THE MAHATMA GANDHI UNIVERSITY

UNDERGRADUATE PROGRAMMES

(HONOURS) SYLLABUS

MGU-UGP (Honours)

(2024 Admission Onwards)

Faculty: Science

BoS: Zoology

Bachelor of Science (Honours) Zoology and Industrial Microbiology (Double Major Programme)

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

MGU-UGP (HONOURS)

Syllabus

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Syllabus Index

Name of Major**: Zoology and Industrial Microbiology (Double Major Programme)**

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
MG1DSCZIM100	Introduction to Zoology	DSC A	4	5	3	--	2	--
MG1DSCZIM101	Introduction to Microbial World	DSC B	4	5	3	--	2	--
MG1DSCZIM102	Fundamentals of Biochemistry	DSC B	4	5	3	--	2	--
MG1MDCZIM100	Ornamental Fish Farming and Aquarium Keeping	MDC	3	4	2	--	2	--

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
MG2DSCZIM100	Environmental Biology	DSC A	4	5	3	--	2	--
MG2DSCZIM101	Public Health Microbiology	DSC B	4	5	3	--	2	--
MG2DSCZIM102	Molecules of Life	DSC B	4	5	3	--	2	--
MG2MDCZIM100	Pet Care Management	MDC	3	4	2	--	2	--

Semester: 3

Course Code	Title of the Course	Type of Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour distribution /week			
					L	T	P	O
MG3DSCZIM200	Protistan Diversity and Animal Diversity Non-Chordata- I	DSC A	4	5	3	--	2	--
MG3DSEZIM200	Animal Diversity Non-Chordata-II	DSE A	4	5	3	---	2	----
MG3DSEZIM201	Bio Analytical Techniques in Microbiology and Immunology	DSE B	4	4	4	--	--	--
MG3DSCZIM201	Bacterial Physiology and Metabolism	DSC B	4	5	3	--	2	--
MG3MDCZIM200	Human Diseases & Their Management	MDC	3	3	3	---	---	---
MG3VACZIM200	Bakery, Confectionary and Convenience Food Technology	VAC	3	3	3	--	--	--

Semester: 4

Course Code	Title of the Course	Type of Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG4DSCZIM200	Animal Diversity Chordata-I	DSC A	4	5	3	--	2	--
MG4DSEZIM200	General Toxicology	DSE A	4	4	4	---	0	---
MG4DSCZIM201	Industrial Microbiology and Fermentation Technology	DSC B	4	5	3	--	2	--
MG4DSEZIM201	Medical Microbiology (Any 1)	DSE B	4	5	3	--	2	--
MG4DSEZIM202	Microbial Quality Control in Food and Pharmaceutical Industry (Any 1)							
MG4SECZIM200	Emergency Life Support and First Aid	SEC	3	3	3	--	---	--
MG4VACZIM200	Nutrition and Life style Diseases	VAC	3	3	3	--	---	--
MG4INTZIM200	Internship		2					

Semester: 5

Course Code	Title of the Course		Type of Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	**T**	**P**	**O**
MG5DSCZIM300	Animal Diversity Chordata- II		DSC A	4	5	3	---	2	----
MG5DSCZIM301	Fundamentals of Genetics		DSC A	4	4	4			
MG5DSEZIM300	Biotechnology-Principles & Practices		DSE A	4	4	4			
MG5DSEZIM301	Wildlife management	Any 1	DSE A	4	4	4	---	---	---
MG5DSEZIM302	Climate Change and Disaster Risk Reduction								
MG5DSCZIM302	Food and Dairy Microbiology		DSC B	4	5	3	---	2	---
MG5SECZIM300	Food and Water Quality Management		SEC	3	3	3	---	---	---

Semester: 6

Course Code	Title of the Course		Type of Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG6DSCZIM300	Physiology and Endocrinology		DSC A	4	5	3	---	2	---
MG6DSEZIM300	Reproductive Biology and Teratology		DSE A	4	5	3	---	2	---
MG6DSEZIM301	Zoogeography and Evolutionary Biology	Any 1	DSE A	4	4	4	---	---	---
MG6DSEZIM302	Fundamentals of Parasitology								
MG6DSCZIM301	Microbes in Sustainable Agriculture and Development		DSC B	4	5	3	---	2	---
MG6SECZIM300	Mushroom and Spirulina Production Technology		SEC	3	3	3	---	---	---
MG6VACZIM300	Reproductive Health and Sex Education		VAC	3	3	3	---	---	----

Semester: 7

Course Code	Title of the Course		Type of Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
						L	T	P	O
MG7DCCZIM400	Biophysics, Instrumentation and Diagnostic Imaging Techniques		DCC A	4	5	3	---	2	----
MG7DCCZIM401	Biostatistics and Research Methodology		DCC A	4	4	4	---	---	---
MG7DCCZIM402	Advanced Genetics		DCC A	4	4	4	---	---	---
MG7DCEZIM400	Economic Entomology	Any 3	DCE A	4	4	4	---	---	----
MG7DCEZIM401	Live Stock and Poultry Management								
MG7DCEZIM402	Aquafarming								
MG7DCEZIM403	Solid Waste Management								
MG7DCEZIM404	Food Processing, Preservation and Packaging Technology		DCE B						
MG7DCEZIM405	Genetics and Genetic Counseling								
MG7DCEZIM406	Intermediary Metabolism								
MG7DCEZIM407	Marine and Fishery Microbiology								

Semester: 8

Course Code	Title of the Course		Type of Course DSC, MDC,SEC etc.	Credit	Hours/ week	Hour distribution /week			
						L	T	P	O
MG8DCCZIM400	Advanced Immunology		DCC A	4	5	3	---	2	---
MG8DCCZIM401	Animal Systematics		DCC A	4	5	3	---	2	---
MG8DCEZIM400	Aquatic Biology	Any 3	DCE A	4	5	3	---	2	---
MG8DCEZIM401	Bioinformatics and Computational Biology								
MG8DCEZIM402	Developmental Biology								
MG8DCEZIM403	Biological Specimen Preparation Techniques								
MG8DCEZIM404	Ecology and Environmental Microbiology		DCE B						
MG8DCEZIM405	Microbial Genetics and Metabolic Engineering of Microbes								
MG8DCEZIM406	Microbial Diagnosis in Health Clinics								
MG8DCEZIM407	Biotechnology, Tissue Culture and Genetic Engineering								
MG8PRJZIM400	Project		PRJ	12					

Semester-I

MGU-UGP (HONOURS)

Syllabus

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**INTRODUCTION TO ZOOLOGY**					
Type of Course	**DSC A**					
Course Code	**MG1DSCZIM100**					
Course Level	**100**					
Course Summary	The course includes several marvelous facts about the animal world which can foster sense of interest, connection, empathy and caring towards the animals. They feel responsible and enthusiastic to learn more about the animal world.					
Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre-requisites, if Any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify the wonders of the animal world and the facts behind the phenomena.	U	2,3
2	Explain Coloration, Mimicry & Parental care.	U	2,3
3	Discover the research avenues & career opportunities in Zoology	U	2,3
4	Predict the Entrepreneurial Possibilities in the field of Zoology	E	1,2,3
5.	Prepare detailed report of field visits to environmentally important places, research institutions and career orientation centers	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		**Wonders of Animal world**	**15**	
	1.1	**Incredible Animal Architects** Introduction to Animal Societies	7	1
	1.2	Honeybees – Skilled Engineers of Nature Comb building in Honey bees		
	1.3	Architectural secret of Termite hills		
	1.4	Weaver Bird-Wonderful Architect		
	1.5	**Glowing Wonders** Bioluminescence – Mechanism Noctiluca – Sparkle of the sea Firefly- Stars on earth Octopus – Wild Glowing Wonder Angler fish – the glowing monster	8	1
	1.6	Story of Pearl , Types of Pearl, Pearl Formation, Process of Picking best Pearl		
2		**Coloration , Mimicry & parental care**	15	
	2.1	**Coloration & Mimicry** Fakers of Nature- Secret behind Coloration & Mimicry Beautiful Butterflies, Colorful Earthworms, Painted Starfish Blue beauty Frog , Lovely Chameleon , Handsome Peacock Magnificent Owl Butterfly Leaf insect – The Walking leaves	7	2
	2.2	**Parental care** Animal Parenting – Facts & examples Who will take care? Father or Mother. Mother – Velvet Spider - Epitome of sacrifice Father – Water bug - Model father Pregnant Father – Sea Horse Father Brooder – Male Darwin frog. Sophisticated parents – Python parenting Supermom – Humming Bird Aggressive Mother – Otter	8	
3		**Major Research Areas & Careers in Zoology**	15	
	3.1	**Exciting avenues for research** Bioinformatics, Molecular biology, Biostatistics, Wildlife Biology, Toxicology & Pharmacology,	5	3

		Forensic biology, Physiology, Genetics, Microbiology, Immunology, Developmental Biology, Ethology, Biotechnology, Environmental Biology, Animal Systematics, Marine biology, Fisheries, Cell biology, Entomology, Biochemistry, Parasitology, **brief description only**		
	3.2	**Attractive career opportunities** **General**- All general UPSC jobs especially IFS (Indian Forest Service), Kerala PSC (all general degree based jobs), jobs in Kerala Forest and wildlife department (Range Forest Officer and Beat Forest officer),Scientists, Research assistants, Lab technicians, Animal house keepers in reputed research centers like ZSI, CSIR, ICAR, RGCB, KFRI, NCBS, TIFR, SACON, BARC, ICZN etc. Jobs in NGOs like WWF, ATREE, Wildlife SOS, Wildlife Trust of India, Center for Wildlife Studies, Nature Conservation Foundations etc. **Specific**- Entomologist in Vector control board and in research institutes like KFRI; Teaching; Biologist and Curator in Museum and Zoological Parks; Fisheries officer in Fisheries department, Junior scientific assistant in pollution control board, District Malaria Officer, forensic assistant in police department and health department; ecologist, conservation biologist and nature education officers in various wildlife sanctuaries and protected areas; jobs in Pharmaceutical companies. Embryologist, Cytological specimen preparation, Cytogeneticist in diagnostic labs and hospitals. Medical coding	5	4
	3.3	**Lucrative Entrepreneurial Possibilities** Products, byproducts & value added products of: Apiculture, Sericulture, Dairy Farming, Poultry Farming, Pets and their management, Aqua culture (Edible and ornamental) and Vermiculture	5	
4		**Practical**	**30**	
	4.1	Identification of any 10 specimens coming under the following categories 1. Animal architects, 2. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.	8	5
	4.2	Search wonders of animal world and make short videos/reports/photos: 1. Animal architects, 2. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.	5	

	4.3	1. Field visit - Nature camp, butterfly garden, museum, pearl culture farm.(any 2) 2. Visit to any 2 research institutes 3. Visit and interact with any two entrepreneurs from different fields and submit the report 4. Career Orientation class by experts	17	
5.		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, group interaction, seminar, presentations **Note:** Only a brief description of the focal topic is required. Teaching aids like photographs, models, videos,short films, documentaries related to the topic may be used
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record, field report, entrepreneur interaction report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays - 5 out of 7 x4 =20 marks Short questions - 10 out of 12 x2 =20 marks Fill in the blanks -10x1=10 marks **Practicals Total = 35 marks; Duration- 2 hrs** **Record 10 marks,** **Examination 25 marks:** spotter identification - 16 marks Viva - 4 marks, research institute visit report- 5 marks

REFERENCES

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2. Barnes R. D. (1982) Invertebrates Zoology 6th endn. Toppan International Co
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8. Colbert, E.H. (1955) Evolution of the Vertebrates. John Wiley and Sons Inc. N.York.
9. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990); Manual of Zoology. Vol. II .S. Viswanathan and Co.
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12. Halstead, L.B. (1969). The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U. S. A.
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14. Hobart M. Smith. Evolution of Chordate structure, Holt, Rinehart and Winston. Inc. N. York.
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18. Meera J.A. (2020). Chordate Zoology of Kerala¸Zoological Sociey of Kerala.
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20. Waterman, AJ. (1971) Chordate Structure and Function. Macmillan Co. London.
21. Young, J.Z. (1950) Life of Vertebrates. Clarendon Press Oxford.

SUGGESTED READING

1. Jolie, M. (1968) Chordate Morphology. East West Press.
2. Parragon Publishing India. (2023) Fascinating facts Animals.Parragon Publishing India.
3. William S. Beck. Karel, F.. Liem and George Gaylord Simpson. (2000). Life: An introduction to biology. Harper Collins Publishers, New York.
4. Young J.Z. (2006). The life of Vertebrates. Oxford University Press.

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**INTRODUCTION TO MICROBIAL WORLD**					
Type ofCourse	**DSC B**					
Course Code	**MG1DSCZIM101**					
Course Level	**100**					
Course Summary	This course gives a sound introduction to Microbiology and it explore the diversity of microbial life with emphasis on how we interact with microbes.					
Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Prerequisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	State knowledge about historical discoveries & scope indomain of Microbiology.	K	1,2
2	Discuss the diversity of bacterial cell structure.	U	1,2,3
3	Demonstrate architecture and characteristics of different group of Virus	U	1,2,3
4	Explain fundamentals Classification and importance of algae& Fungi	U	1,2,3
5	Examine ecology of Protozoa	An	2,3,5 ,10
6	Develop practical skills needed to perform basic microbiology laboratory techniques	S	2,3,4
Remember (K), Understand (U), Apply (A), Analyses (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	**Historical Discoveries & Ultra structureof bacteria**			
	1.1	History &Scope of Microbiology. Spontaneous generation vs.biogenesis, Germ Theory of diseases Contributions of Anton von Leeuwenhoek, Louis Pasteur,Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner	5	1
	1.2	Prokaryotes v/s Eukaryotes, Brief account on characteristics of Archaebacteria, Extremophiles, Actinomycetes, Rickettsiae.	4	1
	1.3	Ultrastructure of bacteria, Size, shape &arrangement ofbacteria. Structure and arrangement of bacterial flagella, pili capsule. Structure and composition of Gram positive andGramnegative cell wall, cell envelope Cytoplasmic membrane, mesosomes, cytoplasm, vacuoles,nuclear membrane and cysts.	6	2
2		**Virology**		
	2.1	Viruses-General characteristics, Morphology & structure	3	2
	2.2	Bacteriophage discovery & significance. Replication of Bacteriophages- Lytic & Lysogenic cycle.	4	3
	2.3	Structure of TMV, HIV. Cultivation of Plant and animal Virus. Cancer & Viruses-Oncogenic DNA Viruses, Oncogenic RNA Viruses. Other infectious agents-viroids and prions.	8	3
3		**Phycology& Protozoology**		
	3.1	Fungi –morphological features, classification, reproduction andeconomic importance-Ascomycota, Basidiomycota, Zygomycota, Deuteromycota. Distinguishing characteristics of *Aspergillus, Pencillium & Rhizopus & Mucor.* Abrief account on *Saccharomyces.*	6	4
	3.2	Biological & Economic importance of algae, Characteristicsof algae. Classificationof algal divisions - Prochlorophyceae,Euglenophyceae, Bacillariophyceae, Tribophyceae, Chrysophyceae, Cryptophyceaeand Dinophyceae. Brief account on Cyanobacteria and its Importance	5	4
	3.3	Ecology of Protozoa, Importance &Morphology of protozoa. Reproduction of Protozoa	4	5

4		**Practicals**		
	1	General rules in Microbiology laboratory. Preparation of Culture media for bacteria. Cultivation Solid media-nutrient agar, SDA, PDA (for fungi). Liquid media-nutrient broth.	3	1
	2	Instrumentation: Microscopy Incubator, Hot Air Oven, AutoclaveQuebec Colony counter, pH Meter	4	
	3	Preparation of cotton plug, Sterilization of media usingAutoclave, glassware using Hot Air Oven. Working principle-Autoclave, Hot Air Oven	4	
	4	Observe Bacterial Motility from the given Sample	4	2
	5	Measurement of Bacterial cell count by Hemocytometer	4	2
	6	Simple staining, Differential staining -. Gram's staining	4	2,6
	7	Structural Staining-Capsule staining/Negative staining Fungal staining- Lactophenol cotton blue Mounting, Acidfast Staining (Permanent slide only)	7	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teachingand Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction, Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Groupdiscussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment** **Theory Total -25 Marks:** Quiz/Test Paper/Seminars **Practical Total 15 Marks:** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks, Short Questions 10 out of 12 x 2 =20 Marks, Fill in the blanks 1x1 0= 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record : 10 Marks; Examination :25 Marks, Perform Gram staining technique-8 Marks, Perform Lactophenol cotton blue Mounting- 8 Marks , SpotterIdentification-8 Marks Viva-1 Marks

REFERENCES

1. Atlas, R. A., & Bartha, R., (2000). Microbial Ecology, FundamentalsandApplication. New York: Benjamin Cummings.
2. Baker. (2012). BIOS Instant Notes in Microbiology (4 th ed). Taylor & Francis. 3Heritage, (2012). Introductory Microbiology, Cambridge: Cambridge University Press
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SUGGESTED READINGS

1. Prescott, Joanne Willey, Linda Sherwood, & Christopher, J.W.,(2017).Microbiology (10 th ed). New York: Mc Graw Hill.
2. Aneja, K. R. (2008) . A textbook of basic and applied microbiology. New AgeInternational
3. Pelczar, M. J., Schan, E. C. and Kreig, N. R. (2010). Microbiology: AnApplicationBased Approach

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FUNDAMENTALS OF BIOCHEMISTRY**					
Type of Course	**DSC B**					
Course Code	**MG1DSCZIM102**					
Course Level	**100**					
Course Summary	This course offers an understanding about basics of biochemistry, particularlyin the realms of water & buffer systems, membrane biochemistry & Plant biochemistry.					
Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, ifAny						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	Recall various disciplines of biochemistry and its scope.	K	1.2.3
2	State the structure of water and interpret the concept ofionization of water, acids, bases and buffers in biological system.	K	1,2,3
3	Summarize membrane structure and functions.	U	1,2,3, 4
4	Describe fluid mosaic model and transport mechanisms across biological membranes	U	1,2,3, 4
5	Illustrate the process of photosynthesis and Biochemistry of nitrogen assimilation in plants	A	1,2,3, 4,5
6	Develop practical skill to prepare solution and Verifybeers Lambertz Law	S	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		**Introductionto Biochemistry**		
	1.1	Origin of life, Evolution of the Discipline of Biochemistry. Scope of Biochemistry	4	1
	1.2	Structure and significance of water in biochemistry. Ionization of water, Ionic product of water. Concepts of pH and pOH, acid and bases, pH Scale.	5	2
	1.3	Buffers, Henderson-Hasselbalch equationwithderivation. Buffers in biologicalsystems–Phosphate buffer, Bicarbonate Buffer, Hemoglobin buffer Classification of colloids and its application	6	2
2		**Membrane Biochemistryand Cell Organelles**		
	2.1	Structural organization of biological membranes,Fluid mosaic model of plasma membrane. Types of membrane proteins (peripheralintegral and amphitropic). Significance of membranelipids.	4	3,4
	2.2	Solute transport across membranes (passive transport—simple diffusion and facilitated diffusion, active transport- primary and secondary, uniport, symport, antiport) and Osmosis.	4	4
	2.3	Structure andfunctions of Endoplasmic reticulum, Ribosomes, Golgi complex, Lysosomes, Mitochondria	5	4
	2.4	Difference between mitosis and meiosis.	2	4
3		**Plant Biochemistry**		
	3.1	Photosynthesis- Structure and functions of chloroplast, photosynthetic pigments, Light reaction -cyclic and noncyclic photophosphorylation. Dark reactions C3,C4&CAM pathway, Photorespiration.	6	5

	3.2	Biological Nitrogen fixation -SymbioticNitrogen fixation, Specific Associations Between bacteria and Plants, Events in root nodule formation .Nonsymbiotic nitrogen fixation- -free living Nitrogen fixing organisms	5	5
	3.3	Biochemistry of Nitrogen fixation-Nitrogenase complex and mechanism of Nitrogen fixation Outline importance of secondary metabolites in plant biochemistry		
4		**Practicals**		
	4.1	Laboratory Safety Practices, Preparation of solutionNormal solutionMolar solution, Percentage solution Dilution of stock solutions	5	1
	4.2	Determination of pH by using pH meter	3	2
	4.3	Separation of amino acids by paper Chromatography (Demonstration only)	5	6
	4.4	Verification of Beer Lamberts Law.	5	6
	4.5	Colorimetric estimation of protein by Biuret Method	6	6
	4.6	Industrial Visit/Laboratory Visit	6	2
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction, Brain storming lecture, Explicit Teaching, E learning,Interactive instruction, Group assignments, Library work,Group discussion Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment(CCA)** **Theory Total -25 Marks** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 =20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practicals Total - 35 Marks Duration – 2 hrs** Record - 10 Marks Examination - 25 Marks: Colorimetric estimation- 8 Marks, Determination pH of the given sample - 8 Marks, Spotter Identification – 8 Marks, Viva-1 Marks

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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ORNAMENTAL FISH FARMING AND AQUARIUM KEEPING**					
Type of course	**MDC**					
Course Code	**MG1MDCZIM100**					
Course Level	**100**					
Course Summary	The course 'Ornamental fish breeding, culture and aquarium keeping' provides a comprehensive understanding of the varieties of ornamental fishes, management aspects of ornamental fish farming, fish transportation, breeding and rearing of ornamental fishes and construction and maintenance of aquarium.					
Semester	I	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	--	1	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify various commercially important freshwater ornamental fishes, aquarium accessories, aquarium fish diseases.	U, An, A	1
2	Understand and apply fish transportation techniques while transporting brooders and fish seeds.	U, A	1
3	Employ skills for breeding and rearing of egg-layers and live-bearers and aquarium setting.	A, S	1
4	Apply the knowledge in aquascaping, water quality management and feed administration.	A	10

