CCA+ESA)	**200**

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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

MGU-UGP (HONOURS)

Syllabus

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

Chairperson:

Dr. Soorej M. Basheer, Associate Professor & Head, Department of Molecular Biology, Kannur University

Members:

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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

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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

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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					

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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					

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Appendix I

Name of the Minor : Food Microbiology

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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	-

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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	-

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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	

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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	

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SEMESTER-I

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="5">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="5">UNSEEN WORLD OF MICROBES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="5">MG1DSCMBG100</td></tr>
<tr><td>Course Level</td><td colspan="5">100 - 199</td></tr>
<tr><td>Course Summary</td><td colspan="5">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.</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="5">Knowledge of plus two level basic science subjects.</td></tr>
</table>

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)***			

MGU-UGP (HONOURS) Syllabus

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="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="15">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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="7">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 colspan="2">Total: 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>

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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.
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.

MGU-UGP (HONOURS)

Syllabus

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.					

MGU-UGP (HONOURS)
Syllabus

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		

<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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Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="10">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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 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	Part - B: 5 Marks Any 3 out of 6	3 X 5 = 15	Record	5
				Viva voce	5
	1 Credit Practical: 17.5 Marks	Part- C: 10 Marks Any 1 out of 2	10 X 1 = 10	**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.
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2. Topley & Wilson's Microbiology and Microbial Infections (1998), 8 volumes, sixth edition edition, Hodder Arnold, London.

MGU-UGP (HONOURS)
Syllabus

SEMESTER-II

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">Perspectives of Microbiology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC A</td></tr>
<tr><td>Course Code</td><td colspan="6">MG2DSCMBG100</td></tr>
<tr><td>Course Level</td><td colspan="6">100 - 199</td></tr>
<tr><td>Course Summary</td><td colspan="6">The course on Perspectives of Microbiology provides a comprehensive knowledge of the morphology, nutrition, reproduction, growth and cultivation of microorganisms.</td></tr>
<tr><td>Semester</td><td>2</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Knowledge of plus two level basic science subjects</td></tr>
</table>

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)***			

MGU UGP (HONOURS) Syllabus

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>Teaching and Learning Approach</td><td colspan="5">➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<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>
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References

1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
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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.					

MGU-UGP (HONOURS)
Syllabus

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		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="5">Classroom Procedure (Mode of transaction)
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<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</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>
</table>

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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.
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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

MGU-UGP (HONOURS) Syllabus

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

MGU-UGP (HONOURS)

Syllabus

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. **Plate** (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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<tr><td>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="4">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2 Hours</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></td><td>Part – C: 10Marks
Any 1 out of 2</td><td>1 X 10 = 10</td><td>Viva voce</td><td>5</td></tr>
</table>

	1 Credit Practical: 17.5 Marks	**Total:**	**50 marks**	**Total**	**35****
				** Adjusted to 17.5 Marks for final calculation	

References

1. Ananthanarayanan and Paniker's (2020) Textbook of Microbiology 11th edition, Universities Press publishes.
2. Daniel Lim (1997), Microbiology. 2^{nd} Edition, United States: WCB/McGraw-Hill.
3. Dr.C.B.Powar & H.F.Daginawala. General Microbiology (Vol-I), Himalaya Publishers.
4. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
5. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood, and Chris Woolverton (2017). Prescott's Microbiology. 12^{th} Edition, Singapore: McGraw-Hill Education.
6. Gerard J. Tortora, Microbiology an introduction. (2015), 13^{th} Edition, United Kingdom: Pearson.
7. James G Cappuccino and Natalie Sherman (2014) Microbiology laboratory manual, 11^{th} Edition, United Kingdom: Pearson.
8. Mackie and McCartney, Microbiology: Principles and Explorations by Jacquelyn G. (1996), 15^{th} Edition, India: Churchill Livingstone.
9. K.Rajeshwar.Reddy, Microbiology and Parasitology. Reddy, K. R. (2010). Microbiology and Parasitology: Question and Answer Review.5^{th} Edition, India: Paras Medical Publisher.

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1. Aneja K.R. 2020 Experiments in Microbiology, Plant Pathology and Biotechnology sixth edition, New Age International publications Private Limited
2. Dubey R.C. and Maheswary A K., (2018) A textbook of Microbiology, 5^{th} Edition, S. Chand Publications
3. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

MGU-UGP (HONOURS)

Syllabus

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)**			

MGU-UGP (HONOURS) Syllabus

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**		

SGOU-UGP (HONOURS) Syllabus

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Time: 2 Hours

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MGU-UGP (HONOURS)

References:

1. Cappuccino, James G., and Natalie Sherman. *Microbiology: a laboratory manual*. 11th Edition, United Kingdom: Pearson Higher Ed, 2013.
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

MGU-UGP (HONOURS) Syllabus

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="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 colspan="3"></td></tr>
<tr><td rowspan="5">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks

Time: 2 Hours</td><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>
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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					

MGU-UGP (HONOURS) Syllabus

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

MGU-UGP (HONOURS)
Syllabus

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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 ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

	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)***

MGU-UGP (HONOURS) Syllabus

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>
<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="15">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="8">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 colspan="2"></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. 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.
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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
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<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">TECHNIQUES IN MICROBIOLOGY</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSC B</td></tr>
<tr><td>Course Code</td><td colspan="6">MG3DSCMBG202</td></tr>
<tr><td>Course Level</td><td colspan="6">200 - 299</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course aims to give a basic idea of microbiology lab safety rules, techniques for isolating microorganisms and how to view a microorganism.</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>1</td><td>0</td><td>75</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Basic knowledge of Instruments</td></tr>
</table>

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)***

MGU-UGP (HONOURS) Syllabus

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

	Theory		Practical	
Continuous Comprehensive Assessment (CCA) **3 Credit Theory: 25 Marks** **1 Credit Practical: 7.5 Marks**	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			

	Theory		Practical	
End Semester Evaluation (ESE) **3 Credit Theory: 50 Marks** **Time: 2 Hours**	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
1 Credit Practical: 17.5 Marks	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.

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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).

MGU-UGP (HONOURS)

Syllabus

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

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS)
Syllabus

	Mode of Assessment
	Classroom Procedure (Mode of transaction)

Teaching and Learning Approach	➢ 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	**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 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. 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)***

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS) Syllabus

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="2">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="15">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="8">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 colspan="2"></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. 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
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

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)

MGU-UGP (HONOURS)
Syllabus

Teaching and Learning Approach		➢ 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)	**Theory**		**Practical**	
3 Credit Theory: 25 Marks **1 Credit Practical: 7.5 Marks**	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)	**Theory**		**Practical**	
3 Credit Theory: 50 Marks **Time: 2 Hours**	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****
1 Credit Practical: 17.5 Marks			** Adjusted to 17.5 Marks for final calculation	

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	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		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)***

MGU-UGP (HONOURS) Syllabus

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		

<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
➢ 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="16">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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="7">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>

MGU-UGP (HONOURS)
Syllabus

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

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Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">INDUSTRIAL MICROBIOLOGY</td></tr>
<tr><td>Type of Course</td><td colspan="6">DSE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG4DSEMBG200</td></tr>
<tr><td>Course Level</td><td colspan="6">200 - 299</td></tr>
<tr><td>Course Summary</td><td colspan="6">This course provides knowledge on concepts in the processes, instruments, quality etc. being used in industries to produce products using microorganisms</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Prerequisites, if any</td><td colspan="6">Basic knowledge of different fermentation processes and application of microorganisms.</td></tr>
</table>

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)***			

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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		

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 (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**

MGU-UGP (HONOURS)

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)

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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	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		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)

Teaching and Learning Approach	➢ 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 (ESE) **4 Credit Theory: 70 Marks** **Time: 2Hours**	**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. 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.

MGU-UGP (HONOURS) Syllabus

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)***

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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	**<u>HANDS-ON TRAINING</u>** ● 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		

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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 (ESE) **4 Credit Theory: 70 Marks** **Time: 2.00 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**

MGU-UGP (HONOURS)

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		

<table>
<tr><td>Teaching and Learning Approach</td><td></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>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="7">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
Time: 2.0 Hours

1 Credit Practical: 17.5 Marks</td><td>Theory</td><td></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>
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<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>

MGU-UGP (HONOURS)

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.

MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

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		**Practical content**	15	3
	3.1	Demonstration of Garden Waste & Kitchen Waste Composting – Different Techniques – Bin Composting, Pit Composting, Tube Composting, In-Vessel Composting, Open Pile		
4		Teacher Specific Contents		

MGU-UGP (HONOURS)

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**

		Theory	
	End Semester Evaluation (ESE) **3 Credit Theory: 50 Marks** **Time: 2.0 Hours**	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

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
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		Lecture	Tutorial	Practical	Others	
	Learning Approach	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)***

MGU-UGP (HONOURS) Syllabus

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		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="2">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="3">Mode of Assessment</td></tr>
<tr><td rowspan="7">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: 2.0 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. 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

MGU-UGP (HONOURS)
Syllabus

	Mahatma Gandhi University **Kottayam**

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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➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<tr><td rowspan="15">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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="7">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>

MGU-UGP (HONOURS)

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 rowspan="7">Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
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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>Experiments</td><td>25</td></tr>
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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>

MGU-UGP (HONOURS)

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
Kottayam

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
	1.2	**Biochemical reactions** Carbohydrate fermentations, IMViC, TSI, H_2S production, Urease, Nitrate reduction, Catalase and Oxidase		
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
	3.2	*Clostridium botulinum.*		
	3.3	*Corynebacterium diphtheriae* *Bacillus anthracis*		
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		

<table>
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<tr><td rowspan="14">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="6">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 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>
</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.*

Mahatma Gandhi University
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		

<table>
<tr><td>Teaching and Learning Approach</td><td></td><td colspan="2">Classroom Procedure (Mode of transaction)
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Laboratory instructions, Demonstration of methods & Hands-on experiments</td></tr>
<tr><td rowspan="16">Assessment Types</td><td colspan="3">Mode of Assessment</td></tr>
<tr><td rowspan="8">Continuous Comprehensive Assessment (CCA)
4 Credit Theory: 30 Marks</td><td colspan="2">Theory</td></tr>
<tr><td>Component</td><td>Mark</td></tr>
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<tr><td>Activity (Related to teacher-specific content)</td><td>10</td></tr>
<tr><td>Total</td><td>30</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="7">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>

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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.*

	Mahatma Gandhi University **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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4 Credit Theory:
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<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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</table>

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

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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.