Remember(K),Understand(U),Apply(A), Analyze(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		**Ornamental fish farming- Management aspects**	**15**	
	1.1	Introduction to ornamental fish farming**.** Common freshwater ornamental fishes; Live bearers (Guppy, Platy, Molly, Sword tail), Egg layers (Varieties of Gold Fish, Gourami, *Betta*, Tetra, Angel Fish, *Puntius* sp.).	2	1
	1.2	Study of Two examples each of Indigenous, Endemic and Exotic ornamental fishes of Kerala	2	1
	1.3	**Food and feeding**: Nutritional requirements of fishes. Types of Feed: Dry feeds, Non -Dry feeds (Moist feeds, Wet or paste feeds), Feeds for colour enhancement. Live feed and live feed culture. Preparation and composition of formulated fish feeds. Feeding rate and management.	4	1, 5
	1.4	**Water quality management** (pH, hardness, salinity, oxygen, carbon dioxide, chlorine, ammonia, nitrites, temperature); Water filtration systems – biological, physical; types of filters. Aerators, Aquarium Plants.	3	5
	1.5	**Common diseases of aquarium fishes** Parasitic (protistan, helminthic, arthropodan), microbial (Bacterial, Fungal, Viral) (Any two from parasitic and microbial) and nutritional deficiency diseases.	3	3
	1.6	Conditioning, packing, transport and quarantine methods.	1	2
2		**Breeding and rearing of ornamental fishes & Construction and maintenance of aquarium**	**15**	
	2.1	Breeding of Live bearers (Guppy, Molly, Sword tail) and Egg layers (Gold Fish, Gourami, *Betta*).-any one from each group. Sex identification, brooder selection and conditioning, induced spawning, hatching and rearing of frys.	10	3
	2.2	Types of aquaria, Setting up of a freshwater aquarium. **ACTIVITY:** Visit ornamental fish farm & submit a report	5	3,4

3		**Practicals**	**30**	
	1	Identification of aquarium fishes-Egg layers and live bearers, both indigenous, exotic and endemic.		1,3, 4
	2	Identification of fish diseases - symptom, causative organism and control measures.		
	3	Study of aquarium accessories		
	4	Determination of pH of water sample		
	5	Demonstration of construction and setting up of an aquarium		
	6	Study of breeding behaviour of any one ornamental fish.		
	7	Identification of live fish feeds and culturing of any one.		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Demonstration, ICT Enabled learning, Experiential Learning Tutorial
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total - 15 Marks** Submission of report on ornamental fish farm visit, Test paper, Viva, Seminar **Practical Total - 15 Marks** Lab performance, record, Lab test
	B. End Semester Examination **Theory Total = 35 Marks; Duration - 1 hr** Short Essays 5 out of 7 x4=20 Marks Short questions 5 out of 7 x 2 =10 Marks Fill in the blanks - 5x1=5 Marks **Practicals Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks,** **Examination - 25 Marks:** Spotter identification 20 Marks, Determination of pH of two water samples - 5 Marks

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Semester-II

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ENVIRONMENTAL BIOLOGY**					
Type of Course	**DSC A**					
Course Code	**MG2DSCZIM100**					
Course Level	**100**					
Course Summary	This comprehensive course covers the fundamental principles of ecosystems, populations, and communities, emphasizing biodiversity & its threats. It explores biogeochemical cycles, renewable and non-renewable resources, and ecological interactions. The module on biodiversity delves into its types, significance, and threats, including climate change & habitat destruction. Conservation efforts, both international & national, are detailed, along with key environmental laws. It concludes with a focus on managing environmental issues, addressing solid waste, watershed management, carbon-related concepts, and eco-friendly initiatives.					
Semester	**II**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Explain the dynamics of Ecosystem and renewable resources.	A	1,2, 7
2.	Describe the attributes of Population, community and animal interaction.	U	1,2, 7
3.	Distinguish concepts of biodiversity, threats to biodiversity and measures to conserve Biodiversity.	A	1,2,6,7
4.	Employ strategies to manage environmental issues.	A	1,2,6,7
5.	Administer experiments in Environmental Biology.	A	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		**Dynamics of Ecosystem**	**10**	
	1.1	Introduction to Environmental Biology; Scope and History.	1	1
	1.2	**Basic concept and structure of ecosystem**: Definition; Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers)	2	1,2
	1.3	**Functions of ecosystem**: Productivity-Food chain-Food web- Energy flow-Laws of Thermodynamics	2	1
	1.4	**Types of Ecosystem**: **Terrestrial** (Forest-Grassland-Desert) and **Aquatic**-(Marine, Fresh water, Wetland); Biome; Ecological pyramids (number, biomass, energy)	2	1,2
	1.5	**Biogeochemical cycles:** Concept, gaseous (Carbon cycle, Nitrogen cycle) and sedimentary cycles (phosphorous cycle).	1	1,3
	1.6	**Renewable resources (**solar, wind, wave, hydroelectric, biomass and geothermal) **and Non-renewable resources** (mineral and metal ore, fossil fuels)	2	1,3
2		**Population and Community**	**8**	
	2.1	**Concept of population**: Population attributes-Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves.	1	2,3
	2.2	**Animal interactions**: **Positive**- Commensalism-Mutualism-Proto-cooperation, **Negative**-Predation-Parasitism-Competition-Antibiosis.	3	2,3
	2.3	**Characteristics of a community**: Species diversity-richness, evenness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Flagship species,Umbrella species. Concepts of Ecological Niche and Guild, Ecological succession, community evolution-climax.	4	2,3
3		**Biodiversity Conservation and Disaster Management**	**27**	

	3.1	**Introduction to Biodiversity:** Types of biodiversity- Alpha, Beta and Gamma diversity. **Concept and importance of Biodiversity**: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity (in brief); Biodiversity indices (Shanon-Weiner index, Simpson's index); Basic sampling techniques (Quadrat and Transect methods). **Significance of Biodiversity** - Ecosystem productivity (Ecosystem services, Biological resources, Social benefits), Ecosystem stability; India as a mega-diversity nation, Biodiversity hotspots. **Threats to Biodiversity:** 1. Climate change and global warming (details of greenhouse effect and Ozone depletion to be included here), 2. Habitat destruction, 3.Pollution (air, water, noise and plastic pollution) - causes, effects and control measures in brief, Invasive species, Over-exploitation of natural resources.	7	1,2, 3
	3.2	**Conservation of Biodiversity** **Protected area concept:** Wildlife Sanctuary, National Park, Biosphere Reserve, Conservation Reserve, Community Reserve	1	3,4
	3.3	**International Efforts in Biodiversity Conservation**: WWF, Convention on Biological Diversity (CBD), International Union for the Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program-World Conservation Monitoring Centre (UNEP-WCMC), Red Data Book, Green Data Book, Blue Data Book; IUCN's Post 2020 Global Biodiversity Framework (GBF) Strategy Initiative, UN's Sustainable Developmental Goal 15 of 2030 Agenda. Overview of G20 Summit 2023 in terms of Biodiversity Conservation and Sustainable development .	3	4
	3.4	**National level initiatives** National Biodiversity Strategy and Action Plan; People's Biodiversity Register. **Regional level initiatives**: The Chipko movement, Narmada Bachao Andolan, The Silent Valley Episode.	4	4
	3.5	**Environmental disasters:** Natural disasters (Earthquakes, Cyclones, Floods, Tsunamis and Landslides) and Man-made disasters-case studies (Global level- Chernobyl nuclear power plant explosion, National level - Bhopal gas tragedy and Regional level- Endosulfan issue). PRRP for disaster	5	2,3

		management.		
	3.6	**Management oF Environmental Issues** Solid Waste Management; Watershed Management; Rainwater Harvesting; **International agreements:** Montreal Protocol, Kyoto Protocol, Inter-government Panel on Climate Change (IPCC), Overview of UN Climate Change Conferences (COP 2023 to be included); Ramsar Convention. Carbon Credit; Carbon Trading (Emission trading); Carbon Sequestration; Carbon Footprint; Ecological Footprint **Environmental Laws (Brief accounts only):** The Wildlife Protection Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act,1981; Indian Forest Act (Revised) 1982; The Environment Protection Act, 1986; The Biodiversity Act, 2002; National Green Tribunal Act, 2010; Environment (Protection) Amendment Rule, 2022.	7	3,5
4		**Practicals**	**30**	
	1.	Estimation of Dissolved Oxygen.	2	4, 5
	2.	Estimation of Carbon-di-oxide	2	
	3.	Analyze the pH and texture (sandy/silty/clayey) of any 2 soil samples.	2	
	4.	Preparation of Temporary mount of any one plankton	2	
	5.	Counting of planktons using plankton counting chamber	2	
	6	Spotters:Plankton counting chamber, Secchi disc & Plankton net	2	
	7.	Individual visit to any polluted site and preparation of a detailed report (it should include observation and remedial measures)	8	
	8.	Present a report on the environmental challenges identified in your Locality and its mitigation measures.(group project of 5 members each)	8	
	9.	Identify five influential personalities (from India) who have contributed towards the conservation of the environment and comment on their contributions (eg. Vandana Shiva,Sundarlal Bahuguna, ,Daya Bhai, Sugathakumari, M.K.Prasad, Prof.Sitaraman, Sankaranarayana, Kallen Pokkudan)	2	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Field Visit to Ecologically significant areas
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record , field report, entrepreneur interaction report
	B. End Semester Examination: **Theory: Total =50 Marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks Short questions-10 out of 12 x2 =20 Marks Fill in the blanks - 10x1 =10 Marks **Practical Total =35 Marks; Duration - 2 hrs** **Record** - 10 **Marks** **Examination - 25 Marks:** Spotter identification - 10 marks Viva - 5 marks, research institute visit report- 10 marks

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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**PUBLIC HEALTH MICROBIOLOGY**					
Type of Course	**DSC B**					
Course Code	**MG2DSCZIM101**					
Course Level	**100**					
Course Summary	This course help students understand basic principles of public health microbiology as they apply to the emergence, transmission, pathogenicity, andcontrol of infectious human disease.					
Semester	II	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre requisites, ifany						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	List the role of microbiologist in public health Department.	U	1,2,3
2	Describe various modes by which infections spread in Community	K	1,2,3
3	Execute the social, economic and cultural challenges to protecting the public by preventing air borne disease.	A	1,2,3, 5,
4	Examine water borne infection.	An	1,2,3, 5
5	Conclude investigative methods to study the role of foodinpublic health. Compare and contrast models of hospitalized infectious disease with respect to pathogens,reservoirs,modes of transmission and control	E	1,2,3, 4,5

6	Acquire skill to isolate microorganism from spoilage foodsanddetermine the presence of coliforms in the givenwatersample	S	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 public health Microbiology & Airborne infection**		
	1.1	Public health: definition, scope, concept and importance of public health microbiology.	2	1
	1.2	Roles of Microbiologist in public health. Basic concept on Pollution (air,water noise,radiation and waste)	3	1
	1.3	Air and its composition, Microbial air pollution, sources of air pollution. Impact ofair pollution on human health and environment.	4	2
	1.4	Methods of enumeration of microorganisms in air – CFU Inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration	2	2
	1.5	Air borne diseases- Bacterial Pneumonia, diphtheria,Tuberculosis, Influenza, Measles	4	3
2		**Water borne Infection**		
	2.1	Microorganisms in water: Transmission of pathogen,Water borne diseases.(Viral, Bacterial, Protozoan). Sources of infection	5	4
	2.2	Characters of organisms and control of : Typhoid ,Cholera, Bacillary Dysentery, Hepatitis A -Causes, symptoms, Treatment, Sample Collection, Treatmentand safety of drinking (potable) water. Control measures - Precipitation, chemical disinfection, filtration, high temperature, UV light.	5	4
	2.3	Methods to detect portability of watersamples (a) standard Qualitative procedure (MPN): presumptive test, confirmed and Completed tests for faecal coliforms (b) Membrane filter technique	5	4

3		**Food borne diseases &Hospital acquired infection**		
	3.1	Definition and importance of food hygiene – types (spoilage of meat and its products, milk and dairy product, fish & fishery products and eggs).	5	5
	3.2	Role of microorganisms in food spoilage and poisoning, Food borne diseases – types of food bornediseases, food poisoning, food borne infection	4	5
	3.3	Prophylactic immunization – disposal of infective hospital and laboratory materials . Monitoring of sanitation in community. Techniques used for the diagnosis of hospital acquired infection	6	5
4		**PRACTICALS**		
	4.1	Demonstration of the presence of microflora inthe environment by exposing nutrient agar plate in air.	4	2
	4.2	Study different shapes of bacteria using permanent slide./Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses(ring worms)	4	2
	4.3	A Visit to a nearby hospital and collect data on nosocomial infections	4	1
	4.4	Assessment of microbiological quality of water by MPN method	8	4
	4.5	Isolation of spoilage microorganism from milk/meat/egg	6	5
	4.6	Total plate count of the given culture plate.	2	5
	4.7	Study of normal microbial flora of human being	2	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments ,Library work,Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment(CCA)** **Theory Total -25 Marks** - Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 =20 Marks Short Questions 10 out of 12 x 2 = 20 Marks Fill in the blanks 10x 1 = 10 Marks **Practicals Total -35 Marks Duration - 2 hrs** Record - 10 Marks Examination-25 Marks: Perform MPN method -8 Marks, Spotter Identification-8 Marks , Hospital visit report- 6 Marks, Enumeration of bacteria from the given culture plate-2 Marks, Viva- 1 Marks

References

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MOLECULES OF LIFE**					
Type of Course	**DSC B**					
Course Code	**MG2DSCZIM102**					
Course Level	**100**					
Course Summary	The primary objective of this course is to establish a strong foundation inbiochemistry for students, with a focus on qualitative analysis of carbohydrates, amino acids, proteins and nucleic acids.					
Semester	II	Credit			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	State the classification and structure ofcarbohydrates	K	1,2,3
2	Classify amino acids and discuss the nature of the peptide bond and various structural level of proteins	U	1,2,3,4
3	Illustrate the structures of hemoglobin andmyoglobin	A	1,2,3,4,
4	Contrast the functions of lipids and compare their structures and Properties	An	1,2,3,4,5
5	Justify the structures of nucleic acids and their Constituents	E	1,2,3,4,5
6	Employ a suitable scheme for the systematic analysis ofcarbohydrates, amino acids, proteins and lipids.	S	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		**Carbohydrates**		
	1.1	Classification of carbohydrates. Monosaccharides and their importance (glucose, galactose, mannose and fructose with structures), Isomerism of carbohydrates - D and L forms, epimers, anomers.	5	1
	1.2	Haworth perspective formula and functions of disaccharides - Sucrose, maltose, lactose.	4	1
	1.3	Structure and important properties of the Homopolysaccharides – Starch, cellulose and glycogen. (without structure) Heteropolysaccharide - Hyaluronate (without structure) Structural polysaccharides and Cellulose, Chitin, Pectin. Storage polysaccharides (starch,inulin, glycogen), Glycosaminoglycans, Bacterial cell wall polysaccharides.	6	1
2		**Proteins**		
	2.1	Name (with one letter and three letter code)ofthe 20 standardamino acids occurring in proteins, general structure of amino acid inthe zwitter ionic form. Classification of amino acids based on chargeand Polarity,Essential and non- essential amino acids.	5	2
	2.2	Peptides: Formation of peptide bond.Proteins: Classification based on solubility, shape and function. Denaturation and renaturation of proteins	5	2
	2.3	Structural organization of proteins- primary, secondary, tertiary and quaternary structures, Structures of Hemoglobin and Myoglobin, forces stabilizing the structure of protein	5	3
3		**Lipids & Nucleic acid**		
	3.1	Biochemical functions of lipids, Classificationof fattyacids, chemical constants of fatty acids- saponification number, acid number, iodine number.	3	4
	3.2	Essential and non-essential fatty acids with examples. Compound lipids: storage and membrane lipids. Structure and functions of phospholipids and glycolipids, Lipoprotein, Steroids: Structure of steroidnucleus, cholesterol, ergosterol	6	5

	3.3	Nature of nucleic acids, purines and pyrimidines, nucleosides, nucleotides, Stability andformation of Phosphodiester linkages, Structure of Nucleic acids- Watson-Crick DNA double helix	6	5
4		**Practicals**		
	4.1	Carbohydrates: (Glucose, fructose, Maltose, Lactose, Starch, dextrin, Glycogen may be given for analysis). Molisch's test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed'stest), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test.	6	1
	4.2	Proteins: (Casein, Albumin, Gelatin, peptone may be given foranalysis). Biuret test, Ammonium sulfate precipitation test, sulphosalicylic acid test, Heat coagulation test.	6	2
	4.3	Identification of Monosaccharide, Disaccharide, Polysaccharide following a systematic scheme of analysis (Single components from the above-mentionedcarbohydrates.	6	1
	4.4	Identification of NPN Non-Protein Nitrogenous compounds (Urea, Uric acid, Creatinine) Urease Test, Phosphotungstic acid test and Jaffe's Test	5	6
	4.5	Study the structure of carbohydrates-Glucose and fructose using Ball stick Model	2	1
	4.6	Saponification Test/Qualitative test of sugar (Abnormal constituents:(sugar- Benedicts Test, Hemoglobin- BenzidineTest ,Ketone bodies-Rothers test, ,Gerhardt'sTest)	6	3
5		**TeacherSpecific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment(CCA)** **Theory Total -25 Marks** Quiz/Test Paper/Seminars **Practical Total 15 Marks** Lab performance/ Record/lab Test
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 =20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record : 10 Marks; Examination :25 Marks,

	Qualitative analysis of - monosaccharides/Disaccharides/Polysaccharide-8 Marks, Identify the givenNPNSample- 8 Marks, Spotter Identification-8 Marks, Viva -1

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**PET CARE AND MANAGEMENT**					
Type of course	**MDC**					
Course Code	**MG2MDCZIM100**					
Course Level	**100**					
Course Summary	Pet care and management course provides a sound introduction to caring for a wide variety of different pets including dogs, cats, birds and some other pets like rabbits, and rodents. This course covers the aspects like diets & nutrition, breeding health and hygiene, care of litters and young animals and more. Pet Care is designed as an introductory course for those seeking to work with animals in positions such as vet nurses, animal welfare and animal rescue.					
Semester	**II**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	**---**	**1**	**----**	**60**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the legal and safety measures in keeping pets	***K***	1
2	Explain different breeds of dog,cat and bird, pet nutrition, grooming, reproductive biology & healthcare management.	***U***	2
3	Apply management techniques of pet care in starting and running a pet-related business, marketing, and customer service.	E	1
4	Identify different breeds of pets and pet diseases.	K	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		**Pet care sector -- Legal and safety measures**	**9**	
	1.1	**Introduction to Pet animals** – Relevance of Pet animals – for leisure, revenue. Common pet animals. Cat, dog, birds, rabbits, hamsters, guinea pigs.	2	1
	1.2	Career Opportunities Associated with pet Animals- Pet breeding & marketing & pet food business.	1	1, 2
	1.3	Laws (animal & bird act regulations) & licenses	2	6
	1.4	Animal charities & societies - Animal Welfare Board of India:(AWBI); 'National Institute of Animal Welfare' (NIAW); NGOs - Federation of Indian Animal Protection organisations (FIAPO); 'Blue Cross of India'- Chennai (BCI-Chennai) 'People for Ethical Treatment of Animals'- India (PETA'-India)	2	6
	1.5	Zoonotic diseases (rabies, capnocytophagosis, Swine flu, avian flu, toxoplasmosis and ecto-parasitic infections)	2	5
2		**Pet Cats, Dogs ,birds and their care**	**21**	
	2.1	Common cat breeds for Indian climate - Small cat breeds (Bombay cat, Siamese cat & Oriental Shorthair) Large cat breeds (Persian Cats, Bengal Cat, & British Shorthair)	2	1
	2.2	**General Habits, nutrition and feeding, breeding and management** of Pet cats. Newborn Kittens - Behaviour and grooming. Feed and nutrition.	3	2
	2.3	**Common diseases** of cats-their diagnosis, treatment and control. Care for a sick cat. Cattery design and management.	3	7
	2.4	**Common dog breeds -** Labrador, German Shepherd, Pug, Beagle, Indian Spitz & Doberman. Selection of dog breeds - Purebred and mix-breeds. Behaviour and Grooming. General habits, Feeding and nutrition. Detection of oestrus and Breeding of dogs. Desexing.	3	7
	2.5	**Common diseases** Microbial, parasitic, fungal and nutritional deficiency disorders. Clinical manifestations, diagnosis, treatment and control. Vaccination/ deworming schedules.	3	7

	2.6	**Pet Birds: Selection of Breeds** (eg. Canaries, Finches, Budgerigars, Small Parrots)	2	1,2
	2.7	**Sexing, Desexing, Containment (Aviaries** – selection, design, size, management). Feed and Feeding methods, Grooming (Wing trim, Beak Trim, Nail Trim), Hygiene	3	2
	2.8	**Common diseases -** diagnosis, treatment and control. Caring for the Sick Bird, Supportive therapy.	2	7
3		**Practicals**	**30**	
	1	Breed identification – dog, cat and bird.	6	3,4
	2	Identification of ecto & endoparasites of dog, cat and bird	3	
	3	Composition of balanced diet for the pets; dog, cat & bird.	3	
	4	Visit to near by Veterinary hospital & report submission on different pet diseases	6	
	5	Collaborate with veterinarians to organize joint workshops or informational sessions, combining medical advice with practical care tips.	6	
	6	Analyse incidence of different diseases on specific pets and submit the report (any two pets).	6	
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 1. Lecture, Videos 2. Demonstrations: Conduct live demonstrations, either in person or through videos, showcasing proper grooming techniques, training methods, or other aspects of pet care.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 15 Marks** Test paper, Viva, Seminar **Practical Total = 15 Marks.** Lab performance, record, Report submission
	B. End Semester Examination **Theory Total = 35 Marks, Duration - 1 hr** Short Essays 5 out of 7 x4=20 Marks, Short questions - 2 out of 4 x5 =10 Marks; Fill in the blanks -5x1=5 Marks **Practicals Total = 25 Marks; Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Breed identification with reasons (2 breeds) - 8 Marks, Parasite identification - 10 Marks, Composition of balanced diet for dog, cat & bird - 7 Marks

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Semester-III

MGU-UGP (HONOURS)

Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**PROTISTAN DIVERSITY AND ANIMAL DIVERSITY - NON CHORDATA- I**					
Type of Course	**DSC A**					
Course Code	**MG3DSCZIM200**					
Course Level	**200**					
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Kingdom Protista, Phylum Orthonectida, Phylum Placozoa, Phylum Coelenterata, Phylum Ctenophora, Phylum Platyhelminthes, Phylum Aschelminthes and Phylum Annelida. The course structure focuses on the key features, classification, and special characteristics of representative examples within each phylum. Additionally, it explores topics such as economic importance, unique features, and adaptations. The course places a strong emphasis on practical knowledge in the area of invertebrate zoology, with a particular focus on developing students' hands-on skills, observational abilities, and collaborative work.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**-**	**1**	**----**	**75**
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Classify the Kingdom Protista, Phylum - Orthonectida, Placozoa, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes and Annelida.	**U**	**1**
2	Compare salient features of different phyla from Orthonectida to Annelida.	**U**	**1**
3	Describe the canal systems in Sponges, Parasitic Protists, Life cycle of *Plasmodium*, Coral and coral reefs and its conservation, Polymorphism in Coelenterates, Pathogenic nematodes in man.	**U**	**1**

4	Distinguish different parasitic/pathogenic Protists, Platyhelminthes, Nematodes and Annelids	**U**	**2**
	Practical		
1	Identification of specimens from Protista, Porifera, Cnidaria, Platyhelminthes, Nematoda & Annelida	**U**	**1**
2	Apply culture techniques of protists and prepare temporary whole mounts of specimens	**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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Kingdom Protista**	**15**	
	1.1	Kingdoms of classification: Two-kingdom, Three Kingdom, Five kingdom and Eight kingdom classifications, Levels of animal organization. (Mention only)	1	1
	1.2	**Animal -like protists** 1. Phylum Rhizopoda Eg.: *Amoeba* 2. Phylum Actinopoda Eg.: *Actinophrys* 3. Phylum Foraminifera Eg.: *Elphidium* 4. Phylum Ciliophora Eg.: *Balantidium* 5. Phylum Opalinata Eg.: *Opalina* 6. Phylum Kinetoplasta Eg.: *Trypanosoma* 7. Phylum Metamonada Eg.: *Giardia* 8. Phylum Choanoflagellata Eg.: *Proterospongia* 9. Phylum Parabasalia Eg.: *Trychonympha* 10. Phylum Sporozoa Eg.: *Toxoplasma* **Plant -like protists** 11. Phylum Euglenophyta Eg. : *Euglena* 12. Phylum Cryptophyta Eg. : *Cryptomonas* 13. Phylum Bacillariophyta Eg.: Diatoms 14. Phylum Chlorophyta Eg.: *Volvox* 15. Phylum Rhodophyta Eg. : Red Algae 16. Phylum Dinoflagellata Eg. :*Noctiluca* **Fungus -like protists** 17. Phylum Mycetozoa Eg.: Slime moulds 18. Phylum Microsporidia Eg.: *Nosema* (Brief description only)	7	1
	1.3	**Type: - *Paramecium* –** Morphology (Mention - cyclosis, respiration, osmoregulation and excretion), asexual reproduction (Binary fission) and sexual reproduction (Conjugation). **General topics**:	7	1

		1. Parasitic Protists (*Entamoeba* and *Leishmania*) 2. Lifecycle of *Plasmodium*		
2		**Kingdom Animalia** **Classification, Phylum Porifera and Cnidaria**	**15**	
	2.1	**Basis of classification** Germ layers: diploblastic, and triploblastic Symmetry – Asymmetry, Spherical, Radial, Biradial and Bilateral Coelom – Acoelomates, Pseudocoelomates and Eucoelomates -Schizocoelom, Enterocoelom, Protostomia and Deuterostomia Metamerism Outline classification of Kingdom Animalia Three branches – Mesozoa, Parazoa and Eumetazoa **Mesozoa**: **Phylum Orthonectida** - Eg. *Rhopalura* **Parazoa**: **Phylum Placozoa** – Eg. *Trycoplax adherens*	5	1
	2.2	**Phylum Porifera** – Classification up to classes. Salient features of phylum and classes. Class I – Calcarea Eg. *Sycon* Class II – Hexactinellida Eg. *Euplectella* Class III – Demospongia Eg. *Cliona* **General topic:** 1. Canal system in Sponges.	4	1, 2
	2.3	**Eumetazoa** **Phylum Cnidaria** Classification up to classes. Salient features of phylum and classes. Class I- Hydrozoa Eg. *Obelia* (Mention metagenesis) Class II- Scyphozoa Eg. *Rhizostoma* Class III- Anthozoa Eg. *Metridium* **General topics**: 1. Coral and coral reefs and its conservation. 2. Polymorphism in Coelenterates	5	1, 3
	2.4	**Phylum Ctenophora** - Salient features Eg. *Pleurobrachia*	1	1
3		**Phylum Platyhelminthes, Nematoda and Annelida**	**15**	
	3.1	**Phylum Platyhelminthes –** Classification up to classes. Salient features of phylum and classes. Class I- Turbellaria Eg. *Planaria* Class II- Trematoda Eg. *Fasciola hepatica* Class III- Cestoda Eg. *Taenia solium* **General topics**: 1. Life history of *Fasciola hepatica*. 2. Platyhelminth parasites of Man and Dog	5	1, 4

		(*Schistosoma*, *Taenia solium*, *Echinococcus*)		
	3.2	**Phylum Nematoda -** Classification up to classes. Salient features of phylum and classes. Class- Phasmidia Eg. *Enterobius*, *Ascaris* Class -Aphasmidia Eg. *Trichinella* **General topics**: Pathogenic nematodes in man. (*Wuchereria bancrofti*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Ascaris lumbricoides*)	5	1, 5
	3.3	Classification up to classes. Salient features of phylum and classes. Class I- Archiannelida Eg. *Polygordius* Class II -Polychaeta Eg. *Chaetopterus* Class III- Oligochaeta Eg. *Megascolex.* Class IV- Hirudinea Eg. *Hirudinaria* **General topic:** 1. Ecological and parasitic Adaptations with reference to the above examples.	5	1
4		**Practicals**	**30**	
		1. General identification and classification (Phylum, Class, Genus and Species) a) Protista (any 6) b) Porifera- 1 c) Cnidaria - 3 d) Platyhelminthes- 2 e) Nematoda – 1 f) Annelida – 2	10	1
		2. Identification of any four economically important parasitic protists (Slides/ photographs may be used)	2	1
		3. Identification of Protistans from pond water (any 2).	4	2
		4. Mounting of earthworm setae.	2	3
		5. Study of sections (Any Two) a. T.S. of *Hydra* b. T.S. of *Ascaris* c. T.S. of *Fasciola* d. T.S. of Earthworm	4	1
		6. Identification of larval stages. (Any two, Slides or photographs may be used) (miracidium, sporocyst, redia, cercaria, metacercaria)	4	1
		ACTIVITY 1. Poster making as a group project on parasitic protists infesting humans and presentation by a group representative	4	4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT THEORY** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record, other assignments
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays - 5 out of 7 x4 =20 Marks; Short questions - 10 out of 12 x2 = 20 Marks Fill in the blanks -10x1 = 10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Spotter identifications: 1. Identification & classification - 6 Marks 2. Identification of economically important parasitic protist - 4 Marks 3. Identification, sketch and labeling of section (any one) - 6 Marks 4. Identify and write notes on larval stage - 4 Marks **5.** Mounting of setae - 5 Marks

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Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ANIMAL DIVERSITY- NON CHORDATA II**					
Type of Course	**DSE A**					
Course Code	**MG3DSEZIM200**					
Course Level	**200**					
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Phylum Onychophora, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata, Hemichordata, and Minor Phyla.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Differentiate salient features of Phylum Onychophora, Arthropoda, Mollusca, Echinodermata, Hemichordata, and Minor Phyla.	An	1,2
2	Describe different systems of Prawn, pearl culture, edible molluscs, the economic importance of insects, water vascular systems, and larval forms of Echinodermata.	U, S	1,2
3.	Dissect the prawn and cockroach nervous systems and mount the prawn appendages, mouth parts of the cockroach, plant bug, and mosquito.	A, S	1,2
4.	Sketch invertebrates scientifically.	A, S	1,2
5	Classify species belonging to the minor phyla and phylum Arthropoda, Mollusca, and Echinodermata.	An, 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		**Phylum Onychophora and Phylum Arthropoda**	**15**	
	1..1	**Phylum Onychophora** Salient features of the phylum Eg. *Peripatus* (Mention its affinities).	1	1, 5
	1.2	**Phylum Arthropoda** Classification up to classes. Salient features of phylum and classes. (Brief mention only) **1. Sub Phylum - Trilobitomorpha** Class -Trilobita (mention the salient features). Eg. *Triarthrus* **2. Subphylum –Chelicerata** Class 1 Merostomata (Xiphosura) (Eg. *Limulus*- Living fossil) Class 2.Arachnida (Eg., *Palamnaeus*- Scorpion) Class 3 Pycnogonida (Eg. *Pycnogonum* – Sea spider) **3. Subphylum- Crustacea** Class 1 Branchiopoda Eg. *Daphnia* Class 2 Ostracoda Eg. *Cypris* -seed shrimp Class 3 Copepoda Eg. *Cyclops* Class 4 Remipedia Eg. *Speleonectes* (eyeless crustacean seen in caves) Class 5.Branchiura Eg.,*Argulus* (common fish louse) Class 6 Cirripedia Eg. *Sacculina* Class 7 Malacostraca Eg. *Squilla* (spot tail mantis shrimp) **4. Subphylum- Uniramia** Class 1 Chilopoda Eg. *Scolopendra* – (Centipede) Class 2 Symphyla Eg. *Scutigerella* – (garden centipedes or pseudocentipedes) Class 3 Diplopoda Eg. *Spirostreptus*- (Millipede) Class 4 Pauropoda Eg. *Pauropus* Class 5 Hexapoda (Insecta) Eg. *Bombyx mori* – (silk moth)	14	
2		**Type study & General topic**	**15**	
		Type: Prawn – *Fenneropenaeus* sp. **General Topic:** Economic importance of insects		2
3		**Phylum Mollusca and Echinodermata**	**15**	

	3.1	**Phylum Mollusca** Classification up to classes. Salient features of phylum and classes. (Brief mention only) Class I- Aplacophora Eg. *Neomenia* Class II- Monoplacophora Eg. *Neopilina* Class III Amphineura Eg. *Chiton* Class IV Gastropoda Eg. *Aplysia* Class V Scaphopoda Eg. *Dentalium* Class VI Pelecypoda (Bivalvia) Eg. *Pinctada* Class VII Cephalopoda Eg. *Sepia* **General Topics** 1. Pearl culture 2. Edible molluscs	7	1, 2
	3.2	**Phylum Echinodermata** Classification up to classes. Salient features of phylum and classes. Class I- Asteroidea Eg. *Astropecten* Class II- Ophiuroidea Eg. *Ophiothrix* Class III- Echinoidea Eg. *Echinus* Class IV- Holothuroidea Eg. *Holothuria* Class V – Crinoidea Eg.*Antedon* **General Topics** 1. Water vascular system in Echinodermata	6	
	3.3	**Phylum Hemichordata** Salient features and affinities Eg. Balanoglossus	1	1,5
	3.4	**Minor Phyla** Salient features of 1. Phylum Chaetognatha Eg. *Sagitta* 2. Phylum Sipunculida Eg. *Sipunculus*	1	
4		**Practicals**	**30**	
	1	**Scientific Drawing:** Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.	5	4
	2	General identification and classification (Phylum, Class, Genus and Species) a). Arthropoda - 6 b). Mollusca - 4 c). Echinodermata – 3 d) Minor Phyla – 2	2	5
	3	**Dissections** 1. Prawn - Nervous system 2. Cockroach - Nervous system	8	3
	4	**Mounting:-** 1. Prawn appendages. 2. Mouth parts - Cockroach/ Plant bug/ Mosquito. (Any Two)	6	3

	5	**Taxonomic identification with key** Identification of insects up to the level of order (Any Three).	3	5
	6	**Larval identification** (Any Two). (Nauplius, Zoea, metazoea, Mysis)	1	2
	7	**Group activity on identification and classification of any five arthropods from college campus. (Group of 3 to 5)** Geotagged photo submission in the form of print out	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Individual/Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 15 Marks** Lab performance, record, Submission of group activity reports
	B. End Semester Examination **Theory Total = 50 Marks; Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 Marks; Short questions 10 out of 12 x2 = 20 Marks Fill in the blanks - 10 x1 =10 Marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 Marks, Examination - 25 Marks:** Dissection - 15 Marks, Mounting/scientific drawing – 5 Marks Spotter identification/taxonomic identification – 5 Marks

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2. Ekambaranatha Ayyar M., (1990). A Manual of Zoology, Volume I. Invertebrate Part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
3. Ekabaranatha Ayyar M., (2000). A Manual of Zoology. Volume 2. S. Viswanathan Printers & Publishers. Pvt. Ltd.
4. Ghosh, K. C. and Manna, B. (2004). Fundamentals of Zoology. New Central Book Agency. Kolkata.

5. Jordan E. L and Verma P.S (2007). Invertebrate Zoology. S.Chand and Co.New Delhi.
6. Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. R. K. Rastogi Publications.
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SUGGESTED READINGS

1. Barnes, R.D., (1987). Invertebrate Zoology, W.B. Saunders, New York.
2. Barrington, E.J.W., (1967). Invertebrate Structure and function. ELBS and Nelson, London.
3. Hall, B. K., and Hallgrimsson, B. (2008). Strickberger's Evolution, 4th Edition. Jones and Bartlett Publishers.
4. Mayer, E. (1980). Principles of Systematic Zoology. Addison-Wesley Publishing Company, Inc.
5. Mayr, E. and Ashlock (1991). Principles of Systematic Zoology, 2nd Edition. McGraw Hill and Company.
6. Minnelli, A. (1993). Biological Systematics. Chapman & Hall.

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOANALYTICAL TECHNIQUES IN MICROBIOLOGY & IMMUNOLOGY**					
Type of Course	**DSE B**					
Course Code	**MG3DSEZIM201**					
Course Level	**200**					
Course Summary	This course provides an advanced understanding of the core principles ofvarious techniques used in biological experiments					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre- requisites, if Any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	List the bio-analytical techniques used in a microbiology lab	K	1,2,3
2	Describe comprehensive understanding of various staining techniques to identify and evaluate bacteria by microscopic examination.	U	1,2,3
3	Illustrate colorimetric and spectrophotometric techniques for quantitative analysis	A	1,2,3, 4
4	Write principle, types and application of chromatography Blotting & electrophoresis	A	1,2,3, 4
5	Predict the fields to enhance various immunological techniques	An	1,2,3, 4,5
6	Estimate the importance of various molecular biological techniques in the field of life science.	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Basic Laboratory Instruments & Staining Techniques**		
	1.1	Common equipment of Microbiology lab. Principle, Instrumentation and applications- Autoclave, Hot Air Oven,Incubator, Laminar Air Flow. Centrifuge, pH meter	5	1
	1.2	Principle of microscopy, types of microscopes – Brightfield, Dark field, Phase contrast, Fluorescence, SEM and TEM and its applications	5	2
	1.3	Stains – acidic, basic and neutral stains. Staining techniques- Simple staining, differential staining (Gramstain and acid-fast stain), Structural staining (spore, flagella, capsule and granule)	5	2
2		**Separation& Identification Techniques**		
	2..1	Chromatography- Principles, Types and application. Planar Chromatography - Principle, procedure &applications of paperchromatography and TLC.	5	4
	2.2	Column chromatography- Principle, procedure & applications of Affinity Chromatography, Gel Exclusion chromatography	**5**	4
	2.3	Electrophoretic techniques -Introduction, principle, procedure and applications of AGE and PAGE.	**3**	4
	2.4	Instrumentation and applications of colorimeter and UV - Visible Spectrophotometer	2	4
3		**Molecular Biological Techniques**		
	3.1	PCR-Definition, application .DNA Finger Printing, Blotting techniques- Principle & Application - Southern, Northern and Western blotting techniques.	8	3
	3.2	Molecular Markers- Definition, Types RFLP, RAPD,VNTR, Simple sequence Repeats ,AFLP – Steps &Application	7	3
4		**Immunological & Molecular Biological Techniques**		

	4.1	Cells of the Immune system- (B Cells, T cells, Macrophages, Dendritic cells, Natural Killer cells), Organs of Immune system. Mention Toll-like receptors	5	5
	4.2	Types of Immunity (Innate and Acquired, Passive and Active, Humoral and Cell Mediated. Antigens. Factors that influence immunogenicity. Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes), Vaccines, Immunoglobulins- structure (basic only), classes and functions of immunoglobulins. Mention Hypersensitivity	5	6
	4.3	Agglutination: Direct &Indirect Radio Immuno Assay (RIA), ELISA-Principle, types and application. Rocket Immuno Electrophoresis Widal Test, VDRL test	5	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive instruction, Group assignments ,Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -30 Marks -** Quiz/Test Paper/Seminars
	End Semester Examination **Theory Total -70 Marks Duration -1.5 hrs** Short Essay 8 out of 10 x 4 =32 Marks Short Questions 14 out of 16 x 2 =28 Marks Fill in the blanks 10 x1 = 10 Marks

References

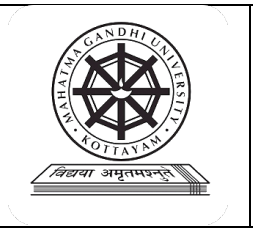
1. Braithwaite, A., & Smith, F. J. (1995). Chromatography: Principles and Instrumentation. Blackie Academic and Professional.
2. Butler, J. M. (2005). Forensic DNA Typing. Academic Press Publishers.
3. Goodwin, W., Linacre, A., &Had, S. (Wiley Publishers, 0470710195).An Introduction to Forensic Genetics.
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 MedicalStudents. 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 (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BACTERIAL PHYSIOLOGY AND METABOLISM**					
Type of Course	**DSC B**					
Course Code	**MG3DSCZIM201**					
Course Level	**200**					
Course Summary	This course emphasis on basic concept of microbial physiology, growth Kinetics and central pathway of metabolism occurs in microbes.					
Semester	III	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline study on fundamentals of microbial nutrition	K	1,2,3,
2	Discuss basic concept of different types of culture media andisolate microorganisms by pure culture techniques	U	1,2,3,
3	Explain growth curve and generation time of bacteria as well as examine the measurement of bacterial growth.	U	1,2,3, 4
4	Illustrate various physical and chemical agents to control microorganisms and discuss about various antimicrobial drugs.	A	1,2,3, 4,
5	Connect comprehensive understanding about various catabolic pathwayoccur in microorganisms	An	1,2,3, 4,5
6	Evaluate factors affecting bacterial growth experiments to develop practical skill on pure culture technique, antibiotics sensitivity test and on biochemical analysis	E	1,2,10 ,12
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		**Microbial Nutrition**		
	1.1	Nutritional requirements - C, N, P, S, and minerals. Nutritional type of microorganisms,Growth factor. Uptake of nutrients - passive diffusion, facilitated diffusion. Active transport,Group Translocation.	6	1
	1.2	Culture media-Definition, Chemical & Physicaltypes of culture media, Media components: Peptone, yeast extract, beef extract,agar,blood/serum. Functional Types of Media: Selectivemedia,Enriched media, Differential media.	5	2
	1.3	Serial Dilution Technique:Isolation of Pure culture (Spread,Pour,Streak plate) Cultural Characteristics, Maintenance and preservation of purecultures	4	2
2		**Bacterial Growthand Control Methods**		
	2..1	Mode of cell division in bacteria. Bacterial growth curveand generation time..Measurement of microbial growth. Continuous culturing of bacteria-Petroff Counting Chamber chemostat,,turbidostat. Effect of Temperature, pH, Oxygen concentration and Radiation on bacterial growth.	5	3
	2.2	Microbial Control methods(Sterilization)-Principles and methods, physical (Heat, Low Temperature, Flteration, Radiation) Chemical methods (Phenolics, Alcohol, Halogens, Heavy Mtetals, Aldehydes,Quaternary ammonium compounds).Chemotherapeutic agents	4	3
	2.3	General characteristics of antimicrobial drugs, Properties of common antibacterial drugs (Pencillin, Cephalosporin,Vancomycin, Tetracyclin, Chloramphinicol) Determine the level of antimicrobial activity (Dilution susceptibility test, Disc Diffussion test)	6	4
3		**Carbohydrate Metabolism**		
	3.1	Central catabolic pathways – glycolysis, hexose monophosphate pathway, Entner Doudoroff Pathway (ED Pathway), tricarboxylic ascid cycle	7	5
	3.2	Electron transport system– components –adenosine tri phosphate structure and theirgeneration types	5	5
	3.3	Fermentations – types – anaerobic Respirations	3	5

4		**Practicals**		
	4.1	Effect of pH on the growth of bacteria on solid media. Effect of salts &temperature on the growth of Microorganisms	5	1,3
	4.2	Determination of growth curve of E.Coli	2	2
	4.2	Isolation pure culture- serial dilution.	6	2
	4.3	Plating methods (Pour, Spread and Streak)	6	2
	4.4	Antibiotic sensitivity test	4	4,6
	4.5	Biochemical test:: IMVIC Test, Triple sugar iron agar test, Urease test. Catalase test	7	4,6
		Teacher Specific Module		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA):** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x 1 = 10 Marks **Practical Total - 35 Marks Duration -2 hrs** Record: 10 Marks Examination :25 Marks, Perform any one of the Plating Method (Spread/Streak/Pour)-8 Marks; Perform antibiotic sensitivity Test/Biochemical Test-8 Marks, Spotters-8 Marks, Viva-1Marks

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1. Doelle, H. W. 1975. Bacterial Metabolism.2nd Edition. Academic Press.
2. Moat, A. G. and Foster, J. W. 1988. Microbial physiology. 2nd Edition. Springer Verlag.
3. White, D. 2000. Physiology and Biochemistry of Prokaryotes. 2nd Edition. Oxford University Press, New York.

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5. Madigan, M. T., Martinko, J . M., Stahl, D. A. and Clark, D. P. 2012 . BrockBiology of Microorganisms, 13 th Edition, Benjamin Cummings, San Francisco.
6. Lim, D. 1998. Microbiology. 2nd Edition; Mc Graw - Hill Publication.
7. Ingraham, J. L. and Ingraham, C. A. 2004. Introduction to Microbiology: Acase history approach. 3rd Edition. Thomson Brooks/ Cole, Pacific Grove, Ca.
8. Madigan, M. T. and Martinko, J. M. 2006. Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
9. Willey, J . M., Sherwood, L. M. and Woolverton, C. J . 2013. Prescott' s Microbiology. 8 th Edition, Mc Graw - Hill Higher Education.

Suggested Readings

1. Prescott, Joanne Willey, Linda Sherwood, & Christopher, J. W., (2017). Microbiology (10 th ed). New York: Mc Graw Hill.
2. Aneja, K. R. (2008). A textbook of basic and applied microbiology.New Age International
3. Pelczar, M. J., Schan, E. C. and Kreig, N. R. (2010) .Microbiology: AnApplication Based Approach .