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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

Mahatma Gandhi University
Kottayam

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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<tr><td rowspan="6">End Semester Evaluation (ESE)
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</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		

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<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="6">End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks

Time: 2 Hours</td><td colspan="2"></td></tr>
<tr><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>

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References

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

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SEMESTER-VI

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University

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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		

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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>
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1 Credit Practical: 17.5 Marks</td><td colspan="2">Theory</td><td colspan="2">Practical</td></tr>
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<tr><td>Viva voce</td><td>5</td></tr>
<tr><td>Total</td><td>35**</td></tr>
<tr><td colspan="4">** 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.*

MGU-UGP (HONOURS) Syllabus

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		

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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**				
		Theory		**Practical**	
		Component	Mark	Component	Marks
	Continuous Comprehensive Assessment (CCA) **3 Credit Theory: 25 Marks** **1 Credit Practical: 7.5 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			
		Theory		**Practical**	
	End Semester Evaluation (ESE) **3 Credit Theory: 50 Marks** **Time:2 hours** **1 Credit Practical: 17.5 Marks**	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. 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	

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	(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

MGU-UGP (HONOURS)
Syllabus

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		

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**		
		Theory	
	Continuous Comprehensive Assessment (CCA) **4 Credit Theory: 30 Marks**	Component	Mark
		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**

MGU-UGP (HONOURS) Syllabus

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.

विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

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="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>
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Any 1 out of 2</td><td>1 X 15 = 15</td></tr>
<tr><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

MGU-UGP (HONOURS)
Syllabus

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	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		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
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<tr><td rowspan="8">Continuous Comprehensive Assessment (CCA)
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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>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="6">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
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<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>
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</table>

References:

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Syllabus

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)***			

MGU-UGP (HONOURS) Syllabus

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="16">Assessment Types</td><td colspan="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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="7">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>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>
<tr><td></td><td></td><td colspan="2">**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.

MGU-UGP (HONOURS) Syllabus

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)			

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS)
Syllabus

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<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

MGU-UGP (HONOURS)
Syllabus

	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)**			

MGU-UGP (HONOURS)
Syllabus

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**		

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

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<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)
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Time: 2 hours

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<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>

MGU-UGP (HONOURS)

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	

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	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		

<table>
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➢ Direct Instruction: Chalk and Board, PowerPoint presentations, Lectures, Explicit Teaching, E-learning
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<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. 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

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<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">Microbial Process Technology</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCC</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DCCMBG402</td></tr>
<tr><td>Course Level</td><td colspan="6">400 - 499</td></tr>
<tr><td>Course Summary & Justification</td><td colspan="6">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.</td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites</td><td colspan="6">Completion of 300-level courses in microbiology</td></tr>
</table>

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)***

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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="7">End Semester Evaluation (ESE)
4 Credit Theory: 70 Marks
Time: 2 Hours</td><td>Theory</td><td></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
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<tr><td>Total:</td><td>70 marks</td></tr>
</table>

MGU-UGP (HONOURS)

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

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<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">Research Methodology and Biostatistics</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DCEMBG400</td></tr>
<tr><td>Course Level</td><td colspan="6">400 - 499</td></tr>
<tr><td>Course Summary</td><td colspan="6">The course provides a comprehensive knowledge of research methodology and statistical analysis of data</td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">No</td></tr>
</table>

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)***

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS) Syllabus

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<tr><td rowspan="1">Teaching and Learning Approach</td><td colspan="4">Classroom Procedure (Mode of transaction)
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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

MGU-UGP (HONOURS) Syllabus

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					

MGU-UGP (HONOURS) Syllabus

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**

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	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**		

<table>
<tr><td>Teaching and Learning Approach</td><td colspan="3">Classroom Procedure (Mode of transaction)
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</table>

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

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Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">AMR AND ONE HEALTH APPROACH</td></tr>
<tr><td>Type of Course</td><td colspan="6">DCE</td></tr>
<tr><td>Course Code</td><td colspan="6">MG7DCEMBG402</td></tr>
<tr><td>Course Level</td><td colspan="6">400 - 499</td></tr>
<tr><td>Course Summary & Justification</td><td colspan="6">Upon completion of this course, students will acquire knowledge of anti-microbial resistance,</td></tr>
<tr><td>Semester</td><td>VII</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites</td><td colspan="6">No</td></tr>
</table>

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

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	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			
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
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		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

MGU-UGP (HONOURS)

Syllabus

Mahatma Gandhi University
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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)***

MGU-UGP (HONOURS) Syllabus

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		

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MGU-UGP (HONOURS)

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)

MGU-UGP (HONOURS)
Syllabus

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		

<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="15">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. 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.
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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
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

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	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		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)			

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS) Syllabus

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**

	Theory		Practical	
	Component	Mark	Component	Marks
Continuous Comprehensive Assessment (CCA) **2 Credit Theory: 15 Marks** **2 Credit Practical: 15 Marks**	Test/Quiz	10	Test/Quiz	5
	Seminar	2.5	Lab involvement	2.5
	Assignment	2.5	*Activity (related to teacher-specific content)	7.5
	Total	**15**	**Total**	**15**

	Theory		Practical	
End Semester Evaluation (ESE) **2 Credit Theory: 35 Marks** **Time: 1.5 Hours** **2 Credit Practical: 35 Marks**	Part -A: 2 marks Any 10 out of 12	10 X 1= 10	Experiments	25
	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**

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.

MGU-UGP (HONOURS)

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.

<table>
<tr><td>Semester</td><td>VIII</td><td colspan="3">Credits</td><td>4</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>90</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6"></td></tr>
</table>

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		

MGU-UGP (HONOURS)
Syllabus

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➢ 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="5">Mode of Assessment</td></tr>
<tr><td rowspan="7">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 colspan="4"></td></tr>
<tr><td rowspan="6">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>

MGU-UGP (HONOURS)
Syllabus

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="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="15">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).

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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**

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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

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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

Meeka Anna Mickle, Assistant Professor, St Mary's College for Women, Thiruvalla

Muhsina Jaleel, Assistant Professor, Indira Gandhi College of Arts & Science

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

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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		

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<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)
<ol type="A">
CCA for 3 Credits Theory : 25 Marks
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>Total</td><td></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>

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	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

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विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

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)***

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COURSE CONTENT
Content for Classroom transaction (Units)

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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

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	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. (5^{th} ed.). S. Chand & Company Pvt. Ltd., New Delhi.
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Syllabus

	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)

MGU-UGP (HONOURS)
Syllabus

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		

MGU-UGP (HONOURS)

Syllabus

<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)
<ol type="A">
CCA for 3 Credits Theory : 25 Marks
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>

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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

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2. James M. Jay. (2004). Modern Food Microbiology (4th ed.). CBS Publishers and Distributors, New Delhi.

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<table>
<tr><td>Programme</td><td colspan="6"></td></tr>
<tr><td>Course Name</td><td colspan="6">Industrial and Entrepreneurial Microbiology</td></tr>
<tr><td>Type of Course</td><td colspan="6">MDC</td></tr>
<tr><td>Course Code</td><td colspan="6">MG2MDCMBG101</td></tr>
<tr><td>Course Level</td><td colspan="6">100-199</td></tr>
<tr><td>Course Summary</td><td colspan="6">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.</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="3">Credits</td><td></td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td><td>60</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">A mindset geared towards entrepreneurship in microbiology-biotechnology sectors</td></tr>
</table>

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		

MGU UGP (HONOURS)
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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
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Industry Visit

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<tr>
<td>Assessment Types</td>
<td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
<ol type="A">
CCA for 2 Credits Theory : 15 Marks
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) or Quiz</td><td>8</td></tr>
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<tr><td>Topic clarity</td><td>1</td></tr>
<tr><td>Presentation skill</td><td>2</td></tr>
<tr><td>Interacting with the audience</td><td>1</td></tr>
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<tr><td>Evaluation of Practical Skill (Test/Experimentation)</td><td>8</td></tr>
<tr><td>Lab involvement</td><td>2</td></tr>
<tr><td>Report of Industry visit</td><td>5</td></tr>
<tr><td>**Total</td><td>15</td></tr>
</table>
**CCA for Practical = Total marks x 0.5
</td>
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MGU UGP (HONOURS)
Syllabus

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. (3^{rd} ed.). K. R. Aneja eds. Panima Publishing Corporation, New Delhi.
2. Caseda JR, L. E. (2009). Industrial Microbiology. (2^{nd} ed.). New Age International (P) Limited Publishers, Bangalore.
3. Patel A. H. (2016). Industrial Microbiology. (2^{nd} ed.). Trinity Press (An Imprint of Laxmi Publication Pvt. Ltd.), New Delhi.
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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)

MGU-UGP (HONOURS)

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		

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 waste water treatment system/Biocompost production unit
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		10
Seminar – Introduction of topic	2	10
Topic clarity	3	
Presentation skill	3	
Interacting with the audience	2	
*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**

MGU-UGP (HONOURS) Syllabus

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.

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8. Daniel, J. C. (1996). Environmental Aspects of Microbiology. (1^{st} ed.). Bright Sun Publications, Chennai.
9. Reed, M. (1992). Environmental Microbiology. John Wiley and Sons, New York.
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5. Daniel, J. C. (1996). Environmental Aspects of Microbiology. (1^{st} ed.). Bright Sun Publications, Chennai.

MGU-UGP (HONOURS)
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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)***

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COURSE CONTENT
Content for Classroom transaction (Units)

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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		

<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.
Scheme for CCA Theory
<table>
<tr><th colspan="2">Components</th><th>Marks</th></tr>
<tr><td colspan="2">Test (MCQ/short answer) 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">*Activity/Assignment</td><td>5</td></tr>
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*Based on Teacher specific content
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End Semester Examination (ESE)
C. ESE for 3 Credits Theory : 50 Marks
<table>
<tr><th>Question type</th><th>Marks per question</th><th>No of questions</th><th>Total Marks</th></tr>
<tr><td>Multiple choice Questions</td><td>1</td><td>10</td><td>10</td></tr>
<tr><td>Fill in the blanks questions</td><td>1</td><td>5</td><td>5</td></tr>
<tr><td>True or false questions</td><td>1</td><td>5</td><td>5</td></tr>
<tr><td>One word/very short answer questions</td><td>1</td><td>5</td><td>5</td></tr>
<tr><td>Short answer questions</td><td>2</td><td>5</td><td>10</td></tr>
<tr><td>Long answer questions</td><td>5</td><td>3</td><td>15</td></tr>
<tr><td>Total</td><td></td><td></td><td>50</td></tr>
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2. Srilakshmi, B. (2005). Food Science (3rd ed.). New Age International (P) Ltd., New Delhi.

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SUGGESTED READINGS

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2. Potter N. M. & Hotchkiss J. H. (2021). Food Science (5th ed.). CBS Publishers and Distributors, New Delhi.
3. 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
4. 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.

Syllabus

Mahatma Gandhi University
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)

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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		

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<tr>
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Industry Visit

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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
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>
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*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>2</td></tr>
<tr><td>Industry Visit</td><td>5</td></tr>
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**CCA for Practical = Total marks x 0.5
</td>
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</table>

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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

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Syllabus

Mahatma Gandhi University
Kottayam

<table>
<tr><td>Programme</td><td colspan="6">BSc (Hons) Microbiology</td></tr>
<tr><td>Course Name</td><td colspan="6">Microbial Perspectives in Disaster Response and Forensic Investigations</td></tr>
<tr><td>Type of Course</td><td colspan="6">VAC</td></tr>
<tr><td>Course Code</td><td colspan="6">MG4VACMBG201</td></tr>
<tr><td>Course Level</td><td colspan="6">200-299</td></tr>
<tr><td>Course Summary</td><td colspan="6">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.</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="3">Credits</td><td>3</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td><td>45</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Basin understanding of biology or any branch of science/disasters and their impacts on human life</td></tr>
</table>

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)**

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COURSE CONTENT
Content for Classroom transaction (Units)

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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		

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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**

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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.
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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	45
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		

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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**

MGU-UGP (HONOURS) Syllabus

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MGU-UGP (HONOURS)

Syllabus

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)***

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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**

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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.

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MGU-UGP (HONOURS) Syllabus

	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)

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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

MGU UGP (HONOURS) Syllabus

	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		

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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**

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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.
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2. Dubey, R. C. & Maheswari, D. K. (2022). A Text Book of Microbiology. (5th ed.). S. Chand & Company Pvt. Ltd., New Delhi.
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6. Robertson, G. L. (2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis.

MAHATMA GANDHI UNIVERSITY · KOTTAYAM ·
विद्यया अमृतमश्नुते
MGU-UGP (HONOURS)
Syllabus

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		

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<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>
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<tr>
<td>Assessment Types</td>
<td>
MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
A. CCA for 3 Credits Theory: 30 Marks
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<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">Lab activity (Report/experimentation)</td><td>5</td></tr>
<tr><td colspan="2">*Assignment/an activity</td><td>5</td></tr>
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</td>
</tr>
<tr>
<td></td>
<td>
End Semester Examination (ESE)
B. ESE for 3 Credits Theory : 70 Marks
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<tr><th>Question type</th><th>Marks per question</th><th>No of questions</th><th>Total Marks</th></tr>
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<tr><td>Fill in the blanks questions</td><td>1</td><td>5</td><td>5</td></tr>
<tr><td>One word/very short answer questions</td><td>1</td><td>5</td><td>5</td></tr>
<tr><td>Short answer questions</td><td>2</td><td>10</td><td>20</td></tr>
<tr><td>Short essay questions</td><td>5</td><td>4</td><td>20</td></tr>
<tr><td>Long answer questions</td><td>10</td><td>1</td><td>10</td></tr>
<tr><td>Total</td><td></td><td></td><td>70</td></tr>
</table>
</td>
</tr>
</table>

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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

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3. Wildman, R.E.C. Eds. (2006). Handbook of Nutraceuticals and Functional Foods. (2^{nd} ed.). CRC Press Taylor & Francis Group, Boca Raton. https://doi.org/10.1201/9781420006186
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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**

MGU-UGP (HONOURS)
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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

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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.

MGU-UGP (HONOURS)
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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.

MGU-UGP (HONOURS)

Syllabus

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					

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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		

MGU-UGP (HONOURS)
Syllabus

<table>
<tr><td>Teaching and Learning Approach</td><td>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, Institution visit/seminar/ lecture attended on microscopic techniques</td></tr>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
1 Credit Practical: 7.5 Marks
<table>
<tr><th colspan="2">Theory</th><th colspan="2">Practical</th></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/Viva</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>
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<tr><td>End Semester Evaluation (ESE)
3 Credit Theory: 50 Marks
1 Credit Practical: 17.5 Marks
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<tr><td>Record</td><td>5</td></tr>
<tr><td>Viva voce</td><td>5</td></tr>
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</table>

Reference

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2014). *Prescott's microbiology*. McGraw-Hill.

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SUGGESTED READINGS

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	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)			

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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		

MGU-UGP (HONOURS)
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<table>
<tr>
<td>Teaching and Learning Approach</td>
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Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Group Assignments, Library work and
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<td rowspan="2">Assessment Types</td>
<td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
2 Credit Theory: 15 Marks
1 Credit Practical: 7.5 Marks
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<tr>
<td>End Semester Evaluation (ESE)
2 Credit Theory: 35 Marks
1 Credit Practical: 17.5 Marks
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<tr><td rowspan="4">End Semester written examination for 35 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>
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MGU-UGP (HONOURS)

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

SUGGESTED READINGS

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)

MGU-UGP (HONOURS)
Syllabus

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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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. 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.

MGU-UGP (HONOURS)
Syllabus

Mahatma Gandhi University
Kottayam

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)			

MGU-UGP (HONOURS)
Syllabus

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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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)** **2 Credit Theory: 15 Marks** **1 Credit Practical: 7.5 Marks**

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

End Semester examination
2 Credit Theory: 35 Marks
1 Credit Practical: 17.5 Marks

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

MGU-UGP (HONOURS) Syllabus

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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. 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

Mahatma Gandhi University
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)			

MGU-UGP (HONOURS) Syllabus

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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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
1 Credit Practical: 17.5 Marks

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

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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.

Mahatma Gandhi University
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)

MGU UGP (HONOURS) Syllabus

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>Activity (Related to teacher-specific content)</td><td>5</td></tr>
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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

MGU-UGP (HONOURS)

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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Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Library work and Group discussion, Presentation by individual student. Laboratory sessions including demonstrations</td></tr>
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3 Credit Theory: 25 Marks
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<tr><td>Assignment</td><td>5</td></tr>
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<tr><td></td><td>End Semester examination (ESE)
3 Credit Theory: 50 Marks
Theory
End Semester examination for 50 marks</td></tr>
</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

MGU-UGP (HONOURS)

Syllabus

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 voce	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.

MGU-UGP (HONOURS)

Syllabus

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)

MGU-UGP (HONOURS) Syllabus

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		

MGU-UGP (HONOURS) Syllabus

<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>
<tr><td>Assessment Types</td><td>MODE OF ASSESSMENT
Continuous Comprehensive Assessment (CCA)
3 Credit Theory: 25 Marks
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3 Credit Theory: 50 Marks
Theory
End Semester examination for 50 marks</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.

Syllabus

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)

MGU-UGP (HONOURS) Syllabus

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

1. Brock, Thomas Dale, et al. *Brock biology of microorganisms*. Upper Saddle River (NJ): Prentice-Hall, 2003.,
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.

MGU-UGP (HONOURS)
Syllabus

	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		

MGU UGP (HONOURS) Syllabus

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<tr><td>Teaching and Learning Approach</td><td>Classroom Procedure (Mode of transaction)
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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."

MGU-UGP (HONOURS)

Mahatma Gandhi University, Kottayam

Programme	**BSc (Hons) Biochemistry**
Course Name	**Biochemistry-The Science of Life**
Type of Course	**DSC A**
Course Code	**MG1DSCBCH100**
Course Level	**100-199**
Course Summary	The primary objective of this course is to establish a strong foundation in biochemistry for students, with a focus on essential molecular components. Additionally, the course covers fundamental procedures within a biochemistry laboratory and the qualitative analysis of biomolecules.

Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Acquire an understanding of the nature of cells, water,buffers and the scope of Biochemistry	K, U, I	2, 3, 4, 6, 10
2.	Demonstrate the structure and functions of carbohydrates	K, U, E	1, 2, 3, 4
3.	Describe the general structure of amino acids and structural organisation of proteins	K,U, E	1,2,3,4
4.	Evaluate the chemical nature of lipids and nucleic acids.	U, E, An	1, 2, 3, 4
5.	Demonstrate laboratory safety practices and preparation of solutions.	An, E, Ap	2, 5, 8,10
6.	Employ appropriate biochemical tests to identify unknown biomolecules	U, A, C, S	2, 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. Introduction to Biochemistry	1.1	History of Biochemistry.	2	1
	1.2	Cells - the basis of living organisms- prokaryotic and eukaryotic cells.	2	1
	1.3	Importance of water in biological systems - interactions in aqueous systems.	3	1
	1.4	Dissociation of water, ionic product of water, concepts of pH and pOH, acids and bases, pHscale, Buffers.	3	1
	1.5	Buffers, biological buffers- bicarbonate buffer, phosphate buffer, hemoglobin buffer.	2	1
	1.6	Different types of biomolecules and their functional groups.	2	1
	1.7	Scope of Biochemistry.	1	1
2. Carbohydrates and Proteins	2.1	Classification of carbohydrates	1	2
	2.2	Monosaccharides and their importance (glucose, galactose, mannose and fructose with structures), Isomerism of carbohydrates - D and L forms, epimers, anomers. Disaccharides - sucrose, maltose, lactose	3	2
	2.3	Haworth perspective formula and functions of disaccharides - sucrose, maltose, lactose.	2	2
	2.4	Structure and important properties of the homopolysaccharides —— starch, cellulose and glycogen. (without structure) heteropolysaccharide - hyaluronate (without structure)	3	2
	2.5	Name (with one letter and three letter code) of the 20 standard amino acids, general structure of amino acid. Zwitter ions.	3	3
	2.6	Elementary study of primary, secondary, tertiary and quaternary structural levels in proteins.	3	3
3. Lipids and Nucleic Acids	3.1	Classification and functions of lipids, Fatty acids - structures of stearic acid, oleic acid and linoleicacid.	2	4
	3.2	Structure and significance of triacylglycerol phosphatidic acid, lecithin and cholesterol.	3	4
	3.3	Chemical nature of nucleic acids- purines and pyrimidines, deoxyribose, ribose, nucleosides, nucleotides. Phosphodiester linkage.	4	4
	3.4	Watson-Crick model of DNA, Chargaff rule, Different forms of DNA-A, B and Z DNA. Introduction to types of RNA (mRNA, rRNA and tRNA). Central Dogma	6	4

4. Practical	4.1	Laboratory Safety Practices, Preparation of normal, molar, percentage solution and dilution of stocksolutions. Determination of pH using a pH meter.	6	5
	4.2	Systematic analysis of carbohydrates and aminoacids in the given unknown samples.	10	6
	4.3	Qualitative analysis of lipids and nucleic acids	9	6
	4.4	Industry/ Laboratory visit	5	6
5. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course content will be transacted through Lectures, E-learning, Seminars, presentations, Group activity, Interactive sessions and Laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination (ESE) Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Nelson D. L., Cox M. M. (2021) Lehninger Principles of Biochemistry, (8^{th} ed.) W.H. Freeman &. Co Ltd.
2. Berg J.M., Gatto G.J., Hines J, Tymoczko J.L., Stryer L. (2023) Biochemistry (10^{th}ed.) W.H. Freeman &. Co Ltd.
3. West E.S., Todd W.R., Mason H.S., Van Bruggen J.T., (2017) Text Book of Biochemistry (4^{th} ed.)
4. Voet D., Voet J., Pratt C.W., (2018) Voet's Principles of Biochemistry (5^{th} ed.)
5. Rastogi V. B., Aneja K.R.,(2020) Zubay's Principles of Biochemistry (5^{th} ed.)

Suggested Readings

1. Das D., (2015) Biochemistry (14^{th} ed.) Academic publishers

	Mahatma Gandhi University **Kottayam**
Programme	**BSc (Hons) Biochemistry**
Course Name	**Sports Biochemistry: The Science of Exercise and Human Performance**
Type of Course	**MDC**
Course Code	**MG1MDCBCH100**
Course Level	**100-199**
Course Summary	The course on sports biochemistry delves into the complex interplay among sports, exercise, and biochemistry. The students will acquire an understanding of the biochemical mechanisms during physical activity, theimpact of exercise on the body's systems, and the ways in which biochemistry shapes both athletic performance and overall well-being.

Semester	1	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Attain a thorough comprehension of the biochemical processes that form the foundation of exercise and sports performance.	K, U, A	1,2,3,4,6
2	Demonstrate the ability to apply biochemistry principles to design personalized training and nutrition plans.	U, A, C,S	1,2,3,4,8
3	Conduct a critical analysis of how hormones, metabolism, and nutrition significantly influence athletic performance.	U, An, E	2,3,4,
4	Develop an understanding of the ethical considerations surrounding sports nutrition and supplementation.	K, U, Ap	1,2,3,4, 6,8
5	Acquire an understanding of fundamental concepts related to sports injuries, recovery, and cellular adaptations.	U, E, A	1,2,3,4
6	Develop practical skills in assessing and optimizing biochemical factors influencing sports and exercise.	A, S, I	1,2,3,4, 7,9,10

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. Fundamentals of Sports Biochemistry	1.1	Introduction Definition and scope of sports biochemistry. Importance in the field of sports science and medicine.	2	1
	1.2	Fuel utilization and Importance of hormones in Sports Fuel utilization in different sports. Role of hormones in Exercise: Adrenaline and noradrenaline, Insulin and glucagon, Cortisol, Growth hormones	4	3
	1.3	Muscle Biochemistry & Adaptations Overview of muscle tissue types (skeletal, smooth, cardiac) with focus on skeletal muscle in the context of sports biochemistry. Role of muscle in energy production during exercise. Overview of Cellular adaptations, Metabolic adaptation, Enzyme and Hormonal Adaptations, Strength and Power Adaptations, Neural adaptations, Endurance Adaptations.	3	3
	1.4	Sports Nutrition Macronutrients and Micronutrients. Hydration: Significance of maintaining proper fluid balance during exercise. Pre-Exercise Nutrition: Timing and composition of pre-exercise meals for optimizing performance. During-Exercise Nutrition: Importance of maintaining energy and hydration during prolonged exercise. Use of sports drinks, gels, and other supplements during activities. Post-Exercise Nutrition: Nutrient timing and composition for post-exercise recovery. Protein intake to support muscle repair and glycogen replenishment.	3	2
	1.5	Ergogenic Aids Definition and Types Legal and Illegal Substances Caffeine: Effects of caffeine on performance and endurance. Recommended dosage and timing for optimal benefits. Creatine: Role of creatine in enhancing strength, power, and muscle recovery. Safe and effective usage guidelines. Nitric Oxide Precursors: Substances that enhance nitric oxide production for improved blood flow and oxygen delivery. Beta-Alanine: Buffering capacity and its role in reducing muscle fatigue.	3	4
2. Diseases, Recovery, Practical Applications	2.1	Sports Injuries Types of Sports Injuries: sprains, strains, fractures, and overuse injuries Biochemical Markers of Injury: Identifying and monitoring Specific biochemical markers (e.g., creatine kinase, cytokines) associated with tissue damage. Using biomarkers to assess the severity and progression of injuries.	3	5

	2.2	Recovery strategies Repair and Regeneration: Overview of the biochemical mechanisms involved in tissue repair and regeneration Recovery strategies Rest and Periodization: Understanding the importance of rest and recovery in preventing overtraining and reducing the risk of injuries. Incorporating periodization in training programmes to allow for adequate recovery. Nutrition for Recovery: Adequate protein intake for muscle repair, carbohydrate replenishment for glycogen stores, and hydration. Cryotherapy and Thermotherapy: Using cold and heat applications to manage inflammation and promote recovery. Understanding the biochemical effects of cryotherapy and thermotherapy Sleep and Circadian Rhythms: Importance of quality sleep in promoting recovery and optimizing performance. Psychological Strategies: Incorporating psychological techniques (e.g., mindfulness, visualization) for stress reduction and mental recovery.	7	5
	2.3	Practical applications and safety in sports: Individualized Training Programs: Designing training programs tailored to an athlete's specific needs, goals, and physical condition. Biomechanical Analysis: Conducting biomechanical assessments to identify and correct movement patterns that may contribute to injuries. Nutrition and Hydration Strategies: Developing personalized nutrition plans to meet the energy demands of training and competition. Emphasizing hydration protocols to prevent dehydration and maintain optimal performance. Monitoring and Recovery Protocols: Implementing monitoring tools (e.g., heart rate variability, sleep tracking) to assess an athlete's physiological responses to training.	5	4
3. Practical	3.1	Measurement of Lung Capacity	3	6
	3.2	Heart Rate Variability (HRV) Assessment	3	6
	3.3	Respiratory Quotient (RQ) Calculation	3	6
	3.4	Hydration Status Assessment	3	6
	3.5	First Aid And Preventive Measures	3	6
	3.6	Field/Industrial Visit	15	6
4. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student Practical: Hands on learning, real world application, problem solving

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 15 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Assignment (2 marks) 5. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one hour (35 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Anshel, M. H., et al. (1991). Dictionary of the Sport and Exercise Sciences,Human Kinetics, USA
2. Beashel, P., & Taylor, N. (1996). Advanced Studies in Physical Education andSport. Thomas Nelson & Sons Ltd. U.K.
3. Blakey, P. (1998). The Muscle Book (2nd ed.). Stafford: Bibliotek Books.
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5. Honeybourne, J., Hill, M., & Moors, H. (2006). Advanced Physical Education &Sport for A Level (3rd ed.). Cheltenham: Nelson Thornes.
6. MacLaren, D., & Morton, J. (2012). Biochemistry for Sport and ExerciseMetabolism, John Wiley & Sons, Ltd. UK.
7. McArdle, D., Katch, V., & Katch, F. (2011). Essentials of Exercise Physiology(4th ed.). Lippincott: Williams & Wilkins, Baltimore
8. Schmidt, R., & Wrisberg, C. (2000). Motor Learning and Performance: A Problem-Based Learning Approach (2nd ed.). Human Kinetics, USA
9. Sharp, B. (1992). Acquiring Skill in Sport. Sports Dynamics, UK
10. Webster, S. (1996). Sport Psychology: An A Level Guide for Teachers andStudents. Widnes: Roscoe Publications.