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**HUMAN DISEASES & THEIR MANAGEMENT**					
Type of Course	**MDC**					
Course Code	**MG3MDCZIM200**					
Course Level	**200**					
Course Summary	Familiarizing various causative organisms and factors for human diseases, how and what preventive and therapeutic measures can be adopted against these diseases, the need to keep away/manage communicable diseases and life style diseases, thereby creating a healthy society, the need for maintaining vectors below damage threshold levels.					
Semester	**III**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	---	---	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the aetiology, symptoms, diagnosis, treatment, and preventive measures of common airborne, waterborne, foodborne, and microbial infectious diseases.	U	1,2, 3
2	Distinguish infectious zoonotic diseases and diseases spread by mosquito vectors.	U	1,2, 3
3	Differentiate the aetiology, symptoms, diagnosis, treatment, and preventive measures of disorders of the central nervous system, immune system, and blood vascular system, as well as genetic, lifestyle, and nutritional deficiency diseases.	An	1,2, 3
4	Explain the causes and types of cancer, the characteristics of cancer cells, and theories of carcinogenesis.	U	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		**Infectious diseases**	**15**	
	1.1	Introduction, health:- Need for being healthy. Classification of diseases:- infectious and non - infectious	5	1, 2
	1.2	Infectious diseases :-Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 disease each from a category. Air borne (Covid 19, measles), water borne (typhoid, hepatitis A), food borne (Botulism, shigellosis), Microbial —bacterial (TB, whooping cough), viral, (Covid 19, chickenpox) fungal (Candidiasis, Aspergillosis), protozoan (Malaria, leishmaniasis), helminthic (Schistosomiasis, ascariasis) Mosquito the terrible vectors – Dengue, Zika, chikun guinea. Bats- Nipah Zoonotic diseases- plague, rabies	10	
2		**Non infectious diseases - 1**	**15**	
	2.1	Non infectious diseases ---Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 diseases each from a category. 1. Genetic disorders (autism, sickle cell anaemia, haemophilia) Life style diseases (Diabetes, obesity). 2. Nutritional Deficiency diseases- Kwashiorkar, Night Blindness, Hypovitaminosis, Pernicious Anaemia.	15	3, 4
3		**Non infectious diseases - 2**	**15**	
	3.1	Non infectious diseases 3. Disorders of blood vascular system (Atherosclerosis, myocardial infarction), disorders of immune system:-Immune deficiency disorders (AIDS, SCID), Autoimmune disorders (Rheumatoid arthritis, SLE), Allergy. Disorders of central nervous system (Parkinson's disease, Alzheimer's disease)	8	3, 4
	3.2	4. Cancer: causes, types, characteristics of cancer cells, theories of carcinogenesis	7	
4		**Teacher Specific module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Presentation of report of the activity.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar
	B. End Semester Examination **Theory Total = 50 Marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 Marks Short questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 =10 Marks

REFERENCES

1. Anil Aggarwal (2001) Modern Diagnostics; National Book Trust
2. Bhattacharya K. & G.K. Chakraborty, (1999) Hand Book of Clinical Pathology. Amer Society of Clinical; 2nd edition
3. Chaterjee K D (2019): Parasitology- Protozoology and Helminthology, Chatterjee Medical Publishers. Kolkatta.
4. Emily Reisner and Howard Reisner (2004) Crowley's An introduction to human diseases: Pathology and Pathophysiology Correlations. 11th edition, Jones and Bartlett Learning
5. Margaret Schell Frazier and Tracie Fuqua (2020) Essentials of human diseases and conditions. 7th edition. Published by Elseivier Health sciences.
6. Marianne Neighbors, Ruth Tannehill Jones (2018) Human diseases 5th Edition, Delmar Cengage Learning.

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BAKERY, CONFECTIONARY AND CONVENIENCE FOOD TECHNOLOGY.**					
Type of Course	**VAC**					
Course Code	**MG3VACZIM200**					
Course Level	**200**					
Course Summary	This course acquaints students with the principles of bakery and confectionery and to familiarize students with processing techniques, quality parameters, andnutritional comparisons of baked products.					
Semester	III	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	State the processes involved in advanced baking technology and explain the role of flour, leavening agent additives, sugar, fats etc. for the production of bakery products.	K	1,2,3,
2	Demonstrate different mixing techniques, baking processes & predict their outcomes with extreme hygiene.	U	1,3,5
3	Define traditional & advanced confectionary products.	K	1,2,3,4
4	Execute more enhanced skills to start career in convenience food technology	A	1.2,3,4
5	Illustrate processing techniques used to make grain-based snack foods.	An	1,3,4,5 10
6	Execute familiarization with chemical agents added to enhance the quality of processed foods and will comprehend the effects of adulterants and toxic products in Foods	A	1,2,12

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		**Bakery Technology**		
	1.1	Principles of Baking, Raw Material and their role-flour, leavening agents, sugars fats, additives, spice.	1	1
	1.2	Types of Bakery Products and Technology for their Manufacture – dough and batters; cakes, pies, pastries, bread, biscuits, icings and fillings.	6	2
	1.3	Sanitation and Hygiene in a Bakery Unit. Equipmentused in the Bakery Industry	5	2
2		**Confectionary Food Technology**		
	2..1	History; Traditional confectionary goods; Types of confectionaries; Classification of confectionery products. Raw Material and their role-interfering agent, inversion of sugars, etc	5	3
	2.2	Types of Confectionery Products and Technology for their Manufacture. Whipping, release agent thickeners, acidulants, milk and milk products flavours, for confectionery, emulsifiers and other additives,	5	3
	2.3	**Activity.** Preparation of Advanced Bakery Products – sourdoughs, pastries, croissants, doughnuts. Preparation of Filled and Iced Cakes, chocolates, coated confectionaries	5	3
3		**Convenience Food& Grain based snacks**		
	3.1	Chocolate – raw material, types, and manufacture, Chewing Gum - raw material, types, and manufacture, Pan Coating – hard and soft panning. Problems in coating; glazing, polishing, and tableting	5	4
	3.2	Technology for Whole Grains Snacks – roasted, toasted, puffed, popped, flaked, Technology for Coated Grain Snacks – salted, spiced, sweetened. Technology for Batter-Based and Dough-Based Products	5	5
	3.3	Technology for Formulated Products – chips, wafers, papads, instant pre-mixes. **Activity** Preparation of Snack Foods based on Cereals	5	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **TheoryTotal -25 Marks -** Quiz/Test Paper/Seminar
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks

References

1. Dubey S.C. 2002. Basic Baking. The Society of Indian Bakers, New Delhi.
2. Francis F.J. 2000. Wiley Encyclopedia of Food Science & Technology. JohnWiley & Sons.
3. Manley D. 2000. Technology of Biscuits, Crackers & Cookies. Second Edition. CRC Press.
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6. Madhavi D.L, Deshpande S.S and Salunkhe D. K. 1996. Food Antioxidants: Technological, Toxicological and Health Perspective. Marcel Dekker.
7. Hathcock J.N. (Ed.). 1982. Nutritional Toxicology. Vol. I. Academic Press.

Suggested Readings

1. Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age InternationalPublishers, New Delhi, 2004.
2. Srilakshmi, B. 2003 Food Science (3rd edition), New Age International (P) LimitedPublishers,NewDelhi
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Semester-IV

MGU-UGP (HONOURS)

Syllabus

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ANIMAL DIVERSITY - CHORDATA I**					
Type of Course	**DSC A**					
Course Code	**MG4DSCZIM200**					
Course Level	**200**					
Course Summary	The course gives an overall idea of the classification of chordates and highlights the differences between different classes of chordates up to Class Reptilia. It also sheds light on the evolutionary significance of certain animals, which form the connecting links between two groups. It also helps in the identification of poisonous and non-poisonous snakes. The course enables skill development in understanding the diversity, systematic position, and economic importance of chordates.					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	----	1	---	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Classify Chordata up to class and Class amphibia and Reptilia up to order.	An	2
2	Examine the general characters of protochordates, agnatha, pisces, amphibia, and reptilia.	A	2
3	Describe fish migration, scales, parental care, and accessory respiratory organs.	U	2
4	Describe the different organ systems of frogs and the key characteristics of both poisonous and non-poisonous snakes.	U	2
5	Demonstrate expertise in the laboratory in mounting scales and identifying specimens.	A, S	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		**Classification of Chordata**	**13**	
	1.1	**Introduction** General Characters and outline **classification** of Chordata up to class	2	1,2
	1.2	**Protochordates**: General characters and Classification	1	1,2
	1.3	**Sub phylum: Urochordata** Class I Larvacea Eg. *Oikopleura* (mention paedogenesis and Oikopleuran house) Class II Ascidiacea Eg: *Ascidia* (Mention Retrogressive Metamorphosis) Class III Thaliacea Eg: *Doliolum*	4	1,2
	1.4	**Sub phylum: Cephalochordata** Example - *Amphioxus* (Structure and affinities)	3	1,2
	1.5	**Sub phylum: Vertebrata** General characters and Classification **Division 1– Agnatha** Class I Ostracodermi Eg: *Cephalaspis* Class II Cyclostomata Eg: *Petromyzon* **Division 2 – Gnathostomata**	3	1,2
2		**Superclass Pisces**	**13**	
	2.1	Super class Pisces General Characters and Classification	1	1,2
	2.2	**Class: Chondrichthyes** - General Characters Sub class – Elasmobranchii Eg: Shark Sub class - Holocephali Eg: *Chimaera*	2	1,2
	2.3	**Class: Osteichthyes** - General Characters Sub class – Choanichthyes Order 1 Crossopterigii (Coelocanths) Eg: *Latimeria* (Evolutionary Significance) Order 2 Dipnoi Eg: *Lepidosiren* Sub class: - Actinopterygii Super order 1. Chondrostei Eg: *Acipencer* Super order 2. Holostei Eg: *Amia* Super order 3. Teleostei Eg: Sardine	4	1,2
	2.4	**General topics** 1. Accessory respiratory organs in fishes. 2. Parental care in fishes. 3. Scales in fishes. 4. Migration in fishes	6	3

3		**Super class: Tetrapoda**	19	
	3.1	General characters	1	2
	3.2	**Class Amphibia** – General characters, Classification up to Orders. Mention the extinct orders. Order I Anura Eg: *Hyla* Order II Urodela Eg: *Ambystoma* (mention axolotl larva and Paedomorphosis /neoteny) Order III Apoda Eg: *Ichthyophis.* Mention Nasikabatrachus sahyadransis	3	1,2
	3.3	Class Amphibia - **Type Frog** (*Euphlyctis hexadactylus)*	10	4
	3.4	**Class Reptilia** - General characters, Classification up to Orders Sub class I: Anapsida Order Chelonia Eg: *Chelone* Sub class II: Parapsida Eg: *Ichthyosaurus* Sub class III: Diapsida Order I Rhynchocephalia Eg: *Sphenodon* Order II Squamata Eg: *Chamaeleon* Order III. Crocodilia Eg:*Crocodylus* Sub class IV: Synapsida Eg: *Cynognathus*	2	1,2
	3.5	General topics 1. Identification of venomous and non- venomous snakes 2. Common venomous and non- venomous snakes of Kerala 3. Biting mechanism of snakes	3	4
4		**Practicals**	**30**	
	1	**Scientific Drawing** Make scientific drawing of 3 locally available vertebrate specimens belonging to different Classes	3	5
	2	**Dissections** Frog: Photographs/diagrams/one dissected & preserved specimen each/models /virtual Dissections may be used for study 1. Frog Viscera 2. Frog Digestive System 3. Frog Arterial System 4. Frog 9th & 1st Spinal nerve 5. Frog Sciatic Plexus 6. Frog Brain	6	
	3	Mounting of placoid scales; study of cycloid and ctenoid scales	4	
	4	**Osteology** Frog vertebrae - typical, atlas, 8th and 9th Pectoral and pelvic girdles of Frog Turtle/Tortoise - plastron and carapace	4	

	5	**Study of sections.** *Amphioxus* T. S. through pharynx/T.S. through intestine	1	
	6	**Identification:** **A,General identification;** Identify, classify and describe the following animals by their scientific names. Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5 **B. Taxonomic identification with key:** i) Identification of fishes up to the level of order (any 4 different orders). ii) Identification of snakes up to family (any 2 venomous and 2 nonvenomous snakes). **C.** Identification of different types of caudal fins	4 4 1	
	7	**Group activity**- Report presentation of homestead /campus biodiversity of Amphibia and Reptilia/ fish diversity of the locality	3	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos, PPT, Field trips, Zoo Visit, Fish landing center visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total=25 marks** Quiz, Test Papers, seminar **Practical Total =15 marks** Lab performance, record, submission of group activity
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10 x 1=10 marks **Practical Total = 35 marks, Duration - 2 hrs** **Record 10 marks, Examination 25 marks:** Dissection – 15 marks Mounting/ scientific drawing/section – 5 marks Spotter identification/ osteology/taxonomic identification – 5 marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**GENERAL TOXICOLOGY**					
Type of Course	**DSE A**					
Course Code	**MG4DSEZIM200**					
Course Level	**200**					
Course Summary	Provides an overview of the principles and practices of toxicology, focusing on the adverse effects of chemicals on living organisms. Students will explore the fundamental concepts of toxicology, including the mechanisms of toxicity, routes of exposure, dose-response relationships, risk assessment, and regulatory aspects.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Distinguish different toxicants, their impacts on human health and environment and the principles of toxicity evaluation	E	1,2,6, 8, 10
2	Describe the toxicants of biological origin and various food additives & their impacts.	U	1,2,10
3	Analyze the toxicity of various products used in day today life.	A	1,2, 6
4	Identify the branches of Applied Toxicology	U	1,2,10
5	Identify the occupational hazards, occupational diseases and their control measures	U	1,2,6, 10

Remember (K), Understand (U), Apply (A), Analyze (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		**Basic Concept of Toxicology**	**18**	
	1.1	Introduction of toxicology, history of toxicology, definition of toxicology, definition of poison, definition of toxicity and classification of toxicants-occurrence/source. Mode of action of toxic agents.	9	1
	1.2	**Evaluation of toxicity** Principles, Acute, sub-acute and chronic assays LD50, LC50, NOEL. Maintenance and general handling of animals for toxicological laboratory.	3	1
	1.3	Toxicants of biological origin:- aflatoxin, botulinum toxin	3	2
	1.4	Food additives	3	2
2		**Xenobiotics**	**17**	
	2.1	Introduction, Important of xenobiotics concerned to Human health, absorption of xenobiotics, distribution of xenobiotics, accumulation of xenobiotics, elimination, biotransformation and excretion.	3	3
	2.2	Adverse effects of xenobiotics through Biological Magnification and Biotransformation, mechanism of Xenobiotic Translocation, Membrane permeability and mechanism of chemical transfer	8	3
	2.3	**Pesticides and Heavy Metal Toxicity** Pesticides and their toxicological effects. Classification of Pesticides, Insecticides, Mode of action of Insecticide. Heavy Metal Toxicity: Introduction, dispersion, general principal of metal toxicity, sources, toxic metals and their toxicity. Arsenic, Aluminium, Cadmium (Itai Itai disaster), Chromium Lead, Mercury, Manganese, Zinc and Nickel	6	2,3
3		**Applied Toxicology**	**13**	
	3.1	**Cosmetic toxicology**- Toxicity of shampoos, conditioners, bleachers, dyes, allergic and respiratory disorders.	2	4
	3.2	**Wildlife toxicology**- Susceptibility of wildlife to chemicals, Acute ecological hazards, Toxicology of chemicals in birds and mammals, Integrated approach to wildlife toxicology	3	4
	3.3	**Medical toxicology**- acute drug poisoning, adverse drug effects, drug abuse, chemicals and hazardous materials	2	4

	3.4	**Toxicology of chemical warfare agents**- Chemical weapons, classification of chemical warfare agents, mustard gas, lewisite, nerve agents, hydrogen cyanide, management of chemical warfare agents	4	1,4
	3.5	**Veterinary toxicology**- Common toxicity in dogs, cats, horses and poultry, by herbicides, house hold chemicals, heavy metals, mycotoxins, blue green algae and toxic plants .	2	1
4		**Occupational toxicology**	**12**	
	4.1	Occupational hazards- Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, Psychosocial hazards	4	5
	4.2	Occupational diseases- Pneumoconiosis, silicosis, asbestosis, anthracosis, byssinosis, bagassosis, Farmers' lung Occupational Cancer- Skin cancer, Lung cancer, Bladder cancer, Leukaemia	4	
	4.3	Prevention of occupational diseases- Medical measures, Engineering measures, Legislative measures, Occupational health in India	4	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Report on activities, Videos, Group discussions and presentation
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks:** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks, Short questions 14 out of 16 x2 =28 marks, Fill in the blanks 10 x1 =10 marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**INDUSTRIAL MICROBIOLOGY AND FERMENTATIONTECHNOLOGY**					
Type of Course	**DSC B**					
Course Code	**MG4DSCZIM201**					
Course Level	**200**					
Course Summary	To study the sources of microorganisms for use in industrial microorganisms. Appreciate how microbiology is applied in manufactureof industrial products, learn methods in discovery of new useful microorganisms and acquire knowledge of the design of Fermenters and process controls					
Semester	IV	Credit			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	State general concepts of industrial microbiology, screening,strain improvement & selection.	K	1,2,3
2	Outline design of fermenters, types of fermenters, sterilizationprocessers, & downstream processing.	K	1,2,3
3	Explain production of fermented food products.	U	1,2,4, 5
4	Illustrate production of various types of enzymes, amino acids,and antibiotics to the students.	A	1,3,4, 5
5	Evaluate the concept of MEOR	E	1,2,3, 5,10
6	Explain how to develop practical skill particularly in production units, micro-labs and Quality Control departmentsof Industrial fermentation Technology	S	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		**General concepts of Industrial Microbiology**		
	1.1	History, development and scope of industrial microbiology. Industrially important microbes, Strain improvement and selection	5	1
	1.2	Screening of industrially important microorganisms- Primary and Secondary Screening, antifoaming agents, Enzyme immobilization	5	1
	1.3	Development of inoculum for industrial fermentation. Industrial sterilization- batch and Continuous sterilization, Types of fermentation- Surface, Submerged and Continuous fermentation, Downstream Processing.	5	1
2		**Types of fermenter & food produced by microbes**		
	2..1	Fermenter, Structure of a typical fermenter, Types of fermenters: Batch Fermenter, Continuous, Stirred Tank Fermenter, Fluidized Bed Fermenter, Solid State Fermenter, Air Lift Fermenter, Tubular Fermenter.	5	2
	2.2	Bread, cheese, malt beverages-wine & beer, vinegar.	5	2
		Fermented dairy products and oriental fermented foods **Activity** A visit to any educational institute/industry to see an Industrial fermenter, and other down- stream processing operations	5	3
3		**Industrial production of enzymes amino acids & antibiotics and MEOR**		
	3.1	Industrial enzymes – amylase, protease, cellulase. Amino acids production: glutamic acid and lysine	5	4
	3.2	Production of antibiotics: penicillin, streptomycin	5	4
	3.3	Microbially enhanced oil recovery MEOR, Microbial recovery of metals- bioleaching of copper, gold and uranium	5	5
4		**Practicals**		
	4.1	Isolation of lactic acid bacteria from curd.	4	3
	4.2	Isolation of lipolytic organisms from butter or cheese	4	3
	4.3	Immobilization of Yeast cell	4	4
	4.4	Study of alcoholic fermentation of fruit juice by yeast	4	4

	4.5	Production & Estimation of citric acid by *Aspergillus niger* - Estimation of Citric acid	6	6
	4.6	Demonstration of Crowded plate technique for screening microbial production of enzymes and antibiotics Preservation techniques: a. Serial sub culturing b. Overlayig with mineral oil c. liquid nitrogen storage	4	6
	4.7	Visit to fermentation industry to study about differenttypes of fermenter used, types of fermentation (Solid state fermentation, Submerged fermentation)technical problems faced by the industry in production, quality control, packaging andwaste management and suggestions for improvement	4	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment(CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practicals Total -35 Marks** Record - 10Marks Examination-25 Marks, Citric acid estimation -8Marks, Perform Immobilization of yeast cell-8 Mark, Perform gram staining (lactic acidbacteria from curd)- 4Marks, Spotters- 4 Marks,Viva-1Marks

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3. Linda Sherwood, & Christopher, J. W.,(2017). Microbiology (10th ed). New York: Mc Graw Hill.
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Programme	**BSc (Honours) Zoology and Industrial Microbiology (DoubleMajor)**					
Course Name	**MEDICAL MICROBIOLOGY**					
Type of Course	**DSE B**					
Course Code	**MG4DSEZIM201**					
Course Level	**200**					
Course Summary	This course helps to develop the knowledge, specialist practical skills and critical awareness needed to pursue a career in medical microbiology, learning opportunities in the basic principles of medical microbiology and infectious disease					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites,if Any						

COURSE OUTCOMES (CO)

CO No.	Expected CourseOutcome	Learning Domains*	PO No
1	Define conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body	K	1,2,3
2	State host pathogen interactions	K	1,2,3
3	Explain opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious Diseases	U	1,2,3,4
4	Execute importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract & urinary tract.	A	1,3.4,5
5	Illustrate the relationship of viral infection to symptoms, relapseand the accompanying pathology	An	1,3,4,5
6	Justify mode of transmission & prophylaxis of protozoan And algal diseases	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Normal microflora of human body and host pathogen interaction**		
	1.1	Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.	5	1
	1.2	Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, pathogenicity, Virulence, Toxigenicity. Carriers andtheir types, Opportunistic infections, Nosocomial infections. Transmission of infection	5	2
	1.3	Respiratory tract infections-infections of the upper and lower respiratory tract. Urinary tract and genital tract infections.	5	3
2		**Bacterial infections**		
	2.1	The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. Respiratory tract infectious agent: *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium Tuberculosis*	7	4
	2.2	Other bacterial diseases -Typhoid, Diphtheria, Pertussis, Tetanus, leprosy, Pneumonia. Syphilis, Leptospirosis, Actinomycosis, Brucellosis, Chlamydial diseases	8	4
3		**Viral, Parasitic and Mycotic infections**		
	3.1	The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control: Viral diseases: AIDS, hepatitis, Syphilis, Gonorrhea and polio, Rabies, Dengue, Influenza with brief description of Swine flu, Ebola, Chikun gunya, Nipha.	5	5
	3.2	Parasitic: Detailed study of malaria - history, causative agents, vectors, life cycle, host parasite interactions, diagnostics, drugs and inhibitors.	5	5
	3.3	Mycoses: cutaneous mycoses- Tinea pedis (Athlete's foot), Systematic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis, Fungal: Aspergillosis, Amoebiasis	5	5
4		**Practicals**		
	4.1	Isolation of microbial flora from human skin. Study of the morphology, staining characters, cultural characters and identification of staphylococci, E.coli, Klebsiella, Pseudomonas and Streptococci.	2	6