Suggested Readings

1. Bubbs, M. (2019). Peak: The New Science of Athletic Performance That is Revolutionizing Sports.Chelsea Green publishing Company

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**
Course Name	**Essentials of Biochemistry: Vitamins, Hormones, Enzymes and Neurotransmitters**
Type of Course	**DSC A**
Course Code	**MG2DSCBCH100**
Course Level	**100-199**
Course Summary	This comprehensive course delves into the fundamental biochemical aspects of vitamins, hormones, enzymes, and neurotransmitters, exploring their roles in maintaining physiological balance and supporting essential cellular functions.

Semester	2	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the fundamentals of vitamins	K,U	1,2,3,4
2	Describe the general features of hormones and their receptors.	U, E	2,3,4
3	Describe the classification, functions, mechanism of action and deficiency disorders of hormones	U, E, A	1,2,3,4
4	Evaluate neurotransmitter and its mechanism of action	A, E	1,2,3,4
5	Analyse the mechanism of enzyme catalysis, kinetics and specificity	U, An, E	1,2,3,4
6	Demonstrate proficiency in enzyme and vitamin extraction and quantification from various sources	U, A, S, Ap	1,2,3,4 ,10
7	Demonstrate the mechanism of action of hormones/neurotransmitters through presentations	A,S,C, I	2,3,4,6 ,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. Vitamins	1.1	Vitamins- General introduction	3	1
	1.2	Classification and nomenclature of vitamins	4	1
	1.3	Fat soluble vitamins (types, biochemical and physiological functions, deficiency diseases) Vitaminsas coenzymes	3	1
	1.4	Water soluble vitamins (types, biochemical and physiological functions, deficiency diseases)	5	1
2. Hormones & Neurotrans mitters	2.1	History of endocrinology	1	2
	2.2	Concept on target gland, negative and positivefeedback, characteristics and transport of hormones	3	2
	2.3	Hormone receptors and its classification	3	2
	2.4	Outline study of hypothalamic, pituitary, thyroid,parathyroid, adrenal, pancreatic and gastro intestinal hormones (types of hormones, physiological and biochemical role, deficiency diseases)	3	3
	2.5	Mechanism of action of peptide and steroid hormones	3	3
	2.6	Neurotransmitters-definition, classification, types of receptors, role in synaptic transmission	3	4
	2.7	Molecular mechanisms of action - Acetylcholine, biogenic amines, catecholamines, serotonin, amino acids. Neuroactive peptides as transmitters.	4	4
3. Enzymes	3.1	Classification of enzymes- six major classes of enzymes with one example each.	2	5
	3.2	Cofactors and coenzymes	1	5
	3.3	Elementary study of the factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH	2	5
	3.4	Michaelis-Menten equation (without derivation). Kmand its significance, Lineweaver Burk plot.	2	5
	3.5	Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes.	3	5

4. Practical	4.1	Extraction and assay of enzymes - Acid phosphatase from Fresh Potato (*Solanum tuberosum*)	5	6
	4.2	Extraction and assay of enzymes - β- amylase from sweet potato (*Ipomoea batatas*)	5	6
	4.3	Extraction and assay of enzymes -Catalase from bovine /porcine liver	5	6
	4.4	Extraction and assay of enzymes -Urease from Jackbean (*Canavalia ensiformis*)	5	6
	4.5	Estimation of ascorbic acid from lemon guice	5	6
	4.6	Demonstration of the mechanism of action of hormones/neurotransmitters through posters, models, and digital presentations	5	7
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course content will be transacted through seminars, power point presentations, Group activity, Interactive sessions and Laboratory sessions.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination (ESE) Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Botham K, McGuinness O.,Weil P.A., Kennelly P., Rodwell V. (2022) Harper'sIllustrated Biochemistry (32nd ed.) Mc Graw Hill Education
2. Kandel E., Schwartz J, Jessell T., Siegelbaum S., Hudspeth A. (2013) Principlesof Neuroscience (5th ed.} Mc Graw Hill Education
3. Nelson D. L., Cox M. M. (2021) Lehninger Principles of Biochemistry, (8th ed.) W.H. Freeman &. Co Ltd.
4. Berg J.M., Gatto G.J., Hines J, Tymoczko J.L., Stryer L. (2023) Biochemistry (10th ed.) W.H. Freeman &. Co Ltd.

5. West E.S., Todd W.R., Mason H.S., Van Bruggen J.T., (2017) Text Book ofBiochemistry (4th ed.)
6. Voet D., Voet J., Pratt C.W., (2018) Voet's Principles of Biochemistry (5th ed.)
7. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi
8. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi
9. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), KalyaniPublishers, Ludhiana

Suggested Readings

1. Banerjee P.K. (2020) Introduction to Biophysics (Revised Edition) AB Book.
2. Das D. (2015) Biochemistry (14th ed.) Academic publishers

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**
Course Name	**Biochemistry in Entrepreneurship**
Type of course	**MDC**
Course code	**MG2MDCBCH100**
Course level	**100-199**
Course summary	The "Biochemistry in Entrepreneurship" course is designed to equip students with a multifaceted understanding of the intersection between biochemistry and business. The course then transitions to the practical aspects of the nutraceutical industry, covering business strategies, regulatory frameworks, and essential marketing principles.

Semester	2	Credits			3	Total hours
Course details	Learning approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Acquire a comprehensive understanding of nutrition and herbal food supplements, emphasizing their benefits for daily nutrition and preventive care.	K, U, A	2,3, 6,10
2	Attain an understanding of the nutraceutical business landscape, encompassing dietary supplements, functional foods,and phytochemicals.	U, A, An	2,3,4, 6
3	Develop expertise in the regulatory aspects of nutraceuticals, including NPD activities, GMP requirements, and quality management systems	U, An, E	2,3,4, 5,8
4	Examine marketing terminology in the nutraceutical industry, emphasising food safety standard labelling, claims, expiration dates, and gluten-free labelling, in order to make well-informed decisions.	K, U, E, Ap	2,3,6, 8,10
5	Explain the foundational concepts of biochemical entrepreneurship, exploring the transformative power of technological innovations.	U, A, E, I	1,2,3, 6,10
6	Develop an understanding of target audiences, marketneeds, and trends, fostering strategic product development.	A,C, S, Ap	2,3,5, 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 (Sub-units)

Module	Unit	Course description	Hrs	CO. No.
1. Foundations of holistic wellness: exploring nutrition, Nutraceuticals, and herbal health supplements	1.1	Health and Nutrition	2	1
	1.2	Role of Nutraceuticals supplements	3	1
	1.3	Lifestyle disorders	3	1
	1.4	Herbal Supplements	2	1
2. Navigating the Nutraceutical landscape: Business, regulations, marketing essential and biochemical entrepreneurship	2.1	Nutraceutical business; Dietary supplements, Functional foods, Phytochemicals, Multivitamins; Nutraceutical product classifications	4	2
	2.2	Regulations and laws; New Product Development and regulatory activities, Good Manufacturing Practice requirements	3	3
	2.3	Key terminologies of marketing; Nutraceutical labelling –FDA, FSSAI labelling, Label claim	3	4
	2.4	Biochemistry Unleashed: Understanding the Entrepreneurial Potential	3	5
	25	Emerging Trends: Current landscape, Future projections, Industry insights	3	5
	2.6	Commercializing Biochemical Dreams: From Labto Market	2	5
	2.7	Social Impact Entrepreneurship: Merging Biochemistry with Societal Well-being	2	5
3. Practical	3.1	Survey on the demand and requirement of herbal products/formulations	4	6
	3.2	Product promotion techniques	4	6
	3.3	Product branding and strategy	2	6
	3.4	Public awareness campaign on healthcare needs	10	6
	3.5	Industrial/Field Visit	10	6

4.Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student Practical: Hands-on learning, real-world application, problem solving
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 15 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Assignment (2 marks) 5. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	C. End Semester Examination (ESE) Written internal examination for one hour (35 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Adams, K. R. (1989). Biochemical Education, 17, 26-28.
2. Cannon, T. (1991). Enterprise: Creation, Development and Growth. Butterworth-Heineman, Oxford, p. 65.
3. DeFelice, S. (2007). The Foundation for Innovation in Medicine. http://www.fimdefelice.org.
4. Emerging Nutraceuticals Market Report. http://www.Nutraingredients-usa.com.
5. Green, S. (1990). The Biochemist, 12, 9-11.
6. Global Industry Analyst Inc. (2008). Report, Global Nutraceuticals Market to Cross US $187 Billion by 2010. http://www.Strategy R.com.
7. Global Nutraceuticals Market Report. India's Nutraceuticals Market Should CrossBillionMark.
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9. Lockwood, B. (2007). Nutraceuticals, 2nd Edition. London, UK: Pharmaceutical Press, p. 1.

Suggested Readings

1. Adebowale, A. O., Liang, Z., & Eddington, N. D. (2000). Nutraceuticals, a call forquality control of delivery systems: a case study with chondroitin sulfate and glucosamine. J. Nutraceut. Funct. Med. Foods, 2, 15–30.
2. Amenta, M., Cascio, M. T., Fiore, P. D., & Venturini, I. (2006). Diet and chronic constipation. Benefits of oral supplementation with symbiotic zir fos (Bifidobacterium longum).
3. Annual Survey of Graduate Employment 1991. Biochemical Society, London, 1992.
4. Dickson, M. (1993, September 24). Financial Times, p. 7.
5. Enterprise in Higher Education Training Agency, Moorfoot, Sheffield. (1989).
6. Zeisel, S. H. (1999). Regulations of nutraceuticals. Science, 285(1853–1855

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Techniques in Biochemistry and Forensic Science**					
Type of Course	**DSC B**					
Course Code	**MG3DSCBCH202**					
Course Level	**200-299**					
Course Summary	This course provides a comprehensive understanding of advanced techniques widely used in biochemistry, molecular biology and forensicscience with a focus on practical applications in research and diagnostics. Students will gain both theoretical knowledge and hands- on experience, preparing them for careers in various scientific fields.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Develop a comprehensive understanding of various biochemical and forensic techniques used in analysing biological samples.	K, U, An	1,2,3,4
2	Evaluate diverse aspects of chromatographic techniques	U, E, A	1,2,3,9, 10
3	Explore electrophoresis and blotting methods	E, An, A	1,2,3,9
4	Explain the fundamental principles of spectroscopy, colorimetry, centrifugation and microscopy	U, An, S	1,2,3,4
5	Demonstrate the crime scene sample collection and processing	U, E, C	1,2,3,9
6	Describe the role of DNA fingerprinting role in clinical settings,such as paternity/maternity testing	U, E, A	1,2,4,6, 8
7	Apply techniques in biochemistry, molecular biology, forensic science, and biotechnology	U, S, Ap	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Separation Techniques	1.1	Introduction to Biochemical Techniques	1	1
	1.2	Chromatography- Terminology, classification basedon principle and type of chromatographic bed used, and the physical state of mobile phase.	3	2
	1.3	Planar chromatography-Principle, procedure & applications of paper chromatography and TLC.	3	2
	1.4	Column chromatography- Principle, procedure & applications of Affinity Chromatography,Gel Exclusion Chromatography	3	2
	1.5	Electrophoretic techniques-Introduction, principle, procedure and applications of AGE and PAGE	3	3
	1.6	Blotting techniques- Southern, Northern and Western	2	3
2. Spectroscopy, Colorimetery, Centrifugation and Microscopy	2.1	Spectroscopy- Types of spectroscopy (an outline study)	2	4
	2.2	Colorimetry-Beer Lambert's law	2	4
	2.3	Instrumentation and applications of colorimeter andUV-Visible Spectrophotometer.	4	4
	2.4	Centrifugation-Principle and types	6	4
	2.5	Introduction to Microscopy (Overview)	1	4
3. Crime site sample collection and Processing	3.1	Source of DNA in Forensic cases, PCR	5	5
	3.2	ELISA, RIA	5	5
	3.3	DNA Finger Printing- Paternity and maternity Testing	5	6
4. Practical	4.1	Beer Lambert's law verification	4	7
	4.2	Paper Chromatography/Thin layer Chromatography	8	7
	4.3	Electrophoresis (Demonstration)	8	7
	4.4	DNA Isolation (from onion/Green peas)	5	7
	4.5	Estimation of isolated DNA	5	7
5. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e- resources, animated videos, virtual lab Indirect session: Group discussion, seminar presentation Practical: Hands on learning, real world application, problem solving

Assessment Types	MODE OF ASSESSMENT
	A. Continuous Comprehensive Assessment (CCA) Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Braithwaite, A., & Smith, F. J. (1995). Chromatography: Principles and Instrumentation. Blackie Academic and Professional.
2. Butler, J. M. (2005). Forensic DNA Typing. Academic Press Publishers.
3. Goodwin, W., Linacre, A., & Had, S. (Wiley Publishers, 0470710195). An Introduction to Forensic Genetics.
4. Jain, J. L., Jain, S., & Jain, N. (2022). Fundamentals of Biochemistry. S. Chand Publishing
5. Murphy, D. B. (2012). Fundamentals of Light Microscopy and Electronic Imaging.Wiley-Blackwell Publishers.
6. Tang, Y. W., & Stratton, C. W. (2010). Advanced Techniques in Diagnostic Microbiology. Springer New York, NY.
7. Vasudevan, D. M., & Sreekumari. (2022). Textbook of Biochemistry for Medical Students. Jaypee Brothers Medical Publishers.

Suggested Readings

1. Patrono, C., & Peskar, B. A. (Eds.). (1995). Radioimmunoassay in Basic and Clinical Pharmacology (Handbook of Experimental Pharmacology No. 82). Springer Publishers.
2. Pound, J. (2008). Immunochemical Protocols. Springer Science & Business Media

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Food as Medicine**					
Type of Course	**MDC**					
Course Code	**MG3MDCBCH200**					
Course Level	**200-299**					
Course Summary	This course is designed to equip students with a deep understanding of the dynamic relationship between food, nutrition, and health, with a focuson practical applications and real-world experiences. The curriculum contributes to a holistic education in the field of nutrition and health.					
Semester	3	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Develop an appreciation for the significance of health in fostering a high quality of life.	K,U, Ap	1,2,3,4,7, 10
2	Acquire information on energy requirements and recommended dietary allowances, facilitating a better understanding of the correlation between nutrition and overall well-being.	U, E, A	1,2,3,4,6,8
3	Attain knowledge about the roles, metabolism, and effects of nutrients.	U, A, E	1,2,3,4,6
4	Recognize the potential of different functional foods and nutraceuticals in enhancing human health.	K,U, A	1,2,3,4,6
5	Acquire knowledge about the principles of diet therapy and the application of various therapeutic diets	U, S,I	1,2,3,4,6, 10
6	Demonstrate the ability to utilize the knowledge in making informed food choices and achieving a well-balanced diet.	U, C, S	1,2,3,4,6, 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. Food, Nutrition and Health	1.1	Food for health promotion	2	1
	1.2	Functions of food – Physiological, psychological and socio - cultural functions, constituents of food and their functions.	3	1
	1.3	Introduction to Nutrition, BMR	2	2
	1.4	Carbohydrates, Proteins, Fats and Lipids	4	3
	1.5	Vitamins: Fat soluble and Water soluble vitamins	1	3
	1.6	Minerals: Micro minerals and Macro minerals	1	3
	1.7	Water Balance; Regulation of acid-base balance in the body	2	3
2. Functional Foods	2.1	Functional food of plant and animal origin, Probiotics, prebiotics and synobiotics	2	4
	2.2	Nutraceuticals- herbal nutraceuticals; Phytochemicals, phytosterols and other bioactive compounds	3	4
3. Dietetics and Diet Therapy	3.1	Objective of diet therapy; Principles of diet preparation and counselling.	5	5
	3.2	Therapeutic diets for disorders; Nutritional status assessment of the critically ill patients	5	5
	3.3	Diet in Allergy; Diet in febrile conditions; Diet inrelation to deficiency diseases	5	5
	3.4	Preparation of dietary charts	3	6
	3.5	Comparative chart for nutraceutical plants	2	6
	3.6	Integrative workshop on dietetics	5	6
4.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student, real world application

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 25 marks 1. Internal test paper (15 marks) 2. Seminar presentation/Quiz (2 marks) 3. Assignments and group discussion (3 marks) 4. Viva (3 marks) 5. Report of the workshop (2 marks)
	B. End Semester Examination Written examination for one and a half hours (50 marks)

References

1. Bamji, M. S., Krishnaswamy, K., & Brahmam, G. N. V. (2009). Textbook ofHuman Nutrition (3rd ed.). Oxford and IBH Publishing Co. Pvt. Ltd.
2. Dash, B. N. (2003). Health & physical education (1st ed.). NeelkamalPublications.
3. Ghosh, D., et al. (2012). Innovations in Healthy and Functional Foods. CRCPress.
4. Krause, L., & Mahan, S. (Eds.). (1992). Food, nutrition, and diet therapy (6th ed.). W.B. Saunders Company.
5. Madhavi, D. L., Deshpande, S. S., & Salunkhe. (1995). Food Antioxidants: Technological, Toxicological and Health Perspective. CRC Press.
6. Shakuntalamanay, N., & Shadaksharaswam, M. (2008). Food Facts andPrinciples(3rd ed.). New Age International.
7. Sizer, F., & Whitney, E. (2000). Nutrition concepts and controversies (8th ed.).
8. Srilakshmi. (2002). Dietetics (4th ed.). New Age International (P) Limited,Publishers.
9. Swaminathan, M. (Ed.). (2007). Essentials of food & nutrition (Vol. II). Bappco.
10. Whitney, P. N., & Roes, S. R. (1996). Understanding nutrition. West Publication Co.
11. Wildman, R. E. C. (2001). Handbook of Nutraceutical and Functional Foods.CRC Press.
12. Yadav, S. (1997). Basic principles of nutrition (1st ed.).