	4.2	Determination of susceptibility of dental caries by Synder Test	3	6
	4.3	Urine culture and its microbiological analysis.	5	6
	4.4	Determination of antibiotic sensitivity of the UTI causing organisms.	2	6
	4.5	Culture methods for isolation and Identification of fungi-KOH mount preparation, Lactophenol cotton blue staining, Slide culture technique etc	3	6
	4.6	On the Job Training programme-in Hospitals/Medical Laboratories	5	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -**Lab performance/ Record/Field report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 = 10 Marks **Practicals Total -35 Marks** Record - 10Marks Examination-25 Marks, Isolation of Microbial flora from human skin-6 Marks, Antibiotic sensitivity test of UTI causing organisms-6 Marks, Spotter Identification-8 Marks, Viva based on industrial visit- 2 Marks and submit the report-3 Marks,

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MICROBIAL QUALITY CONTROL IN FOOD & PHARMACEUTICAL INDUSTRY**					
Type of Course	**DSE B**					
Course Code	**MG4DSEZIM202**					
Course Level	**200**					
Course Summary	Offers a comprehensive understanding of quality control, principles and procedures within the food and pharmaceutical sector. It covers various aspects, such as quality assurance, compliance with regulatory standards, analytical methodologies, and the implementation of measures to uphold the safety and effectiveness of products.					
Semester	IV	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if Any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Demonstrate the fundamental principles of quality control within the food and pharmaceutical industry.	K, U	1,2,3
2	Examine and apply regulatory frameworks that oversee qualityassurance in both the food and pharmaceutical sectors.	U, E,	1,2,3, 4
3	Describe the various analytical techniques employed in quality control practices.	U, A,	1,2,3, 5
4	Develop insights into contemporary issues and emerging trendsin the field of quality control	U, E	1,2,3, 4
5	Acquire the skills to implement and effectively manage quality control processes in relevant industries.	An, E	3,4,5, 10
6	Ascertaining microbial quality of milk by MBRT and rapid detection methods of microbiological quality of milk at milk collection centers	A, An	1,2,3, 4, 5

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Basic concept of Quality control and Quality Assurance**		
	1.1	Definition and distinction between quality control and quality assurance. HACCP concept, principle and application in food industry. General principles, fundamentals and standard requirement of QMS (ISO 9000:2000)	5	1
	1.2	TQM tools and techniques. Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3 EMS/Laboratory Management system ISO 17025.NABL accreditation of food Laboratory.	5	1
	1.3	Food & drug administration (FDA) US department of Agriculture (USDA) and other regulatory bodies. Statistical methods in quality control, Testing procedures and protocols	5	2
2		**Quality Assurance in Food and Pharmaceuticals**		
	2.1	Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP), International standards (ISO, ICH) in the food and pharmaceutical industry	5	2
	2.2	Principles of quality assurance, Quality policy, quality objectivesand quality manual. Sampling techniques in food and pharmaceutical industries Microbiological risk profile of toxins/pathogens. Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion sterility testing for pharmaceutical products	5	2
	2.3	Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Detection of specific microorganisms - in XLD agar, mannitol agar, EMB agar, McConkey Agar, Saboraud Agar, Rapid detection methods of microbiological quality of milk at milk collection centres (10 min Resazurin assay)	5	2

3		**General Principles of food laws**		
	3.1	Integrated Food Laws and its harmonization: standard,specifications, and guidelines, 2&3 class sampling plan	7	3
	3.2	FSSAI microbiological criteria for dairy products. Rapid detection method/commercial kits for hygiene and safety indicators.	5	3
	3.3	Biosensors and current application in food safety evaluation	3	4
4		**Practicals**		
	4.1	Instrumental technique for food quality - Gas chromatography, olfactometry, spectrophotometer.	3	5
	4.2	Detection of bacteria in spoiled tinned food/ Presumptive test for coliforms in butter.	5	5
	4.3	Detection of adulterant from: • Milk • Honey • Squash	2	5
	4.4	Detection of specific microorganisms in food/ water/ pharmaceutical samples by using EMB agar, McConkey Agar, Saboraud Agar.	5	5
	4.5	Rapid detection methods of microbiological quality of Milk by resazurin test.	3	6
	4.6	Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts	5	6
	4.7	ISI (Indian standard institute) specification for drinking water.	2	6
	4.8	Demonstration of related and foreign substance in drug and raw materials (synthetic/herbal)	5	6
		Teacher Specific Module		

EVALUATION AND ASSESSMENT

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, laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report

	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record - 10 Marks; Examination-25 Marks: Quality testing of milk by resazurin test-6 Marks, Detection of specific microorganisms in food/ water/ pharmaceutical -6 Marks, Spotter Identification-8 Marks, Viva -5 Marks

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2. Miller, D. D. (2013). Food Chemistry: A Laboratory Manual (2nd ed.). Wiley

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**EMERGENCY LIFE SUPPORT AND FIRST AID**					
Type of course	**SEC**					
Course Code	**MG4SECZIM200**					
Course Level	**200**					
Course Summary	Equips the learner with life-saving techniques and knowledge about the fundamentals of first aid and safety protocols to respond confidently to emergencies					
Semester	**IV**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Apply the basics of first aid and crisis management.	A,S	1,2, 3
2	Demonstrate CPR	A,S	1,2, 5, 6
3	Apply first aid for fractures, sprains, wounds, and drowning.	A,S	1,2, 3, 6
4	Employ tailored treatments for various types of burns, bites, and stings.	A,S	1,2, 3, 6
5	Demonstrate basic life support care and safety measures.	A,S	1,2, 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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**First Aid Essentials**	**8**	
	1.1	**First aid -** Definition, Importance of first aid, Rules of first aid, contents of an ideal first aid kit.	4	1
	1.2	**Crisis management** Dealing with an emergency- crisis management and emotional support including effective communication with casualities and bystanders, responses in casualities- AVPU (Alert, Voice, Pain, Unresponsive). Stroke symptom management-FAST(Face, Arms, Speech, Time)	4	1
2		**First aids for frequently encountered emergency situations**	**20**	
	2.1	Initial care for falls, fractures, dislocations, sprains, and strains, including immobilization techniques.	5	3
	2.2	**Different Types of wounds** Small cuts and abrasions, Head injury, nosebleed, bleeding gums, bleeding from varicose veins.	4	3
	2.3	**Burns** Types, danger of burns, first aid in dry burns and scalds, electrical burns, chemical burns, sunburn, heatstroke.	4	4
	2.4	**Bites, Stings and Poisoning** Snake bite, bed bug/ spider/ animal bite, wasp/ bee/ fire-ant/scorpion sting and poisoning- poisoning by swallowing, gases, injections, skin absorption.	5	4
	2.5	**Drowning –** Rescue from water, First aid measures- Position(supine) Observe, alert medical service	2	3
3		**Basic Life Support care & Safety Education**	**17**	
	3.1	**Cardiopulmonary Resuscitation** Airway, Breathing and Circulation (ABC), Cardiopulmonary Resuscitation (CPR) in adults, children and infants, automated external defibrillators (AED).	4	2, 5
	3.2	**Choking Relief Techniques** Techniques in adults and children, recovery position.	5	5

	3.3	**Safety education: Fundamental principles** Accident prevention, hazard identification, risk assessment, and mitigation strategies, Safety at home and different workplaces like laboratories, construction sites, healthcare facilities, schools. Safety in sports.	4	5
	3.4	**Safety management** An overview on safety technologies, including sensors, alarms, personal protective equipment (PPE), and software tools for risk assessment and management.	4	5
		ACTIVITY: (Anyone) **1.** Preparation of First aid kit 2. Role play (group) on given hypothetical situations/ Pamphlet preparation on emergency care & distribution in community. 3. Survey on safety management, its assessment and evaluation, if required conduct of awareness sessions in the area of concern in the survey (group) **4.** Demonstration class on CPR/ recovery position & reporting **(Anyone)**		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Participatory learning, Experiential learning, ICT enabled discussion. Tutorial, Focus group discussions,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 Marks** Quiz, Test Papers, activity
	B. End Semester Examination **Theory Total = 50 marks, Duration - 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

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3. First Aid –medical First Responder, Published by: District Disaster Management Authority, East Khasi hill District , Shillong Meghalaya
4. First Responder Manual , GVK Emergency Management and Research Institute , Secunderabad –500014,AP,India (https://www.redcross.org/take-a-class/cpr.)
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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**NUTRITION AND LIFESTYLE DISEASES**					
Type of Course	**VAC**					
Course Code	**MG4VACZIM200**					
Course Level	**200**					
Course Summary	This course provides insights into lifestyle diseases, the associated risk factors, and strategies for their prevention. Additionally, this course provides acomprehensive understanding of the biochemical aspects of nutrition and their practical implications in promoting health and addressing nutritional challenges across diverse populations					
Semester	IV	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre-requisites, ifany						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Define nutrition and draw its basic concepts	K	1,2
2	State fundamentals of vitamins andminerals	K	1,2,3
3	Describe fundamental concepts of enzymes,coenzymes Specificity	U	1,2,3
4	Write the principles of enzyme kinetics- Michaelis-Menten and Line weaver-Burk plots.	A	2,3,4,5
5	Illustrate the impact of life style on health	K	2,3,5,10
6	Describe the characteristics, causes, diagnosis and treatment of various life style diseases.	E	1,2,10 12

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		**Basic concept of Nutrition, Vitamins &Minerals**		
	1.1	Basic Concept of Nutrition. Principle foods - Cereals, Pulses,Vegetables, Fruits, Egg, Fish, Meat, Milk and Milk Products. Calorific Value of food Essential & Non -essential amino acid, Essential & Non- essentialfatty acids, BMR, Calorific Value, RQ Value, Body Mass Index, BV of Proteins, Protein Energy Malnutrition	**5**	**1**
	1.2	Vitamins- General introduction Classification. Fat soluble vitamins. Water soluble vitamins B1, B2, pyridoxine, Nicotinic acid, B12 and Folic acids (sources, functions, deficiency diseases)	**5**	**2**
	1.3	Biological Nutritional importance of macro and micro minerals, Calcium, Magnesium, sodium Potassium, iron and copper.	**5**	**2**
2		**Enzymes**		
	2.1	Classification of enzymes- six major classes of enzymes with one example each. Cofactors and coenzymes	**5**	**3**
	2.2	Elementary study of the factors affecting velocity of enzyme catalyzed reactions- effect of substrate concentration, enzyme concentration, temperature and pH	**5**	**3**
	2.3	Michaelis-Menten equation (without derivation). Km and its significance, Line weaver Burk plot. Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes	**5**	**4**
3		**Life Style Diseases**		
	3.1	Lifestyle diseases- definition, Importance of life style factors in preventing disease development-Diet, exercise, smoking, alcohol.	**5**	**5**
	3.2	Diabetes-Type1, Type2, Cancer (characteristics, causes, diagnosis, Prevention.)	**4**	**6**
	3.3	Obesity, Atherosclerosis- Myocardial infarction, congestive heart failure –causes, diagnosis Prevention and management ofischemic diseases and hyper tension	**5**	**6**
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **TheoryTotal -25 Marks -** Quiz/Test Paper/Seminar
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 5= 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks

References

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4. Satyanarayana, U., & Chakrapani, U. (2021). Essentials of Biochemistry (3rd ed.).
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Suggested Readings

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2. Das D. (2015) Biochemistry (14th ed.) Academic publishers

Semester-V

	Mahatma Gandhi University Kottayam

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course	**ANIMAL DIVERSITY CHORDATA – II**					
Type of Course	**DSC A**					
Course Code	**MG5DSCZIM300**					
Course Level	**300**					
Course Summary	The course is designed to understand the characteristics and basic classification of Aves and Mammals along with an attempt to provide an insight on the concepts of comparative anatomy					
Semester	**V**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Describe the classification and general characters of Aves and mammals.	U	1,2
2	Compare different systems of Euphlyctis, Pigeon, and Rabbit.	A	1,2
3	Identify the avian and mammalian fauna and their peculiarities.	U, I	1,2,3
4	Explain flight adaptations in birds, endemic birds of the Western Ghats, and aquatic mammals.	U	2
5	Dissect the pecten and hyoid of a bird.	A, I	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 Theory (45 Hrs)	Hrs	CO. No.
1		**Class Aves**	**16**	
	1.1	General characters - Aves **Subclass Archaeornithes** Eg.: *Archaeopteryx* **Subclass Neornithes.** Super order Paleognathae: eg: *Struthio* Super order Neognathae: Brahminy Kite	3	1,3
	1.2	**Type: Pigeon** (*Columba livia*) External characters, Skeletal System (Skull may be excluded), Respiratory System, Digestive system, Circulatory system, Excretory system, Reproductive system, Nervous system and sense organs	10	2
	1.3	**General Topics**. Flight adaptations in Birds. Endemic birds of Western Ghats with special reference to Kerala (Nilgiri - Wood Pigeon, Malabar Grey Hornbill, Malabar Barbet, Malabar Parakeet, Malabar Wood shrike, White-bellied Tree pie, Nilgiri Flower pecker, Crimson-backed Sunbird, Broad-tailed Grass bird, Flame-throated Bulbul, Grey-headed Bulbul, Rufous Babbler, Wynand Laughing thrush, White-bellied Blue Flycatcher, Nilgiri Flycatcher, Malabar Starling , Black-and-orange Flycatcher, Palani Laughing thrush White-bellied Blue Robin) (brief mention only)	3	4
2		**Class Mammalia**	**15**	
	2.1	General characters and Classification of Mammals. (Modified version of McKenna and Bells Classification - Updated in 2005 with contributions from Don E. Wilson and DeeAnn M Reeder) **Subclass Prototheria** - Order Tachyglossa. Eg: Echidna Order Platypoda. Eg: Platypus **Subclass Theria.** Infra class- Metatheria Eg: *Macropus* Infra class - Eutheria Order Rodentia. Eg :*Funambulus* Order Chiroptera. Eg : *Pteropus* Order Soricomorpha Eg : Mole Order Afrosoricida. Eg : Tenrec	5	1,3

		Order Erinaceomorpha. Eg : Hedgehog Order Primates Eg : Lion tailed Macaque Order Artiodactyla. Eg . Camel Order Perissodactyla Eg. Rhinoceros Order Cetacea. Eg. *Delphinus* Order Hyracoidea. Eg. Procavia Order Sirenia. Eg .Dugong Order Proboscidea. Eg : Elephas Order Tubulidentata. Eg : Aardvark Order Carnivora. Eg: *Panthera tigris* Order Lagomorpha. Eg : Rabbit Order Xenarthra. Eg: Armadillo Order Scandentia. Eg: Tree shrews Order Macroscelidea. Eg : Elephant Shrews Order Pholidota. Eg: Pangolin		
	2.2	**Type: Rabbit** External Characters, Integumentary system and Glands, Axial and Appendicular Skeleton (Skull bones may be avoided), Digestive System (Mention Dentition and Secondary digestion), Respiratory System, Circulatory system, Urinogenital system, Nervous system and sense organs	8	2
	2.3	**General Topic** Adaptations of aquatic mammals with representative examples from Sirenia and Cetacea	2	4
3		**Comparative Anatomy of Selected Vertebrates**	**14**	
	3.1	**Type Specimens (***Euphlyctis*, Pigeon and Rabbit - Brief study only) Integumentary System, Locomotor organs, Skeletal System: Axial Skeleton (skull excluded), Appendicular skeleton, Digestive System, Circulatory System, Respiratory system, Sense organs, Urinogenital system	14	2
4		**Practical**	**30**	
	1	Dissection of pecten and hyoid of a bird	6	5
	2	Study of specimens (5 Birds and 5 Mammals)	3	3
	3	Prepare and write in the record, the list of the common names and scientific names of smallest/ biggest/tallest/ heaviest/ other peculiarities/ animals of different states /national animal etc. from all classes of animals.	1	3
	4	Study of Skeletal Structures: Bird- Heterocoelous vertebra, Synsacrum, pygostyle, keel and sternum Mammals: Skull with special reference to dentition (Diastema/Carnassial teeth), vertebrae, pectoral	8	2

		girdle, pelvic girdle		
	5	Study of arterial system of bird and mammal using pictures	6	2
	6	Study of different parts of Heart and Kidney of rabbit from photograph/picture	4	2
		ACTIVITY 1. Digital photo book / Printed Album of local Avian and Mammalian Fauna 2. Prepare a list of common names, Malayalam names and scientific names of mammals of Kerala. 3. Field visit to Zoo/Protected Area (2 fields) and report submission	2	3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Verbal Teaching, Video Classes, Documentaries, Seminars, Album making,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Paper, seminar **Practical Total = 15 marks** Lab performance, record, submission of activity report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks** **Record - 10 marks, Examination - 25 marks:** Minor Dissection – 8 Marks, osteology – 4 marks; Spotter identification - 4 marks, Taxonomic identification – 6 marks Identify the labelled parts and write notes on -3 marks

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Kingdom: Prentice-Hall.

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SUGGESTED READINGS

1. Bentley, P.J. (1998): Comparative Vertebrate Endocrinology (3rd edition) Cambridge University
2. Physiology. Italy: Wiley Press.
3. Prosser C.L. (1991) Comparative Animal Physiology, Environmental and Metabolic Animal Animal Physiology, 4th Edition
4. The Book of Indian Animals by S H Prater BNHS Oxford University Press.
5. William S. Hoar, General and Comparative Physiology

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FUNDAMENTALS OF GENETICS**					
Type of Course	**DSC A**					
Course Code	**MG5DSCZIM301**					
Course Level	**300**					
Course Summary	This course covers the foundational aspects of genetics, offering a comprehensive understanding of inheritance, molecular mechanisms, genetic variation, and their practical applications.					
Semester	**V**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	---	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Discuss Mendelian principles of inheritance and gene interactions; apply these to predict the outcome of genetic crosses	U, A, An	1,2
2.	Understand and analyze genetic recombination, linkage and sex determination, and solve problems related to these phenomena.	U, An	1, 2
3.	Evaluate the mechanism of mutation and generate awareness about the impact of various chemicals and drugs used in day-to-day life	E, A	2, 6
4.	Comprehend the organization of genetic material	U, An	2
5.	Familiarize with genetic diseases and analyze their pattern of inheritance	U	1, 6
*Remember (K), Understand (U), Apply (A), Analyze (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		**Principles of Transmission Genetics**	22	
	1.1	**Mendelian inheritance and Chromosome Theory:** Mendel's Experiments- Monohybrid cross, dihybrid cross, test cross, back cross, reciprocal cross (Genetic problems to be included). Principles of inheritance, Chromosome theory of heredity. **ACTIVITY** Problems on Genetics	8	1
	1.2	**Extension of Mendelism:** Interaction of genes: (Brief account with one example each) **I**ncomplete dominance, Co-dominance, Complementary, Supplementary, Dominant and Recessive epistasis, Polygenes, pleiotropism, Modifying genes, Lethal genes. Multiple allelism - ABO Blood group system, Rh group and its inheritance in human, Erythroblastosis fetalis. Pseudo autosomal genes, sex-limited, sex-influenced, sex-linked genes and holandric genes. Mitochondrial inheritance (Brief account only).	10	1
	1.3	**Linkage and Recombination:** Linkage and recombination of genes based on Morgan's work in Drosophila (Complete and incomplete linkage). Recombination mapping using two point test cross.	4	2
2		**Sex determination**	**10**	
	2.1	**Basics of sex determination:** Chromosome theory of sex determination (sex chromosomes and autosomes), Chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ). Genic balance theory	3	2
	2.2	Sex determination in Honey bees, Drosophila (Intersex) and Man. Role of SRY genes and gonad development. Hormonal influence & Environmental influence on sex determination.	4	2
	2.3	Barr bodies, Dosage compensation and Lyon hypothesis, gynandromorphs, sex mosaics, Hermaphroditism- Freemartin.	3	2
3		**Mutations**	10	
	3.1	**Types of Mutations**: Germinal & Somatic, Spontaneous & Induced mutations. Chromosomal	3	3

		mutation - structural and numerical aberrations.		
	3.2	Molecular basis of gene mutation – tautomerism, addition, deletion, substitution, frame shift mutation.	3	3
	3.3	Factors affecting mutation, mutagens and their mode of action. Detection of mutation - CIB method	4	3
4		**Cytogenetics and Genetic disorders**	**18**	
	4.1	Nucleus & Chromosome structure: Chromatin (euchromatin, heterochromatin), Chromosome – structure, types, different levels of organization (Nucleosomes, Solenoid, Chromosome loop), Giant chromosomes (Polytene and Lampbrush chromosomes), Karyotyping - Normal human chromosome complement.	5	4
	4.2	Human chromosomal anomalies: Autosomal (Down syndrome, Edward's syndrome and Cri du chat syndrome). Sex chromosomal anomalies (Klinefelter syndrome, and Turners syndrome), Single gene disorders - Sickle cell anemia, cystic fibrosis, Tay Sachs disease. **ACTIVITY:** Study of syndromes and karyotypes using photograph	5	5
	4.3	Inborn errors of metabolism: Genetic basis of Phenyl ketonuria, Alkaptonuria, Albinism.	3	5
	4.4	Multifactorial disorders - Cleft lip and cleft palate.	1	5
	4.5	Pedigree Analysis (Brief account only) – Pedigree symbols and construction of Pedigree.	2	5
	4.6	Human Genome Project (Brief account only), Genetic counselling- Eugenics and Euthenics.	2	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)**
AssessmentTypes	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 30 marks** Quiz, Test Papers, seminar, Activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

REFERENCES

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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOTECHNOLOGY: PRINCIPLES & PRACTICES**					
Type of Course	**DSE A**					
Course Code	**MG5DSEZIM300**					
Course Level	**300**					
Course Summary	This course encourages the students to master the fundamental principles underpinning genetic engineering and provides insight into the transformative applications shaping the forefront of modern science and industry.					
Semester	**V**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the principles and techniques of rDNA Technology	U, S	1, 2, 9, 10
2	Describe techniques in cell culture & genetic engineering.	U	1, 2, 3,10
3	Analyze the biotechnological applications in various fields	An	1, 2, 3, 6,7, 8
4	Describe biosafety concerns in biotechnology	U	1, 2, 4, 5, 6, 8
5	Explain the provisions for the protection of intellectual property.	U, Ap	1, 5, 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		**Fundamentals of Recombinant DNA Technology**	**20**	
	1.1	**Introduction to Biotechnology** Historical background, Prospects of biotechnology	2	1
	1.2	**Tools & Techniques** Enzymes- restriction enzymes, ligases, polymerases. Vectors- Plasmids, Bacteriophage-derived vectors, artificial chromosomes. Techniques- DNA Extraction (Brief account of RNA & plasmid extraction), Electrophoresis- Agarose Gel, PAGE. PCR-Principle & application. Hybridization of nucleic acid- Southern and Northern blotting. DNA sequencing-Sanger sequencing, Next Generation Sequencing (NGS) (Brief account only) Brief account of protein/proteome; identification/sequencing - (using a flowchart/schematic representation only)	10	1
	1.3	**rDNA technology** Gene isolation, integration of the desired gene into Vector, Insertion of rDNA into host cell. Screening methods of recombinants. Gene transfer - Transformation, Transduction, Transfection, Retro-virus, Gene gun, Microinjection, Electroporation, Ultrasonication. Genomic and cDNA library. **(Brief description only)**	8	1
2		**Cell culture and Genetic Engineering**	13	
	2.1	**Cell culture** Animal cell culture-Media-Natural & Synthetic media (one example each) Stem cell- type & uses	3	2
	2.2	**Genetic Engineering** Organismal cloning by nuclear transfer, transgenic technology: development of transgenic animals- Transgenic mice- knock-in, knock - out models, Transgenic *C.elegans*. Cell line transfections. Gene silencing - RNA interference, gene editing - **CRISPR Cas** (brief account only).	10	2

3		**Biotechnology & Human welfare**	17	
	3.1	**Medical Biotechnology & Forensics** Gene therapy (SCID). Stem cell therapy - regenerative medicine, Personalized medicine. Development of Pharmaceuticals- biopharmaceuticals of immune system –(interferons, IL) Hormones (insulin, somatostatin), Antibiotics, monoclonal antibodies, vaccines. DNA finger printing and its applications. **ACTIVITY** Case studies and report submission and presentation of: any criminal case, disputed paternity etc. based on DNA fingerprinting, from Newspapers [any one]	7	3
	3.2	**Agricultural & Environmental Biotechnology** Agriculture: Transgenic plants -Pest resistant (Bt-cotton), herbicide resistant, disease resistant varieties. Microbial pesticides. Qualitative improvement of livestock-Milk production in cows Environment: Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Bio-fertilizers: Algal and fungal biofertilizers (VAM), Bioleaching. Development of Biodegradable polymers-PHB.	6	3
	3.3	**Fermentation Biotechnology: Principles and applications** Enzymes - Amylase, Invertase, Zymase, General overview of synthesis of vitamins, food and beverages Single Cell Proteins.	4	3
4		**A. Biosafety concerns B. Intellectual Property Protection**	10	
	4.1	**A. Biosafety concerns** Levels of Biosafety. Risks associated with Genetically Modified Organisms (terminators seeds, impact on biodiversity, transferring transgenes from food to intestinal microbes, toxins/allergens in foods). Biological warfare & biopiracy. Ethics in Cloning	5	4

	4.2	**B. Intellectual Property Protection** Intellectual Property Rights (IPR)- Patents, Indian Patent law (overview).Copyright-TRIPS agreement, Trade secret, trademark, Plant breeder's right, Geographical indication (GI)	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, ICT Enabled Learning, Experiential learning, Participatory learning. Tutorial.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, seminar, Case study report submission & presentation
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs.** Short Essays 8 out of 10 x4=32 marks Short questions 14 out of 16 x2=28 marks Fill in the blanks 10x1=10 marks

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MAHATMA GANDHI UNIVERSITY
KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**WILDLIFE MANAGEMENT**					
Type of Course	**DSE A**					
Course Code	**MG5DSEZIM301**					
Course Level	**300**					
Course Summary	To convey basic information in Forests, Wildlife, Man wildlife conflict and Wildlife Conservation.					
Semester	**V**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Prerequisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain biodiversity hotspots, forest ecosystems, and species richness-diversity indices.	U	1,2,10
2	Describe primate biology, ecology, and behaviour; animal barriers; and wildlife, with special reference to mammals, birds, and reptiles.	U	1,2,6
3	Describe the consequences of the man-wildlife conflict.	A	1,2,6,7
4	Explain the threats faced by wildlife, protected areas; research institutes, and types of wildlife conservation.	A	1,2,10
5	Summarise the advances in wildlife conservation.	U	1,2,3,6, 7,10
Remember (R), 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		**Forest ecosystems**	**14**	
	1.1	Introduction to Forest ecosystems. Structure and functioning, forest succession. Keystone species, flagship species, Umbrella species	5	1
	1.2	Types of Forests - classification, distribution, composition and structure. Estimation of volume of individual tree and forest stands. Species richness-diversity indices (Shannon Weiner; Simpson).	5	1
	1.3	Biodiversity hotspots with special reference to Western Ghats.	4	1
2		**Introduction to wildlife & Man wildlife conflict**	**18**	
	2.1	Wild life - with special reference to Mammals, Birds and reptiles in international, national and local perspective	4	2
	2.2	Introduction to Biology, ecology and behaviour of Primates (Bonnet Macaque), Carnivora (Tiger, Leopard) and Elephants.	7	2
	2.3	Man wildlife conflict- Case studies-(one each) Elephant, Monkey (Bonnet Macaque), Large carnivores (Tiger/leopard) & Wild boar.	6	3
	2.4	Animal barriers: Mechanical and electrical.	1	2
		ACTIVITY: Compilation of newspaper reports and seminar presentation of Wildlife/ Man- Wildlife conflict.		
3		**Wildlife Conservation**	**15**	
	3.1	Threats faced by wildlife. Conservation of wildlife- Ex-situ conservation and in-situ conservation. Management of Protected Areas.	6	4
	3.2	National Park, Sanctuaries, Tiger reserves, Biosphere Reserves, Community reserves. Ramsar Sites. Protected areas of Kerala	4	4
	3.3	Research institutes of Wildlife in India. Special projects for wildlife conservation- Project Tiger, Project Elephant, Crocodile Conservation Initiative. Wildlife (Protection) Act, 1972 and 2022 amendments. CITES, TRAFFIC. IUCN red list categories, Red Data Book.	5	4

4		**Advances in Wildlife Conservation**	**13**	
	4.1	Remote sensing (RS): Introduction, definition, brief history, fundamental principle of RS, Stages of RS, Classification of RS: Active and Passive RS- based on source of energy and wavelength; Aerial and space remote sensing, Merits and limitations of RS. Recent developments.	10	5
	4.2	GIS; GPS; Radio collaring.	3	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Paper, seminar, Compilation of newspaper reports and seminar presentation
	B. End Semester Examination **Theory Total =70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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MAHATMA GANDHI UNIVERSITY
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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**CLIMATE CHANGE AND DISASTER RISK REDUCTION**					
Type of Course	**DSE A**					
Course Code	**MG5DSEZIM302**					
Course Level	**300**					
Course Summary	The course on Climate Change and Disaster Management is designed to provide a comprehensive understanding of the interplay between climate change and the increasing frequency and intensity of natural disasters. Students will explore the scientific foundations of climate change, its impact on the environment, and the resulting challenges in disaster management. The course integrates theoretical knowledge with practical applications to equip participants with the skills necessary for effective mitigation, adaptation, and response strategies.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Develop a comprehensive understanding of climate change & disasters, including the causes & consequences.	A	1,2,6, 10
2	Administer strategies in risk assessments and disaster mitigation preparedness and adaptation.	A	1,2,6
3	Infer Carbon trading, Carbon credit; Carbon footprint; Carbon Sequestration, Green & Energy audit	U	2,6
4	Understand the Policies/treaties to combat Climate change and the challenges and issues of climate change.	U	3,6, 10
5	Evaluate the impact of disasters and climate change	E	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		**Climate Change & Disasters**	**10**	
	1.1	**Fundamentals of Climate change** : Introduction, Climate change over geological history. Causes & effect of climate change	2	1
	1.2	**Current status** - Greenhouse gases and global warming, acid rain, Ozone layer depletion	3	2
	1.3	**Climatic and meteorological disasters:** Extreme temperature (El Nino & La Nina), drought, fog, wildfire (forest fire and land fire), Cyclone & storms, floods, landslides, earthquake and tsunami	5	1, 2
2		**Disaster Risk Reduction (DRR)**	**20**	
	2.1	**Basic concepts and terminologies:** Hazard, Risk, vulnerability, Disaster, Mitigation, DRR and its evolution, Disaster Risk Management (DRM), Emergency, Response, Relief; Resilience, Reconstruction, Recovery	4	2
	2.2	**Disaster Risk Mitigation** Disaster management journey and paradigm shift; Approaches in disaster management–Engineering centric, Community Based Disaster Preparedness (CBDP), Indent management, Ecosystem-based Disaster Risk Reduction (ecoDRR). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions - Structural and Non Structural measures of mitigation International and national policy frameworks and guidelines.	5	2
	2.3	**Disaster Risk Management** Tools and Methods in Disaster Risk Management: Hazard, risk and vulnerability analysis; Legislations, Codes & Standards, Risk sensitive land use planning, Safety auditing, Role of Strategic Environmental Assessment (SEA)/ Environmental Impact Assessment (EIA), Situation analysis, Incident response system, Post-Disaster Needs Assessments (PDNA), Environmental economics & DRR, Recovery framework. DM Planning for Government at national/ sub-national, Ministry/ departments, organization/establishments and at local levels.	5	1,2

	2.4	**Applications of science and technology for DRR & Climate Change Adaptation (CCA)** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination), S&T Institutions for Disaster Management in India.	3	2
	2.5	**Disaster Preparedness** Crisis management, Early warning and communication, Emergency response, Local preparedness, Relief management-Shelter, "water, sanitation and hygiene" (Watsan), environmental health, trauma care; Role of agencies, technology and coordination; Issues of green relief, sustainable recovery, built back better; Climate Change Adaptation - Disaster Risk Reduction (CCA-DRR) and sustainability integration into post-disaster/post-conflict development, International response.	3	2
3		**Adaptation strategies**	**15**	
	3.1	Natural Resource Management-Disaster Risk Management (NRM-DRM) integration, ecosystem-based adaptation and eco DRR; Role of Green growth, sustainable NRM – IWRM (Natural Resource Management - Integrated Water Resources Management), Watershed, River basin, Integrated Coastal Zone Management Plan: (ICZM), Socioeconomic resilience, Capacity building,	5	2
	3.2	Carbon trading, carbon credit; Carbon footprint; Carbon Sequestration. Carbon neutral, alternate sources of energy, ecological footprint, Polluter pays principle, 3'R Principle, Green auditing **ACTIVITY** 1. Energy audit of your house/college 2. Survey in your locality regarding measures adopted for energy utilisation, rain water harvesting etc. and conducting awareness programs	4	1
		Policies/treaties to combat Climate change: **International** - Montreal protocol, Kyoto Protocol, Earth summit, Paris Agreement 2005, IPCC, & UNFCCC **National** - Disaster Management Act, 2005, NAPCC - National Action Plan on Climate Change Role of government, NGOs, and communities.		

	3.3	**Methods of risk assessment in the Kerala context:** GIS and remote sensing applications for risk mapping Role of local government in disaster management Case studies on policy implementation Early warning systems and their implementation Community-based disaster preparedness Infrastructure planning for disaster resilience Analyzing successful disaster management cases in Kerala Data analytics for predicting and managing disasters **ACTIVITY** 1. Case studies; Field work at areas with history of natural disasters in Kerala – Report submission and Presentation. 2. Visit to disaster prone areas & report.	6	4
4		**Challenges, issues & impact of Climate change**	**15**	
	4.1	Issues in Urban, Rural and Industrial disaster risks management with respect to climate change. Resilient agriculture, Disaster Resilient - Infrastructure, Industry, Livelihoods, Schools, Hospitals.. Issues of special needs - gender, aged, children, disabled, psycho-social	6	4
	4.2	Impact of climate change in India/Kerala: Extreme Heat, changing rainfall patterns, increased droughts, depletion of ground water, melting of glaciers, rise of sea level, faunal decline	5	1, 2
	4.3	Impact on Agriculture & Food Security, Energy Security, Water Security. Health, Migration & Conflict	4	1, 2
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lecture, Case studies, guest speakers .
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Paper, Evaluation of report on the basis of activities
	B. End Semester Examination **Theory Total =70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4=32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FOOD AND DAIRY MICROBIOLOGY**					
Type of Course	**DSC B**					
Course Code	**MG5DSCZIM302**					
Course Level	**300**					
Course Summary	Will help understand the current trends and concepts related to Microbiology of food and other dairy products. Gives an insight into various types of foodborne diseases and their interaction between micro-Organisms & food.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Recall the significance and activities of microorganisms in food & the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on nutritive value of milk	K, U	1,2,3
2	Discuss about the principle behind food spoilage and microbes causing food spoilage.	U, A	1,2,3, 4,5
3	Understand the principles in traditional food preservation techniques including salting, pickling, refrigeration, freezing, oxidation, and canning/bottling and chemical Preservation	U, A, An	2,3,4, 5
4	Detailed study on fermented dairy products.	A, An	2,3,4, 5,10
5	Evaluate food intoxication and food borne pathogen	E ,An	2,3,4, 5,10
6	Practical section improves skills to perform isolation, detection and identification of microorganisms in milk /food samples and also evaluate quality of food & Airy products by visiting an Industry	S	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		**Food & milk as a substrate for Microorganism and Principles of spoilage**		
	1.1	Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.	4	1
	1.2	Milk–introduction, composition,microorganisms in milk-bacteria, yeast, mold. Nutritive value of milk. Starter cultures and their biochemical activities	5	1
	1.3	Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.	6	1
2		**Methods of food preservation & Fermented dairy Products**		
	2.1	Principles, physical methods of food preservation: temperature (low,high canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging	5	2
	2.2	Chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins Preservation of milk, Pasteurization, different methods and advantages.	5	3
	2.3	Fermented dairy products- cheese, cultured buttermilk, bulgarian butter milk, ice cream, lassie Condensed and dry milk products, yoghurt; low lactose milk, kefir and kumiss. Distinguish between Probiotics & Prebiotics.	5	4
3		**Food borne Diseases**		
	3.1	Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and *mycotoxins* Food infections: - *Bacillus cereus, Vibrio parahaemolyticus, Escherichia.coli, Salmonellosis*	8	5
	3.2	*Shigellosis*, *Yersinia enterocolitica Listeria monocytogenes* and *Campylobacterjejuni* (causative agents foods involved, symptoms and preventive measures	7	5
4		**Practicals**		
	4.1	Preparation of milk products like paneer, yoghurt lassi and whey drink.	5	1,6
	4.2	Isolation of any food borne bacteria from food products. (vegetables/ fruits/ bread).	4	6
	4.3	Isolation of bacteria from idli batter & curd.	5	1

		Isolation of bacteria from milk - Isolation of *Lactobacillus* and *Staphylococcus* from curd		
	4.4	Qualitative analysis of milk by standard plate count method.	4	2
	4.5	MBRT of milk samples and their Standard plate count	4	2
	4.6	Quality testing of milk by resazurin test Determination of phosphatase activity of milk	3	2
	4.6	Visit to a Microbiology laboratory of Food/Dairy industries./ Report based on market survey of Milk & Milk products	5	1
5		**Teacher specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks** Lab performance/Record/Field report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record - 10 Marks; Examination-25 Marks: Isolation of organism from idli batter/food products -6Marks, MBRT test-6 Marks, Spotter Identification-8 Marks, Viva based on Industrial visit- 2 Marks and submit the report-3 Marks,

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Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FOOD AND WATER QUALITY MANAGEMENT**					
Type of course	**SEC**					
Course Code	**MG5SECZIM300**					
Course Level	**300**					
Course Summary	Aimed at ensuring the safety & quality of both food & water. Discusses issues like food adulteration and the indiscriminate use of food additives. Delves into the identification & management of spoilage bacteria, along with methods for monitoring & assessing microbial quality. It also explores the regulatory frameworks at both national& international levels that oversee food & water quality, highlighting the responsible agencies entrusted with enforcing these regulations.					
Semester	**V**	Credits			3	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	--	--	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No.
1	Identify various food adulterants & additives and their health implications	U	1
2	Describe the causes and consequences of quality deterioration of food and water	U	3
3	Apply skills in food and water quality analysis	S	6, 10
4	Explain the laws and regulations pertaining to food safety and consumer protection and quality management systems operating at national and international levels.	U	1
5	Analyse the chemical & microbial quality of different categories of food & water	An, 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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Food adulterants and food additives**	**16**	
	1.1	**Food adulteration** Definition; types-intentional, incidental. Poisonous substances, cheap substitutes, metallic and packaging hazard. Common adulterants and detection methods. General impact on human health.	3	1
	1.2	**Food additives** Definition, classification: Preservatives, colourants, flavour enhancers, anti-oxidants, artificial sweeteners and stabilizers, thickening agents, leavening agents, emulsifiers, anti-caking agents and humectants. Food additives generally recognized as safe (GRAS); toxicology and safety evaluation of food additives.	4	1
	1.3	**Food laws & regulations:** Food Safety and Standards Act 2006, Role of Food Safety and Standard Authority of India (FSSAI). FSS Regulations 2011: Regulations on Contaminants, toxins and residues, FSS Regulations on Food products standards and food additives, FSS Regulations on Packaging and Labeling, Regulations on Approval of non-specified food and food ingredients, 2017. Consumer protection act 2019.	4	4
	1.4	**Quality management**: Introduction**,** Scope, significance & objectives of quality management systems. Good Manufacturing Practices. Hazard Analysis and Critical Control Point (HACCP). Management and certification systems: Role of FDA, FAO, Codex Alimentarius Commission, ISO 2000, FSSC 22000, Agmark, BIS, QCI, NABCB.	5	4

2		**Food and water quality analysis**	**14**	
	2.1	**Food Spoilage:** Introduction, definition, types of spoilage - Physical, chemical and microbial. Chemical spoilage - Oxidation of fat, Physical spoilage - Browning of fruits and vegetables.	2	5
	2.2	**Microbial spoilage of food** Factors affecting microbial spoilage of food. Contamination and spoilage of fish and shell fishes, dairy products, fruits and vegetables, meat and meat products. Control measures.	4	5
	2.3	**Analysis of spoiled foods** Microbiological analysis of spoiled foods: isolation, total plate count and biochemical tests for the identification of spoilage bacteria (Brief account)	2	3
	2.4	**Physico-chemical parameters of water** Turbidity, colour, odour, taste, conductivity, pH, acidity, alkalinity, TDS, total hardness, nitrate, phosphate, residual chlorine.	2	2
	2.5	**Microbiological quality of water** Etiology of water borne diseases (Eg:Typhoid and Cholera). Microbial water quality analysis - most probable number, total coliforms, faecal coliforms, *E.coli*. BIS specifications for drinking water.	4	2,3
3		**Hands on training**	**15**	
	3.1	Detection of adulterants in honey (jaggery, sugar syrup), in milk – tests for urea and starch, in chilli powder, turmeric powder and coriander powder	5	1
	3.2	Detection of castor oil, cotton seed oil and argemone oil in edible oils and detection of adulteration in ghee	3	1
	3.3	Determination of alkalinity, hardness and residual chlorine in water, Microbial analysis of water	6	3
	3.4	Sensory/organoleptic evaluation of fish	1	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, ICT enabled classes, Group discussions, seminar presentations, case studies and activities.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks** Quiz, Test Paper, Tests on hands on training
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x 4 = 20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks

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5. Huub, L.M., Yasmine, M. (2013). Food Safety Management: A Practical Guide for the Food Industry. Academic Press.
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7. Lewis, R. J. (1990). Food Additives Handbook. Springer New York
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9. Suri, S., Malhotra, A. 2013. Food science Nutrition and safety. Pearson education

Semester-VI

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**PHYSIOLOGY & ENDOCRINOLOGY**					
Type of course	**DSC A**					
Course Code	**MG6DSCZIM300**					
Course Level	**300**					
Course Summary	Provides an enthralling exploration of human physiology. Learn the mysteries of nutrition, the ways in which food nourishes our bodies, and the multifaceted mechanism of respiration - the inhalation of oxygen that maintains life. Unravel the enigmatic realm of excretion, where the removal of waste preserves the equilibrium of our systems. Uncover the mysteries of movement and feeling by venturing into the realm of muscle and neuron physiology. Know about the secret capabilities of hormones in the endocrine system and how these chemical messengers regulate our physical selves.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe the structure, functions, and mechanisms of human systems such as the cardiovascular, endocrine, respiratory, and nervous systems.	An	1,2
2	Analyse the physiological underpinnings, mechanisms, and impacts of prevalent health issues such as diabetes, nutritional disorders, cardiovascular ailments, neural disorders, kidney disorders, endocrine disorders, and respiratory disorders.	A	1,2
3	Explain homeostasis and feedback mechanisms, renal physiology, and basic aspects of nutritional science.	An	1,2

4	Investigate the intricate interactions between the nervous system and muscles, the mechanisms governing muscle contractions, and the impact of neuromuscular complexities on human movement and physiological function.	C	1,2
5	Demonstrate skills in analyzing physiological data and evaluating bodily functions.	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**	**Cardiopulmonary Physiology**	**12**	
	1.1	Overview of circulatory system, Cardiac cycle and cardiac output, Haemostasis: Pathways of blood coagulation	3	1
	1.2	Cardiovascular diseases: Atherosclerosis, Myocardial infarction, stroke. ECG (brief) Cardiopulmonary resuscitation (CPR)	2	2
	1.3	Overview of respiratory system, Mechanism of breathing: Inspiration and Expiration, Gas exchange in the alveoli, Oxygen and Carbon Dioxide transport, Oxygen-Hemoglobin dissociation curve; Factors affecting the curve.	3	1
	1.4	Neural and chemical control of respiration, Respiratory problems (Hypoxia, Asphyxia, Hypercapnia, Oxygen toxicity, CO poisoning). Respiration in unusual environments (High Altitude, Diving, foetal).	2	1,2
	1.5	Importance of lung capacity and respiratory efficiency. Breathing exercises: Diaphragmatic Breathing, Pursed lip breathing, and lung expansion techniques, Physical activities and practices to enhance respiratory fitness (very brief account)	2	1
2		**A. Nutritional Science & B. Neuromuscular Physiology**	**17**	
	2.1	**A. Nutritional Science** Introduction to nutrition, balanced diet, RDA, antioxidants, importance of dietary fibre and water.	2	3

		Disorders: Ulcer, Bulimia nervosa, anorexia nervosa, irritable bowel syndrome. obesity. BMI .		
	2.2	Digestion, absorption, and assimilation of carbohydrates, proteins, and lipids	4	3
		B. Neuromuscular Physiology Types of neurons, mechanism of nerve impulse conduction, neuromuscular junction, synaptic transmission, types of neurotransmitters Neural disorders: Dyslexia, Parkinson's, Dementia, Alzheimer's, Schizophrenia	5	4
		Ultrastructure of striated muscle, mechanism of muscle contraction: Sliding filament theory, role of ATP in muscle contraction. Electrophysiology of muscle contraction, Muscle twitch, summation, fatigue, treppe, tetanus. Cori cycle, Rigor mortis.	6	4
3		**A. Renal Physiology & B. Endocrinology**	**16**	
	3.1	**A. Renal Physiology** Structure of nephron, mechanisms of urine formation: glomerular ultrafiltration, tubular re-absorption, tubular secretion, countercurrent exchange	3	3
	3.2	Kidney disorders: glomerular nephritis, pyelonephritis, kidney stones, dialysis, kidney transplantation (brief account)	3	2
	3.3	Role of kidney in homoeostasis	1	3
	3.4	**B. Endocrinology** Hormone - classification and mechanism of action	1	1
	3.5	Major endocrine glands, their secretions, functions, and disorders (Hypothalamus, pituitary, pineal gland, thyroid, parathyroid, islets of Langerhans, adrenal gland, gonads)	7	1
	3.6	Homoeostasis and feedback mechanisms	1	1
4		**Practical**	**30**	
	1	Estimation of the RBC count of blood.		5
	2	Estimation of the WBC Count of blood.		5
	3	Estimation of hemoglobin content.		5
	4	Determination of bleeding time.		5
	5	Determination of clotting time.		5
	6	Determination of erythrocyte sedimentation rate (ESR).		5
	7	Determination of heart rate, pulse rate and blood pressure using sphygmomanometer		5

	8	Analyze the effect of different concentrations of NaCl solution on RBC..		5
	9	Study of endocrine glands		5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** lecturing with ICT
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz-, Test Papers, seminar **Practical Total = 15 marks** Lab performance, record , Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks; Short questions- 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks - Duration - 2 hrs** **Record 10 marks,** **Examination 25 marks:** Estimation of RBC/WBC count – 15 marks Estimation of Haemoglobin content/ ESR – 6 marks Spotter identification – 4 marks

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SUGGESTED READING

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2. Marshall, P., Gallacher, B., Jolly, J., & Rinomhota, S. (2017). Anatomy and Physiology for Healthcare. EBSCO eBook.
3. Morton, D. A., Foreman, K. B., & Albertine, K. H. (2018). Big Picture: Gross Anatomy, Medical Course & Step 1 Review [Access Medicine].
4. Netter, F. H. (2014). Atlas of Human Anatomy. R2 Digital Library eBook.