Suggested Reading

1. Antia, F. P. (1987). Clinical dietetics and nutrition. Oxford University Press.
2. Robinson, et al. (1987). Normal and therapeutic nutrition (17th ed.) Mac MillanP

	Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Microplastics and Environment**					
Type of Course	**VAC**					
Course Code	**MG3VACBCH200**					
Course Level	**200-299**					
Course Summary	This course offers an in-depth knowledge of the origins, destiny, movement, and effects of microplastics within the environment. Students will analyze the consequences of microplastic pollution and explore potential strategies for alleviation and control.					
Semester	3	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Discuss the sources and types of microplastics	K, U	1,2, 3,4
2	Analyze the transport and fate of microplastics in various environmental compartments	U, An, E	1,2,3, 4,7,10
3	Evaluate impacts of microplastic pollution on aquatic and terrestrial ecosystems.	U, E, I	1,2,3, 6,8
4	Explore the effects of microplastics in food and drinking water	U, A, I	1,2,3, 6
5	Evaluate health risks along with regulatory perspectives, concerning the impact of microplastics on biological systems.	E, A	2,3,6, 8,10
6	Develop strategies for mitigating and managing microplastic pollution	U, A, Ap	1, 2,6,7, 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. Introduction to Microplastics	1.1	Overview of microplastics: definition, classification,and size range	2	1
	1.2	Sources of microplastics: primary and secondarysources	2	1
	1.3	Types of microplastics, microbeads, microfiber, Degradation	3	1
	1.4	Environmental pathways: air, water, soil	3	2
2. Fate and Transport of Microplastics	2.2	Bioaccumulation and biomagnification	5	2
	2.3	Microplastic transport in different ecosystems	5	2
3. Impact of Microplastics on biological systems and climate change & microplastic removal	2.1	Effects of microplastics on marine and freshwater ecosystems	3	3
	2.2	Impact on terrestrial ecosystems, wildlife exposure and responses	3	3
	2.3	Microplastics in food and drinking water	4	4
	2.4	Health risks and uncertainties, Regulatory perspectives	5	5
	2.5	Impact of Microplastics on climate change	5	6
	2.6	Microplastic removal strategies	5	6
4. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos, virtual lab Indirect session: Group discussion, assignments
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 25 marks 1. Multiple Choice Questions (10 marks) 2. Seminar presentation (2 marks) 3. Assignment and discussions (3 marks) 4. Viva (3 marks) 5. Report of awareness programmes and seminars (2 marks) 6. Report of field visit (5 marks)
	B. End Semester Examination Written examination for one and a half hours (50 marks)

References

1. Bank, M. S. (2022). Microplastic in the environment: Pattern and process. In Environmental Contamination Remediation and Management. Springer.
2. Cole, M., Lindeque, P., Halsband, C., & Galloway, T. S. (2011). Microplastics as contaminants in the marine environment: A review. Marine Pollution Bulletin, 62(12), 2588-2597.
3. Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science Advances, 3(7), 1700782.
4. Wright, S. L., & Kelly, F. J. (2017). Plastic and human health: A micro issue? Environmental Science & Technology, 51(12), 6634-6647.
5. Ziajahromi, S., Neale, P. A., Rintoul, L., Leusch, F. D., & Wasternack, D. (2017). Occurrence and fate of microplastics in wastewater treatment plants: Implication to environmental management. Water Research, 123, 448-456.

Suggested Readings

1. Hester, R. E., & Harrison, R. M. (2019). Plastics and the environment. In Issues in Environmental Science and Technology. Royal Society of Chemistry

Mahatma Gandhi University
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Programme	**BSc (Hons) Biochemistry**
Course Name	**Metabolism of Carbohydrates, Proteins and Lipids**
Type of Course	**DSC C**
Course Code	**MG4DSCBCH202**
Course Level	**200-299**
Course Summary	This course offers a thorough examination of the biochemical processes that regulate the metabolism and corresponding energetics of carbohydrates, proteins, and lipids in living organisms.

Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the mechanisms involved in the digestion and absorption of carbohydrates, proteins, and lipids	K, U, E	1,2,3,4
2	Explain the enzymatic reactions and energetics of breakdown and synthesis of carbohydrates	U, E	1,2,3,4,6
3	Discuss the processes and pathways involved in protein Metabolism	U, An,E	1,2,3,4
4	Compare the catabolic and anabolic pathways of lipids	U, An,	1,2,3,4
5	Analyze and calculate energy yield in oxidation of Palmitic acid	An, A, S	1,2,3,4,6
6	Develop practical skills to determine the amount of carbohydrates, lipids and amino acids in a biological source	An, S, Ap	1,2,3,6,9, 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. Metabolism of Carbohydrates	1.1	Introduction to carbohydrate metabolism, Digestion and Absorption	1	1
	1.2	Glycolysis (with structure), Energetics and its Regulation (Over view)	2	2
	1.3	Fates of Pyruvate and TCA Cycle and energetics	3	2
	1.4	Electron Transport Chain and Oxidative Phosphorylation	2	2
	1.5	Gluconeogenesis (With Structure)	2	2
	1.6	HMP Shunt Pathway (structure not necessary)	2	2
	1.7	Glycogen Metabolism -Glycogenolysis and Glycogenesis	3	2
2. Metabolism of Proteins	2.1	Introduction to protein metabolism, Digestion and Absorption	3	1
	2.2	Oxidation of amino acids- transamination, deamination, (oxidative and Nonoxidative), Decarboxylation	4	3
	2.3	Glucogenic and ketogenic amino acids	2	3
	2.4	Nitrogen excretion, Urea cycle (structure Not necessary)	3	3
	2.5	Inborn errors of Protein metabolism – albinism, Alkaptonuria, Phenylketonuria (defensive enzyme, Symptoms and effects)	3	3
3. Lipid Metabolism	3.1	Lipids- Introduction to Lipid metabolism, Digestion, Absorption	3	1
	3.2	Fatty acid Oxidation-Alpha, Beta, Omega (Overview)	2	4
	3.2	Beta Oxidation (Activation, Transport with structure), Energy yield in oxidation of Palmitic acid,Ketone bodies	5	5
	3.4	Fatty acid synthesis (in detail), Desaturases and elongases (outline only)	5	4
4.	4.1	Beer Lamberts law verification (Mandatory)	6	6
	4.2	Estimation of carbohydrates (Anthrone Method, Di Nitro Salicylic acid, Folin Wu Method, Nelsons –Any 2)	6	6

Practical	4.3	Protein Estimation (Lowry and Biuret method)	6	6
	4.4	Amino acid estimation (ninhydrin Method)	3	6
	4.5	Estimation of Cholesterol	3	6
	4.6	Enzymatic breakdown of starch	6	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct instruction: Lecture, E-learning Indirect session: Seminars, Power point presentations, Group discussions, Questions and clarifications, Assignments, Laboratory sessions including demonstrations, hands on training
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks **B. End Semester Examination** Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Nelson, D. L. (2005). Lehninger Principles of Biochemistry. New York: W.H.Freeman.
2. Murray, R., Granner, D., Mayes, P., & Rodwell, V. (2006). Harper's IllustratedBiochemistry (Harper's Biochemistry) (27th ed.). McGraw-Hill Medical.
3. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry (5th ed.).John Wiley & Sons
4. Jain, J. L., Jain, S., & Jain, N. (2022). Fundamentals of Biochemistry. S. ChandPublishing.
5. Vasudevan, D. M., & Sreekumari, S. (2022). Textbook of Biochemistry forMedicalStudents. Jaypee Brothers Medical Publishers

Suggested Readings

1. McKee, T., & McKee, J. R. (2009). Biochemistry: The Molecular Basis of Life.Oxford University Press.
2. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2007). Biochemistry. W. H. Freeman.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**
Course Name	**Biochemical Tests in Disease Diagnosis**
Type of Course	**SEC**
Course Code	**MG4SECBCH200**
Course Level	**200-299**
Course Summary	This course provides a focused exploration of the clinical significance of biochemical tests in the field of disease diagnosis. Its aim is to equip students with the essential knowledge and abilities to identify and applybiochemical tests, facilitating accurate and efficient monitoring and treatment of various diseases.

<table>
<tr><td>Semester</td><td>4</td><td colspan="3">Credits</td><td>3</td><td rowspan="2">Total Hours</td></tr>
<tr><td rowspan="2">Course Details</td><td rowspan="2">Learning Approach</td><td>Lecture</td><td>Tutorial</td><td>Practical</td><td>Others</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>45</td></tr>
<tr><td>Pre-requisites, if any</td><td colspan="6">Nil</td></tr>
</table>

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamentals of biochemical tests used in disease diagnosis and the ethical practices	U, E, A	1,2,3,4, 6,8
2	Discuss the various methods for collecting blood, urine and CSF, ensuring accuracy and patient comfort.	K, U, E	1,2,3,4, 6
3	Interpret blood analysis results accurately and communicatethese findings effectively.	A, An, E, Ap	1,2,3, 4, 6, 10
4	Develop a comprehensive understanding of various testsused in diagnosing and monitoring diabetes	U, An, E	1,2,6,8
5	Explore the identification and applications of biomarkers inliver function Tests	U, A, An	1,2,3,4
6	Attain proficiency in accurately interpreting results of thyroid function tests results	An, E, S	1,2,3, 9, 10
7	Evaluate how results of renal function test aid in diagnosingand monitoring kidney diseases	An, E, I	1,2,3,9
8	Enhance the ability to present and communicate observations obtained from experiments, laboratory visits, as well as share insights on emerging techniques.	E, An, S	1,2,4, 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. Introduction to Biochemical tests	1.1	Overview of biochemical tests and its importance in disease diagnosis, Ethical practices in laboratory medicine	3	1
	1.2	Sample collection and handling of blood, urine and cerebrospinal fluid.	3	2
	1.3	Blood routine analysis- Erythrocyte Sedimentation Rate (ESR), Hemoglobin (Hb), Red Blood Cell (RBC)Count , White Blood (WBC) Count , Platelets, Differential Count (DC), Packed Cell Volume (PCV)	5	3
	1.4	Lipid profiling - Total cholesterol, High Density Lipoprotein (HDL) Cholesterol, Low Density Lipoprotein (LDL) Cholesterol, Triglyceride (TG)	4	3
2. Common biochemi cal tests in diagnosis andtheir clinical interpretation	2.1	Tests related to Diabetes Mellitus -Fasting BloodSugar FBS, Post Prandial Blood Sugar (PPBS), Random Blood Sugar (RBS), Glycosylated	3	4
	2.2	Hemoglobin (HbA1C),Glucose Challenge Test (GCT), Glucose Tolerance Test (GTT)	3	4
	2.3	Liver Function Test– Total protein, Albumin,Globulin A/G ratio, Total bilirubin, Serum Glutamate Oxaloacetate Transaminase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT), Alkaline Phosphatase (ALP), Alpha Feto Protein (AFP).	3	5
	2.4	Thyroid Function Tests-Thyroid Stimulating Hormone (TSH), T3,T4, Thyroxine Binding Globulin antibody (antithyroglobulin), Thyroid peroxidase antibody (TPO)	3	6
	2.5	Renal Function Tests-Urea, Creatinine, Uric acid	2	7
	2.6	Emerging technologies in biochemical testing	1	8
3. Laboratory visit and Case study	3.1	Laboratory Visit and Report Submission	8	8
	3.2	Case Study-Interpretation of a clinical Laboratoryreport	7	8
4.Teacher specific content/ Teacher facilitatedactivities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos Indirect session: Group discussion, assignments Practical: case study, laboratory visit

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 25 marks 1. MCQ test for one and a half hour (10 marks) 2. Assignment- (2 marks) 3. Involvement in group discussion (2 marks) 4. Viva (3 marks) 5. Case study report (3 marks) 6. Report of Laboratory visit (5 marks)
	B. End Semester Examination Written examination of one and a half hours (50 marks)

References

1. Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2013). Clinical Chemistry: Principles, Techniques, and Correlations (7th ed.)
2. Burtis, C. A., & Bruns, D. E.(2005).Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics. Elsevier (8th ed.).
3. Goldberg, S. (2010). Clinical Biochemistry Made Ridiculously Simple. MedMaster Inc.
4. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2023). Textbook of Biochemistry for Medical Students. Jaypee Publishers.
5. Walker, S. W., Beckett, G. J., Rae, P., & Ashby, P. (2013). Clinical Biochemistry.John Wiley & Sons.