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**REPRODUCTIVE BIOLOGY AND TERATOLOGY**					
Type of Course	**DSE A**					
Course Code	**MG6DSEZIM300**					
Course Level	**300**					
Course Summary	This Course aims to give an idea about the development process, defects in development and the techniques applied in reproductive biology to rectify the developmental defects which can be an added milestone to the fertility related medicinal filed.					
Semester	**VI**	Credits			4	Total Hours
Course details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	---	75
Pre-requisites if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the basic concepts and theories in Reproductive biology.	U	1
2	Describe the different developmental stages in animals.	U	3
3	Analyse various techniques in prenatal diagnostics and assisted reproduction.	An, A	3
4	Differentiate the concepts of Experimental embryology	U	1
5	Compare teratogens, their effects and other common developmental defects.	An	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 (Theory)	Hrs	CO No.
1		**Reproductive Biology**	**22**	
	1.1	Introduction to Reproductive biology, Definition, Theories of development- Preformation theory, Theory of Epigenesis, Recapitulation theory, Germplasm theory, Mosaic theory and Regulative theory	2	1
	1.2	Patterns of development – Oviparity, Ovo-viviparity and Viviparity	1	1
	1.3	Gonads - anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Oestrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, Types of placenta, parturition and lactation.	7	1
	1.4	**Early Embryonic development** **Egg types:** Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and non-cleidoic eggs. Polarity and symmetry of egg. **Fertilization:** Mechanism of fertilization- (Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, capacitation of sperm, Activation of Ovum, Migration of Pronuclei and Amphimixis), Significance of fertilization, Polyspermy. Parthenogenesis- Different types and significance.	5	2
	1.5	**Developmental patterns with special reference to frog and chick** **Blastulation:** Morula, blastula formation, types of blastula with examples. **Fate maps:** Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map. **Gastrulation:** Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on	7	2

		gastrulation. Concept of germ layers and derivatives.		
2		**Prenatal diagnostic techniques Assisted Reproductive Techniques**	10	
	2.1	Invasive techniques: Amniocentesis, Chorionic villi sampling, Alfa fetoprotein test, cordocentesis, Foetoscopy, fetal tissue biopsy, Maternal serum beta-HCG. Non-invasive techniques: Ultra sound scanning, MRI, Cell free fetal DNA	4	3
	2.2	Assisted Reproductive Techniques**:** *In vitro* fertilization (IVF) and Embryo transfer (ET), ZIFT, GIFT, ICSI TET in detail	6	3
3		**Experimental embryology & Teratology**	13	
	3.1	Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning.	5	4
	3.2	**Significance of model organisms** (*Caenorhabditis elegans, Danio rerio and Mus musculus)* in embryological studies (brief account).	2	4
	3.3	**Teratology:** Teratogenesis, Teratogenic agents [Physical (Radiations), Chemical (Environmental toxins and drugs), Biological (infectious agents)], Teratogenic mechanisms- Genetic mutations, cellular processes and physiological disruptions).	3	5
	3.4	**Developmental defects**: Prenatal death (miscarriage &still birth). Intrauterine Growth Retardation (IUGR).	3	5
4		**Practical**	30	
	1	Calculation of gonado-somatic index of fish.	4	3
	2	Male and female reproductive organs in a teleost fish	3	2
	3	Study of placenta – pig and man.	2	2
	4	Study of permanent slides of blastula of frog & chick	3	2
	5	Study of permanent slides of gastrula of frog & chick	3	2
	6	Study of permanent slides of 18 hour, 24 hour, 33 hour and 48 hour chick embryo.	4	2
	7	Candling of eggs	1	3
	8	Study of chick development using live eggs – Vital staining-Window method (Demonstration)	3	2,3
	9	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.	7	2,3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure(Mode of transaction)** Lecture, Tutorial (Videos , Practicals)
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks:** Quiz-, Test Papers, seminar **Practical Total = 15 marks:** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4=20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks - 10x1 =10 marks **Practical Total = 35 Marks, Duration - 2 hrs** **Record - 10 marks, Examination - 25 marks:** Dissection and display – 15 marks Calculation of Gonadosomatic index/candling of eggs-6 marks Spotter identification – 4 marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ZOOGEOGRAPHY AND EVOLUTIONARY BIOLOGY**					
Type of Course	**DSE A**					
Course Code	**MG6DSEZIM301**					
CourseLevel	**300**					
Course Summary	Uncover the mysteries of evolution, unravel the geographical distribution of species, and journey through the fossilized record of Earth's evolutionary tapestry.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---		----	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the origin of earth and life.	U	1,2,7,10
2	Discuss the patterns and factors affecting the distribution of animals on earth.	U	1, 2,3
3	Describe the concept of evolution.	U	2,3, 10
4	Extrapolate evolutionary mechanisms.	A	1, 2, 10
5	Analyse the central role of fossils in evolution.	An	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		**Zoogeography**	**20**	
	1.1	**Introduction to Zoogeography** Historical Biogeography Origin of oceans and continents, Plate tectonics – continental drift theory, rift valley, African great rift and its consequences- *(recent trends)*	4	1
	1.2	**Dispersal & Migration** Types and means of animal distribution, Factors affecting animal distribution.; Types of animal distribution,; Insular fauna – oceanic islands and continental islands with examples	8	2
	1.3	**Zoogeographic realms** Different Zoogeographical realms-Palearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian- with their sub regions - their boundaries, physical characteristics, climatic conditions, vegetation and fauna. Wallacea and its fauna; Zealandia **ACTIVITY:** Locating on the world map, zoogeographical realms and the animals endemic	6	2
	1.4	**Biogeography of India** Topographic features and Zoogeography, Western Ghats and its fauna and conservation measures	2	2
2		**Theories and genetic basis of organic evolution**	**14**	
	2.1	**Evolution of life- origin & theories** Brief account of Origin of Earth, Theory of origin life - biochemical origin- by Oparin and Haldane. Urey Miller experiment Lamarckism - Critical analysis of Lamarck's propositions Weisman's germplasm theory, Mutation theory Darwinism-Critical analysis of Darwinism Neo Darwinism Synthetic Theory of Evolution(brief account only) Neutral theory of molecular evolution by Kimura	9	1,3

	2.2	**Genetic basis of organic evolution** Genetic basis of variation, population genetics Hardy Weinberg law-gene pool, gene frequency, gene flow. Factors affecting gene frequencies	5	3
3		**Mechanism of evolution**	**17**	
	3.1	**Isolating Mechanisms** Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution	3	4
	3.2	**Species and Speciation** Species concept, subdivisions of species- sibling species, deme, cline, semi species, sub-species. Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation.	8	4
	3.3	**Nature of Evolution** Microevolution, Macroevolution Mega evolution, Adaptive radiation – process, causes, types (Darwin's finches, adaptive radiation in placental mammals). Punctuated equilibrium vs Gradualism Homologous and analogous structures	6	4
4		**Palaeontology**	**9**	
	4.1	**Fossils & Fossilization** Definition and scope of Palaeontology Types of Fossilization, Types of fossils, microfossils, Index fossils, trace fossils and living fossils, Transitional fossils Dating of fossils	4	5
	4.2	**Trends in Evolution** Convergent evolution. Co-evolution. Mass extinction. Geological Time Scale: Major events in different stages with special reference to connecting links and fossils in human evolution (brief reference to African origin on modern man- Mitochondrial Eve and Y chromosomal Adam).	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, Seminar, Activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x 4 =32 marks Short questions- 14 out of 16 x2 =28 marks Fill in the blanks -10x1 =10 marks

REFERENCES

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FUNDAMENTALS OF PARASITOLOGY**					
Type of Course	**DSE A**					
Course Code	**MG6DSEZIM302**					
Course Level	**300**					
Course Summary	A broad and multi-disciplinary approach to the complex and dynamic relationships between parasites and their hosts. This course offers an overview of the biological and epidemiological bases of important parasitic diseases and an understanding of the impact of parasitic diseases on endemic communities.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	--	---	60
Pre--requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the fundamentals of host-parasite interactions, adaptations, and parasitism.	U	1,2
2	Describe the morphology, life cycle, pathogenicity, preventative measures, and control strategies of parasitic protists, nematodes, Platyhelminthes, and arthropods.	A	2
3	Identify parasitic vertebrates.	U	2
4	Demonstrate techniques used in molecular diagnosis and clinical parasitology.		
5	Determine career options in parasite research and the medical sciences.	A	2

Remember (K), Understand (U), Apply (A), Analyze (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		**Parasites – An introduction**	**8**	
	1.1	Parasites, parasitoids, host, zoonosis, Origin and evolution of parasites, Basic concept of Parasitism, Symbiosis, Phoresy, commensalisms and mutualism, Host-parasite interactions, and adaptations.		1
2		**Parasitic Protists and Parasitic Platyhelminthes**	19	
	1.2	**Parasitic Protists** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Entamoeba histolytica, Giardia intestinalis, Leishmania donovani, Toxoplasma gondii*	10	2
	2.2	**Parasitic Platyhelminthes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Fasciolopsis buski, Diphyllobothrium latum, Hymenolepis nana* ACTIVITY: Isolation, observation and documentation of trematode larval stages.	9	
3		**Parasitic Nematodes, arthropods and vertebrates**	18	
	3.1.	**Parasitic Nematodes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Ascaris lumbricoides, Ancylostoma duodenale, Brugia malayi, Trichinella spiralis* Nematode plant interaction; Gall formation	10	2,3
	3.2.	**Parasitic Arthropods** Biology, importance and control of Ticks (Soft tick *Ornithodoros*, Hard tick *Ixodes*), Mites (*Sarcoptes*), Lice (*Pediculus*).Flea (*Xenopsylla*), Bug (*Cimex*), Parasitoid (Wasps)	5	
	3.3	**Parasitic Vertebrates** Cookicutter Shark, Hood Mocking bird and Vampire bat and their parasitic behavior and effect on host	3	
4		**Molecular diagnosis & clinical parasitology**	**15**	

	4.1	General concept of molecular diagnosis for parasitic infection Advantages and disadvantages of moleculardiagnosis Fundamental techniques used in molecular diagnosis of endoparasites Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules (*Giardia intestinalis*, E. *coli, Entamoeba Histolytica, Leishmania donovani)*. Malarial parasite using ELISA, RIA, Counter Current Immunoelectrophoresis (CCI), Complement Fixation Test (CFT), PCR, DNA, RNA probe		4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, Seminar/Activity report
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 8 out of 10 x4=32 marks Short questions- 14 out of 16 x2 = 28 marks Fill in the blanks 10x1 =10 marks

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1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.
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3. Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBSnP.
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2. Chandler, A. C. and Read. C. P. (1961). Introduction to parasitology, 10th ed. John Wileyand Sons Inc.
3. Cheng, T. C. (1986). General Parasitology. 2nd ed. Academic Press, Inc. Orlando. U.S.A.
4. Schmidt, G. D. and Roberts, L. S. (2001). Foundation of Parasitology. 3rd ed. McGrawHill Publishers.
5. Schmidt, G. D. (1989). Essentials of Parasitology. Wm. C. Brown Publishers.
6. John Hyde (1996) Molecular Parasitology Open University Press.
7. Joseph Marr J and Miklos Muller (1995) Biochemistry and Molecular Biology of Parasites 2nd Edn A P.

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT**					
Type of Course	**DSC B**					
Course Code	**MG6DSCZIM301**					
Course Level	**300**					
Course Summary	This course helps students to gain knowledge on the types of soil, microbial interactions in soil, nitrogen fixing organisms, bio fertilizer and bio pesticide production using microbes and plant disease management to promotes prevention and enhance the plants growth.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	State brief account on beneficial soil microbes & their interactions amongplants.	K ,U	1,2,3
2	Discuss biogeochemical cycles in environment	U, A	1,2,3, 4,5
3	Execute knowledge on nitrogen fixation and importance of VAM fungi on agriculture.	A, An	1,2,3, 4,5
4	To improve biofertilizer technology to ensure high quality & improved delivery.	A,, An	2,3,4, 5
5	Assess knowledge on various symptoms, epidemiology & management of various plant diseases. Secondary agricultural biotechnology use different scientific techniques to improve plants and its products to increase agricultural productivity	An ,E	1,2,3, 4,5
6	Develop practical skill to isolate microorganisms from soil sampleand perform group activity to attain practical knowledge	U,E	1,2,3, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Soil Microbiology**		
	1.1	Distribution of microorganisms in soil, Soil microorganisms andmicrobial interactions. Factors influencing soil microflora. Different agriculturally important beneficial microorganismsfreeliving, symbiotic, (rhizobial, mycorrhizal, actinorhizal), Associative and endophytic nitrogen fixers including cyanobacteria. mutualism, synergism.	7	1
	1.2	Definition-Mutualism, Synergism, Commensalisms, Amensalism, competition, parasitism, predation, neutralism	4	2
	1.3	Biogeochemical Cycling: role of microorganisms in cycling ofelements- nitrogen, carbon, sulfur, phosphorus cycles.	4	2
2		**Plant Microbial Interactions & Nitrogen Fixation**		
	2..1	Plant – microbe Interaction -Soil Plant microbe interactions leading to symbiotic, associative, endophytic and pathogenic interaction. Microorganisms of rhizosphere, rhizoplane phylloplane. Plant growth promoting rhizobacteria (PGPR) Mechanism of plant growth promotion by PGPR.	5	1
	2.2	Mycorrhizae- ectomycorrhiza, endomycorrhiza, Mycorrhizal associations. Vesicular Arbuscular Mycorrhizae (VAM Fungi)-morphology, isolation, mass production, field application and their importance in agriculture.	5	3
	2.3	Biological nitrogen fixation- nitrogenase enzyme, nif genes, Symbiotic and Non symbiotic nitrogen fixation. Root nodulation. Mechanism of nitrogen fixation. Role of *Azotobacter*, *Anabena* and *Klebsiella Pneumoniae* in Nitrogen fixation	5	3
3		**Biofertilizers, Microbial disease of Plants & Secondary Agricultural Biotechnology**		
	3.1	Biofertilizers: *Rhizobium, Azotobacter Azospirillum, Azolla* (Mass production, Field application, Uses). Biopesticide and its application.	3	4
	3.2	Bacterial diseases: Bacterial leaf blight of rice Citrus canker. Fungal diseases: Root rot of pepper, Downy mildew of grapes, and Tikka disease of groundnut.	5	5

		Mycoplasmal diseases - Sandal spike, Grassy shoot disease of sugar cane, Viral Disease :TMV		
	3.3	Biogas: Production of biogas, Uses of biogas, bio hydrogen, Photoproduction of hydrogen, Hydrogen production From marine organisms, Use of hydrogen fuel. Biofuel: Industrial production of bioethanol and biobutanol, Uses, Biodiesel. Introduction to Agricultural Biotechnology, Application of agricultural biotechnology. Genetically modified crops. Advantages, social and environmental aspects: Bt crops & Golden rice	7	5
4		**Practicals**		
	4.1	Isolation and enumeration of microorganisms from soil sample	7	6
	4.2	Morphological observation of rhizobium from root nodules	4	6
	4.3	Rhizobium as soil inoculants characteristics & field application.	4	6
	4.4	Azotobacter as soil inoculants characteristics & field application	4	6
	4.5	**Group Activity-** Composting/Biofertilzer/Biopesticide	7	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments ,Library work ,Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record/Field report/entrepreneur interaction report
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practicals Total -35Marks -** Record - 10 Marks Examination-25 Marks, Isolation and enumeration of microorganisms from soilsample -8 Marks, Morphological observation of rhizobium from root nodule -6 Mark , Spotters-8 Marks, Viva based on industrial visit – 1 Mark and submit the report-2 Marks

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1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008).

Prescott,Harley,Klein's Microbiology (7th ed.). McGraw Hill International Edition.

2. Mandell, G. L., Douglas, R. G., & Bennett, J. E. (2010). Principles and Practices ofInfectious Diseases (7th ed.). Churchill Livingstone Elsevier.McGraw-Hill.
3. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2004). MedicalMicrobiology.ElsevierHealth Sciences.
4. Devlin, T. M. (2011). Textbook of Biochemistry with Clinical Correlations (6th ed.).JohnWiley& Sons, Inc.
5. Sherwood, L. (2013). Introduction to Human Physiology (8th ed.). CengageLearningBrooks/Cole.
6. Snustad, D. P., & Simmons, M. J. (2012). Principles of Genetics.
7. Cooper, G. M., & Hausman, R. E. (2009). The Cell: A Molecular Approach(5thed.).ASM Press & Sinauer Associates.
8. Hall, J. E., & Hall, M. E. (2020). Guyton and Hall Textbook of MedicalPhysiology(14thed.).

Suggested Reading

9. Soil Microbiology: Soil Microorganisms and Plant Growth by NS Subba Rao
10. Recent Advances in Plant Biochemistry by SL Mehta, ML Lodha and PV Sane

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MUSHROOM AND SPIRULINA PRODUCTION TECHNOLOGY**					
Type of Course	**SEC**					
Course Code	**MG6SECZIM300**					
Course Level	**300**					
Course Summary	This course provides an overview on cultivation technique for mushroom& spirulina and its economic importance as value added products.					
Semester	VI	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Define basic concepts and production of various edibleand non-edible mushroom	K, U	1,2,3
2	Summarize raw material needed for mushroom cultivation.	U,A	1,2,3, 4,5
3	Write mechanism, significance and economic importance of mushroom cultivation.	A, An	2,3,4, 5
4	Illustrate nutritional and medicinal properties of various by-products and Extracts of mushroom and spirulina	An,A	1,2,3, 4,5
5	Outline laboratory cultivation of spirulina	An,U	2,3,5, 10
6	Evaluate various novel value-added products for profit maximization in food industry	An,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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Edible and non- edible mushroom & its cultivation**		
	1.1	Historical account of edible and non – edible mushroom, Nutritive Value of Edible Mushroom, Poisonous Mushroom	4	1
	1.2	Most commonly cultivated mushrooms in the world, Agaricus bisporous, Morphology of common Edible Mushroom, Volvariella volvacea, Pleurotus sajor-caju. Cultivation of paddy straw mushroom (Substrate, spawn Making, Bed Method, Polytene BagMethod, polytene bag method, Field cultivation.	7	1
	1.3	Cultivation of Oyster and White button Mushroom. (Substrate, spawn treatment of substrate, spawning, Maintenance of Mushroom bed, Harvesting, Diseases andstorage of mushroom	4	3
2		**Economics of mushroom cultivation**		
	2.1	Precautions in mushroom cultivation – precaution to be taken while selecting the area, spawn preparation, spawn run, during cropping, harvesting	5	2
	2.2	Mushroom and its value-added products- Mushroom western and Indian recipes, pickles, powders, jams,Cutlet, Omelets, Samosa, Pickles, Curry.etc. **Activity** Food Preparation– mushroom soup powder, mushroom biscuit, mushroom nuggets, mushroom ketchup, candy, chips etc	5	3
	2.3	Economic importance of Mushroom and their uses **Activity** Field visit to study the diversity of cultivation - Mushroom.	5	2
3		**Introduction to SCP production**		
	3.1	Definition, Advantage of SCP, Algae as SCP, Spirulina as SCP, Chlorella as SCP and its Mass production, Scenedesmus as SCP, its mass production. Bacteria as SCP, Fungi and Yeast as SCP	5	4
	3.2	Biochemical composition including proximate composition – amino acids – unsaturated fatty acids – minerals and vitamins. Human health benefits of Spirulina. Importance of light and pH	5	5

		in Spirulina cultivation – harvesting, drying and packing		
	3.3	Laboratory cultivation of Spirulina, small scale commercial production, mass cultivation (tank construction, culture medium, strain selection, scaling up of the process)	5	5,6
4		**Teacher Specific Module**		

EVALUATION ANDASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, Elearning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminar
	Semester End examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks

References:

1. Manjit Singh, Bhuvnesh vijay, Shwet kamal, GC Wakchaure (Eds.) 2011. Mushrooms- cultivation, marketing and consumption. Directorate of Mushroom research,ICAR, Chambaghat, Solan.
2. Marimuthu, T, Krishnamoorthy, AS, Sivaprakasam, K & Jayarajan, R (1991). Oyster Mushrooms. Department of Plant Pathology, Tamil Nadu AgriculturalUniversity,Coimbatore.
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4. Swaminathan, M. (1990). Food and Nutrition. Bappco, The Bangalore Printingand Publishing Co. Ltd.,Bangalore.
5. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications. NewDelhi.