Suggested Readings

1. Gaw, A., Murphy, M. J., Srivastava, R., Cowan, R. A., & O'Reilly, D. St. J. (2013).Clinical Biochemistry: An Illustrated Colour Text. Churchill Livingstone/Elsevier.
2. Wallach, J. (2000). Interpretation of Diagnostic Tests. Lippincott Williams &Wilkins.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Narcotics and Psychotropic Substances**					
Type of Course	**VAC**					
Course Code	**MG4VACBCH200**					
Course Level	**200-299**					
Course Summary	This course seeks to equip students with knowledge that goes beyond conventional limits, encouraging critical thinking and well-informed decision-making in both personal and professional realms. Student's will gain insight into the fundamental principles governing the utilization, impacts, and control of narcotics and psychotropic drugs.					
Semester	4	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate how narcotics and psychotropic drugs interact with the human body	K, U, E	1,2,4, 8
2	Describe the different classes of NDPSs, their mechanism of action	K, U, An	1, 2,3,4
3	Analyse the potential risks associated with the use of narcotics and psychotropic drugs	U, An, I	1,2,3, 6
4	Evaluate the mechanism for drug addiction and formulate management strategies	U, E, A	1,2,3, 4,8
5	Assess the legal and ethical implications of using narcotics and psychotropic substances.	U, E, I, Ap	1,2,3, 4,6,8
6	Communicate and educate effectively about the risks, benefits,and responsible use of narcotics and psychotropic substances, orally/writing, to diverse communities	U, E, C,S, Ap	2,4,5, 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. Overview of NDPSs	1.1	Introduction to NDPSs, understanding the basic principles of how drugs interact with the body, including pharmacokinetics (how the body affects the drug) and pharmacodynamics (how the drug affects the body).	5	1
	1.2	Study of narcotic drugs, their classification, mechanisms of action (in brief), therapeutic uses, and potential for abuse or addiction. Examples include opioids like morphine, heroin, oxycodone	5	2
	1.3	Exploring drugs that affect mental processes, including antipsychotics, antidepressants, anxiolytics, and mood stabilizers. Study of their mechanism of action, indications, and potential side effects. Examples include MDMA, LSD, Barbiturates	5	3
2. Addiction and Dependence	2.1	Investigation of the physiological and psychological mechanisms behind drug addiction and dependence.Thisinclude studying tolerance, withdrawal symptoms	6	4
	2.2	Strategies for managing addiction.	3	4
	2.3	Narcotic Drugs and Psychotropic substances Act1985 - use, prescription, and distribution of narcotics and psychotropic drugs.	6	5
3. Deaddiction centre visit and awareness programmes	3.1	Conduct of awareness programmes	10	6
	3.2	Deaddiction centre visit and submission of report	5	6
4.Teacher specific content/ Teacher facilitatedactivities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos Indirect session: Group discussion, assignments, seminar presentation, involvement in awareness programmes,Deaddiction centre visit

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 25 marks 1. MCQ test for one hour (10 marks) 2. Assignment- (2 marks) 3. Involvement in group discussion (2marks) 4. Viva (2 marks) 5. Involvement in awareness programmes (2 mark) 6. seminar presentation (2 marks) 7. Report of deaddiction centre visit (5 marks)
	B. End Semester Examination Written Examination of one and a half hours (50 marks)

References

1. Jeffries, J. J. (Ed.), Bezchlibnyk-Butler, K. Z. (Ed.), & Procyshyn, R. M. (Ed.). (2021). Clinical Handbook of Psychotropic Drugs. Hogrefe Publishing.
2. Knollmann, B., & Brunton, L. (2022). Goodman and Gilman's The Pharmacological Basis of Therapeutics [Hardcover]. McGraw-Hill Education.
3. Liese, B. S., & O'Connor, C. K. (2006). Substance Use Disorders: A Practical Guide (2nd ed.). Lippincott Williams & Wilkins.
4. Pagliaro, L. A., & Pagliaro, A. M. (2004). Pagliaros' Comprehensive Guide to Drugs and Substances of Abuse. American Pharmacists Association.
5. Tozer, T. N., & Rowland, M. (2006). Introduction to Pharmacokinetics and Pharmacodynamics: The Quantitative Basis of Drug Therapy [Paperback]. Lippincott Williams and Wilkins.
6. The Narcotic Drugs and Psychotropic Substances Act, 1985.

Suggested Readings

1. Abadinsky, H. (2017). Drug Use and Abuse: A Comprehensive Introduction (9thed.). Cengage Learning.
2. Stahl, S. M., & Muntner, N. (2013). Stahl's Essential Psychopharmacology: Neuroscientific Basis and Practical Applications (4th ed.). Cambridge University Press.

PROPOSED SYLLABUS- DBT MAC - MGU UGP

	TYPE	NAME OF THE COURSE
SEM I	DSC A	FUNDAMENTALS OF BIOTECHNOLOGY
	DSC B	Minor I - BIOCHEMISTRY
	DSC C	Minor II- MICROBIOLOGY
	AEC	ENGLISH
	OL	HINDI/ OL/MAL
	MDC	COURSES OFFERED BY CS/ELE/BBA
SEM II	TYPE	NAME OF THE COURSE
	DSC A	APPLIED BIOTECHNOLOGY
	DSC B	Minor I - BIOCHEMISTRY
	DSC C	Minor II- MICROBIOLOGY
	AEC	ENGLISH
	OL	HINDI/ OL/MAL
	MDC	COURSES OFFERED BY CS/ELE/BBA
SEM III	TYPE	NAME OF THE COURSE
	DSC A I	CELL BIOLOGY & GENETICS
	DSC A II	BIOPHYSICS AND INSTRUMENTATION
	DSC E	PLANT AND ANIMAL PHYSIOLOGY
	DSC B	MINOR I - BIOCHEMISTRY
	MDC	KERALA CULTURE
	VAC	INNOVATION AND TECHNOLOGY TRANSFER
	TYPE	NAME OF THE COURSE
	DSC A I	MOLECULAR BIOLOGY
	DSC A II	IMMUNOLOGY

SEM IV	DSC E	BIOSAFETY AND BIOETHICS
	DSC C	MINOR II - MICROBIOLOGY
	SEC	QUALITY CONTROL IN BIOLOGY
	VAC	NUTRITION AND HEALTH
	INTERNSHIP	
SEM V	TYPE	NAME OF THE COURSE
	DSC A I	RECOMBINAT DNA TECHNOLOGY
	DSC A II	ENZYME TECHNOLOGY
	DSC E I	BASIC BIOINFORMATICS
	DSC EII	RESEARCH METHODOLOGY
	DSC E III	MARINE BIOTECHNOLOGY
	SEC	SCIENTIFIC COMMUNICATION IN RESEARCH
SEM VI	TYPE	NAME OF THE COURSE
	DSC A I	PLANT AND ANIMAL BIOTECHNOLOGY
	DSC A II	CANCER BIOLOGY AND CELL SIGNALING
	DSC E I	INDUSTRIAL BIOTECHNOLOGY
	DSC EII	SUSTAINABLE BIOTECHNOLOGY
	SEC	ADVANCED STATISTICS AND DATA ANALYSIS
	VAC	ENVIRONMENTAL BIOTECHNOLOGY AND HUMAN RIGHTS
SEM VII	TYPE	NAME OF THE COURSE
	DSC A I	GENOMICS AND INSILICO GENOME ANALYSIS
	DSC A II	ADVANCED CELL AND MOLECULAR BIOLOGY
	DSC A III	RESEARCH METHODOLOGY AND SCIENTIFIC WRITING
	MINOR/ DSC E I	ADVANCED BIOINFORMATICS
	MINOR/ DSC E II	PROTEOMICS

	MINOR/ DSC E III	DISEASE AND MOLECULAR DIAGONOSTICS
	MOOC- OPTIONAL	
SEM VIII	TYPE	NAME OF THE COURSE
	DSC A I	ADVANCED INSTRUMENTATION TECHNIQUES
	DSC A II	ANALYTICAL MOLECULAR TECHNIQUES
	MOOC/MDC	MOLECULAR MECHANISM OF LEARNING AND MEMORY
	PROJECT/DSC EI	BIOPHARMACEUTICAL AND NANO BIOTECHNOLOGY
	DSCE II	FORENSIC BIOTECHNOLOGY
	DSC E III	STEM CELLS AND TISSUE ENGINEERING