Suggested Readings

1. https://blog.ffreedom.com/spirulina-cultivation/

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**REPRODUCTIVE HEALTH AND SEX EDUCATION**					
Type of Course	**VAC**					
Course Code	**MG6VACZIM300**					
Course Level	**300**					
Course Summary	This course is designed to provide students with a thorough understanding of reproductive health & sex education, covering biological, psychological & sociocultural aspects. The course aims to equip students with the knowledge and skills necessary to make informed decisions about their sexual health, foster healthy relationships & contribute to the promotion of sexual well-being in diverse communities.					
Semester	**VI**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	---	---	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarise the necessity of sex education, primary and secondary sexual characteristics, and reproductive health.	U	1,2,3,6
2	Describe teenage pregnancy, sexual harassment, sexual awareness, and policies related to adolescent sexual behaviour.	U	6
3	Appreciate the broad spectrum of sexual orientations and gender identities, equity, inclusivity, and healthy relationships.	U, Ap	7,8
4	Explain sexual health, sexually transmitted infections (STIs) and contraception methods.	U	6
5	Analyse safe sex practices, various options for reproductive choices, responsible parenthood and family planning	U, An	6,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Sexual and Reproductive Health**	**17**	
	1.1	Definition of reproductive health and sex education, Importance of comprehensive sex education	3	1
	1.2	Cultural and societal perspectives on sexuality, Ethical considerations in sex education	3	1
	1.3	Primary and secondary sexual characters and puberty, Physical and emotional changes during puberty. Neural and hormonal peculiarities of male and female brain. Role of hormones in the development of secondary sexual characters.	5	1
	1.4	Personal hygiene and self-care during adolescence, Emotional well-being, self-esteem, and body image.	3	1
	1.5	Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects)	3	2
2		**Healthy Relationships, Sexual orientations and gender identities**	**14**	
	2.1	Healthy relationships (Five Es-empathy, enthusiasm, empowerment, equality, energetics, Five As-acceptance, accommodation, appreciation, adaptability, agreement, Five Ls-love, loyalty, listening, laughter, lust, Five Ts-trust, talking, time together, tenderness, thoughtfulness), Consent, boundaries, and respect in relationships, Recognizing and respecting boundaries, sexual assault, harassment, and coercion and supporting survivors.	8	3
	2.2	Sex Determination in Humans, diverse sexual orientations and gender identities (LGBTQ), Addressing stereotypes and prejudices related to sexuality.	6	3
3		**Safe Sex, Reproductive Choices and Parenthood**	**14**	
	3.1	Importance of safe sex practices**,** Types of contraceptives (condoms, birth control pills, IUDs, Emergency contraception and its availability etc.)	3	4

	3.2	STDs and Prevention of sexually transmitted infections (STIs), Testing, treatment, and counseling for STIs	5	4
	3.3	Options for reproductive choices (parenting, adoption, abortion, surrogacy), Postpartum care and mental health.	3	5
	3.4	Responsible parenthood and family planning, Balancing career, education, and parenthood.	3	5
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, videos.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA)** **Theory Total =25 marks:** Quiz, Test Papers, assignment
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

REFERENCES

1. Czerwinski, B. S. (1992). Relationship between feminine hygiene practices, body image, and self-esteem. Texas Woman's University.
2. Frankowski, B. L., & Committee on Adolescence. (2004). Sexual orientation and adolescents. Pediatrics, 113(6), 1827-1832.
3. Goldberg, A. E. (Ed.). (2016). The SAGE encyclopedia of LGBTQ studies. SAGE publications.
4. Leon, I. (2008). Psychology of reproduction: Pregnancy, parenthood, and parental ties. Global Library of Women's Medicine.
5. Owen, R. R., & Matthews, D. (1982). Developmental and acquired disabilities in adolescence. In Adolescent Health Care (pp. 131-141). Academic Press.
6. Tortora, G. J., & Derrickson, B. H. (2018). Principles of Anatomy and Physiology. John Wiley & Sons.

SUGGESTED READING

1. SOGIE handbook
2. https://www.lausd.org/cms/lib/CA01000043/Centricity/domain/156/pdfs/SOGIE%20Handbook.pdf
3. https://www.health.ny.gov/prevention/sexual_violence/docs/sogie_handbook.pdf

Semester-VII

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOPHYSICS, INSTRUMENTATION AND DIAGNOSTIC IMAGING TECHNIQUES**					
Type of Course	**DCC A**					
Course Code	**MG7DCCZIM400**					
Course Level	**400**					
Course Summary	To understand and interpret the basics of biophysics & facilitate an understanding of the principle, design, working & applications of various instruments & imaging techniques relevant to biology and medicine.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	---	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the theoretical underpinnings of biophysics and bioenergetics.	A	2
2	Describe the concepts of radiation physics, radiation detection, & applications.	A	1
3	Compare the underlying principles, designs, and workings of different separation techniques, microscopes, analytical instruments, diagnostic imaging techniques, and electrophysiological methods.	An	2
4	Explain the utility of bio instruments and their importance in biology.	U	2
5	Apply skills in using the camera Lucida, TLC, micrometry, colorimetry, centrifuge, and pH meter.	A, S	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		**Foundation Concepts in Biophysics and Bioenergetics**	**7**	
	1.1	**Principles of Biophysics** Diffusion- Kinetics of diffusion, Fick's law and diffusion coefficient, Stoke-Einstein's law, Gibb's Donnan equilibrium, Biological importance of diffusion. Applications of diffusion process in Biology. Osmosis - osmotic concentration, osmotic pressure and osmotic gradient, Vant Hoff's laws, Electro-osmosis; Electrolyte and ionic balance in biological fluid. Biological significance of osmosis.	5	1
	1.2	**Bioenergetics** Laws of Thermodynamics, Reversible and Irreversible Thermodynamics, Entropy, Enthalpy, Gibb's Free energy, Carnot cycle, Chemical potential.	2	1
2		**Radiation Biophysics**	12	
	2.1	**Radiation Biology** Nature of radioactivity, Units of radioactivity. Interaction of radiation with matter. Ionising radiations, Cherenkov radiations. Radioactive isotopes. Radiation dosimetry. Biological effects of radiation.	3	2
	2.2	**Radiation detection** Ionization chamber, Liquid scintillation counter, Geiger-Muller (GM) counter, Semiconductor detectors	3	2
	2.3	**Applications :** Diagnosis and Radiotherapy, Radioimmunoassay, Autoradiography, Radio tracer techniques, Nuclear Medicine.	2	2
	2.4	**Radio-Ultrasound Imaging Techniques for diagnosis**: X-ray radiography**,** Angiography, PET, MRI, fMRI, CAT, Ultrasound Imaging.	4	3

3		**Instrumentation**	26	
	3.1	**Microscopy:** Light microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy, Electron Microscopy- Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), STEM, Specimen preparation- shadow casting, Freeze fracturing, Freeze etching. Electron Cryo-Microscopy. Micrometry and Camera Lucida	5	3,4
	3.2	**Separation Techniques** Centrifuge- Principle and applications, high-speed centrifuge, Density gradient centrifuge, Ultracentrifuge, Decanter centrifuge. Chromatography-Principle and applications, Column Chromatography, Ion exchange chromatography, HPLC, Gas Chromatography. Electrophoresis- Principle and applications, Gel electrophoresis-SDS PAGE, 2D Gel electrophoresis, Disc electrophoresis, Agarose Electrophoresis, High voltage electrophoresis, Capillary electrophoresis, Electrophoretic mobility shift assay (EMSA), Isoelectric focusing. BRIEF ACCOUNT ONLY	8	3,4
	3.3	**Analytical Instrumentation** Colorimetry & Spectrophotometry. Beer-Lambert's Law Spectroscopy- Raman Spectroscopy, Circular Dichroism, Fourier Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR) Spectroscopy Electron Spin Resonance (ESR) Spectroscopy, Mass Spectroscopy-MALDI-TOF, LCMS, Tandem Mass pH Meter, Flow Cytometry	10	3,4
	3.4	**Electrophysiological methods** Single neuron recording, Patch-clamp recording, Tread mill test, Application of Deep Brain Stimulator and Pacemaker	3	3,4
4		**PRACTICALS**	30	
		1. Micrometry- Principle and measurement of microscopic objects. 2. Camera Lucida- Drawing of specimens using Camera Lucida 3. TLC using amino acids and calculation of RF values 4. Identification of absorption maxima of given		5

		sample by colorimetry 5. Determine the pH of two prepared buffer samples 6. Separation of Casein from milk using centrifugation **7.** Demonstration/Institutional Visit for understanding the instrumentation and working of any three Techniques from Microscopy/ Spectroscopy/ Electrophoresis/Flow Cytometry/ Imaging Techniques and submit the report		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Group Discussion, Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz, Test Papers, Seminar **Practical Total = 15 marks** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration 2 hrs** **Record 10 marks, Examination - 25 marks:** TLC/Micrometry – 15 marks Camera lucida/determination of pH/Casein separation – 4 marks Spotter identification (instruments) any 2 – 6 marks

REFERENCES

1. Agarwal, L. (2019). *Concise Textbook of Basic Radiography*. Jaipur: JBD Publications.
2. Alonso, A. And Arrondo, J.L.R. (2006). *Advanced techniques in Biophysics*: Heidelberg: Springer Verla.
3. Cotterill, R. (2003). *Biophysics: An Introduction*. Hoboken: John Wiley and Sons.

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9. Levine, I.N. (2009). *Physical Chemistry*. New York: Tata McGraw-Hill.
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11. Nicholis, D.G. and Ferguson, S.J. (1992). *Bioenergetics*. New York: Academic Press.
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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOSTATISTICS & RESEARCH METHODOLOGY**					
Type of Course	**DCC A**					
Course Code	**MG7DCCZIM401**					
Course Level	**400**					
Course Summary	**Introduce students to key concepts in designing and conducting scientific studies. Modules include understanding the research process, exploring study designs, and learning data collection techniques. Students delve into descriptive and inferential statistics, with a focus on applying these principles in Biology related research. Practical skills are honed through hands-on experience with statistical software, and the course concludes with sessions on reporting findings & critically appraising research.**					
Semester	**VII**	**Credits**			**4**	**Total Hours**
Course Details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4	**---**	**---**	**---**	**60**
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the basic concepts of biostatistics and research methodology.	**U**	**2 ,3**
2	Demonstrate skills to collect, organise, and present data for biological research.	**S, I**	**2**
3	Analyse biological data using appropriate statistical methods and software.	**An**	**1,2**
4	Demonstrate skills in scientific documentation and communication.	**A**	**2,4**
5	Test hypotheses in biological research with appropriate statistical tools and interpret the derived information to aid in the decision-making process.	**S, C, 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		**Overview of Biostatistics and Descriptive Statistics**	**15**	
	1.1	Scope and application in life sciences. Steps in Statistical Investigation. Meta analysis. Data and Variable (Types, Sources). Data collection methods: Census and Sampling techniques, Sampling Errors. Organization of Data - Tabulation, Types, and characteristics of a Frequency table. Presentation of Data - Graphs and Diagrams.	**4**	**1,2**
	1.2	Measures of central tendency: mean, median, mode. Corrected mean.	**5**	**3**
	1.3	Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation. Corrected standard deviation. Skewness and kurtosis.	**6**	**3**
		ACTIVITY: 1. Preparation of frequency distribution table from raw data 2. Problems related to mean, median and mode (Individual, discrete and continuous series) 3. Problems related to range, Quartile deviation, mean deviation and standard deviation (Individual, discrete and continuous series) 4. Preparation of bar diagrams, pie diagram, line graph, frequency polygon, frequency curve, histogram and ogives. Computation of mean, standard deviation, correlation, regression equation, 't' test, ANOVA (Using MS Excel or any other package) **Note:** Use Clinical/Biological data for the problems		
2		**Correlation, Regression, Probability, Statistical Inference & Statistical Software**	**25**	
	2.1	**Correlation Analysis: Types and methods of correlation analysis, Karl Pearson's correlation coefficient.**	**5**	**5**

	2.2	**Regression analysis: Graphic methods - Scatter method, Line of best fit; Algebraic method- Regression equations. Relationship between correlation and regression**	**6**	**5**
	2.3	Classical definition of probability. Addition and multiplication theorems. **Probability distributions: Binomial and Normal distribution.**	**5**	**5**
	2.4	Testing of hypothesis - null and alternative hypothesis, test statistic, type-I and type-II errors, critical region, level of significance, p-value. Parametric Tests: t-test, Z test, ANOVA (one way). Non-parametric Test - Chi-square test.	**7**	**5**
	2.5	Statistical Software: SPSS, R, PRIMER (Brief account only)	**2**	**3,5**
		ACTIVITY: 1. Calculation and interpretation of corrected mean and corrected standard deviation 2. Calculation and interpretation of Pearson correlation coefficient. 3. Calculation and interpretation of regression equation (x on y & y on x) 4. Calculation and interpretation of Chi square test (2×2 table only) 5. Calculation and interpretation of 't' test 6. Calculation and interpretation of one-way ANOVA		
3		**Research: Types, Design , Literature review and Ethics in Research**	**8**	
	3.1	Types of Research – Deductive/Inductive, Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical. Defining and formulating the research problem.	**2**	**1**
	3.2	Research Design: Basic principles, Significance and features of good design. Types of research designs.	**2**	**1**
	3.3	Literature review - Importance of literature review in defining a problem, Critical literature review.	**2**	**1**
	3.4	Ethics in research - Plagiarism, Plagiarism checking software - Turnitin, Viper, Urkund. Citation and Acknowledgement	**2**	**1**
4		**Scientific Documentation and Communication**	**12**	
	4.1	Structure and components of Scientific Report. Types of Report – Technical Reports and Thesis/dissertations.	**3**	**4**

	4.2	Preparation of Project Proposal to Project funding agencies. Preparing Research papers for journals, Seminars and Conferences. SCOPUS, Web of Science, Impact factor, Citation Index, h-index. DOI. ISBN & ISSN.	**5**	**4**
	4.3	Conventions and strategies of authentication – Citation styles, bibliography, referencing and foot notes. Software for managing bibliographies – EndNote, Mendley. Global Information System – BIOSIS, Medline and Medlars, AGRIS, PubMed, Google Scholar.	**3**	**4**
		ACTIVITY: 1. Publish a scientific paper in any peer reviewed journal/ publish a book chapter / present a paper (Oral/Poster) in a seminar. (Any one compulsory) 2. Review a scientific article in Biology and submit the report 3. Prepare bibliography in APA format from the given details of a published scientific paper		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction) Lecturing, problem solving, writing a review of any published article. Preparing a sample project proposal.**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 30 marks** Quiz, Test Papers, Problems from module 1 &2, Activity from module 4
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs.** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks **Fill in the blanks 10x1 =10 marks**

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ADVANCED GENETICS**					
Type of Course	**DCC A**					
Course Code	**MG7DCCZIM402**					
Course Level	**400**					
Course Summary	The course is designed for students with a solid foundation in basic genetics who seek a deeper understanding of advanced topics and their practical applications. The course aims to prepare students for advanced studies or careers in research, healthcare, biotechnology, and related fields by providing a comprehensive understanding of the latest advancements in genetics.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the molecular organization of the chromosome, linkage, recombination, and transposons.	K	2
2	Explain the role of chromatin remodeling complexes in modulating gene expression through epigenetic changes.	U	2
3	Describe the latest developments and advancements in the field of cytogenetics.	U	1
4	Explain the genetic basis of familial cancer and the implications for risk assessment and genetic counselling.	U	3
5	Analyze the ethical implications of HGP, GM crops, personal DNA data, and gene therapy.	An	2,6,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Molecular organization of Chromosome, Linkage, Recombination & Transposons**	**20**	
	1.1	Genome size and c-value Paradox. Molecular structure of centromere and telomere, telomere shortening and aging process, Repetitive nucleotide sequences in eukaryotic genomes - mini and micro satellites.	5	1
	1.2	**Linkage and recombination:** Crossing over as the physical basis of recombination, Molecular mechanisms of recombination (Holliday model), Recombination mapping with two-point and three - point test cross in *Drosophila*, Coincidence and Interference. Mitotic recombination, Genetic recombination in Phage, complementation test, deletion mapping, conjugation mapping.	10	
	1.3	**Transposable genetic elements:** Transposons in prokaryotes (IS elements, composite elements - Tn10, non-composite elements - Tn3) and eukaryotes (DNA transposons, Retrotransposons - SINE and LINE, Ac/Ds elements in maize).	5	
2		**A. Epigenetics & B. Cytogenetic techniques**	**15**	
	2.1	**A. Chromatin modifications and their mechanism of action:** Histone code hypothesis, Modification of histone proteins - acetylation, phosphorylation, methylation, ubiquitylation, SUMOylation, Chromatin remodeling, Genomic imprinting.	6	2, 3
	2.2	**Epigenetics in *Drosophila*:** Position effect variegation (PEV) and Polycomb Group Genes (PcG) in *Drosophila* model	3	
	2.3	**B. Cytogenetic techniques** Karyotyping - G-banding, C-banding, R-banding Sex chromatin analysis (buccal mucosa, hair bud) and COMET assay.	3	
	2.4	FISH (Fluorescent In-situ Hybridization), CGH (Comparative genomic hybridization), aCGH (Array comparative genomic hybridization)	3	
3		**Cancer Genetics**	**15**	
	3.1	Oncogenes, tumour suppressor genes, DNA repair genes and genetic instability, epigenetic & Post translational modifications.	5	4

	3.2	Role of proto-oncogenes in regulating cell growth and survival, mechanisms of activation of oncogenes, Cell cycle and Cancer.	3	
	3.3	**Familial cancers** (Retinoblastoma, Colorectal cancer and Breast cancer), Biomarkers and Cancer therapy: at cellular, gene and protein level. Chemotherapeutics for cancer, Advance therapies in cancer, Monoclonal antibody therapies for cancer.	7	
4		**Genetics and Society**	**10**	
	4.1	**Pedigree:** Analysis of Pedigree charts for different inheritance patterns, Consanguinity and its effects in the pedigree pattern.	2	4,5
	4.2	**Genetic counseling:** Components of genetic counseling - Physical examination, Patterns of inheritance, risk assessment and counseling, Indications for chromosomal testing.	4	
	4.3	**Human Genome Project (HGP):** Sequencing of the Human Genome, promises and achievements, ethical, legal, and social issues of the HGP. Areas of concerns in modern genetics (GM crops, personal DNA data, Gene Therapy)	4	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing with ICT , Assignments/ Seminar, Group discussion/ Presentation.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, seminar, Assignment
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ECONOMIC ENTOMOLOGY**					
Type of Course	**DCE A**					
Course Code	**MG7DCEZIM400**					
Course Level	**400**					
Course Summary	Economic Entomology is a specialised field of study that focuses on the economic impact of insects on agriculture, forestry, and other human activities. This course typically covers a wide range of topics related to insect biology, ecology, and management strategies to mitigate their economic impact.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify major insect pests and beneficial insects that are economically significant in agriculture, forestry, and urban settings.	K	1
2	Explain the life cycles, behaviour, and ecology of key insect pests and beneficial insects.	U	2
3	Describe the principles and practices of IPM.	An	3
4	Explain emerging trends and issues in forensic, medical, and industrial entomology.	I	9
5	Demonstrate skills to analyse complex pest management problems and propose practical solutions.	C, S	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		**Insects as pests**	**15**	
	1.1	Kinds of insect pests - Major pests, minor pests, sporadic pests, endemic pests, exotic pests, seasonal pests, occasional pests, regular pests, persistent pests. Causes of pest outbreak- deforestation, destruction of natural enemies, pest resurgence, secondary pest outbreak, intensive and extensive cultivation, introduction to new crops, hybrid varieties, introduction to new pests.	5	1
	1.2	Damages caused by selected insect pests and their management. (i) **Pests of Crops:** 1. Coconut Pests - *Oryctes rhinoceros* and *Rhyncophorus ferrugineus* 2. Paddy Pests - *Leptocorisa acuta* and *Spodoptera mauritia*. (ii) **Stored grain pests** - *Trogoderma granarium* and *Tribolium castaneum* (iii) **Pests of vegetables -** 1. Brinjal: *Leucinodes orbonalis* and *Euzophera perticella,* 2. Gourds: *Bactrocera cucurbitae* and *Anadevidia peponis*. (iv) **Pests of fruits:** 1. Citrus fruits - Citrus leaf miner (*Phyllocnistis citrella*) and Citrus psylla (*Diaphorina citri*) *2.* Banana Pests - *Cosmopolites sordidus* and *Pentalonia nigronervosa* 3. Mango Pests - Stem borer (*Batocera rufomaculata*) and Scale insect (*Chloropulvinaria polygonata, Aspidiotus destructor*) **ACTIVITY** 1. Insect collection and preservation: Collection and submission of insect pests of crops and vegetables and prepare an Insect Pest Box. 2. Collect & submit different pests of stored grains from the local provision shops or houses and prepare a power point presentation	10	1, 5

2		**Control of insect pests**	**15**	
	2.1	**Integrated pest management (IPM)** What is IPM? Need for IPM. Planning of IPM, Different techniques used in IPM;, Few examples and advantages of IPM. (Pest surveillance-Forecasting pest outbreaks and surveillance, short term and long-term forecasting, legal/Regulatory practices, cultural, physical, Mechanical, genetic, biological and chemical control)	3	3
	2.2	**Chemical Control:** i. Broad classification of insecticides. Inorganic insecticides (Arsenicals, Lime Sulphur, Mercury compounds, Fluorine compounds) , Fumigants (Para dichlorobenzene, Methyl bromide, Hydrogen cyanide) ii. Natural organics – oils, insecticides of plant origin (Pyrethrins, Nicotine, Azadiractin) Synthetic Organics – Chlorinated Hydrocarbons (BHC, Methoxychlor) Organophosphate (Malathion, Parathion, Dicrotophos, clorpyriphos) Carbamates (Carbaryl, Propoxur) and Pyrethroids (Allethrin, Cypermethrin). iii. Advantages and disadvantages of chemical control.	7	5
	2.3	i. **Biological control** by [predators, parasites and microbes (Bacteria, viruses), fungi, Nematodes]; Biological control Strategies - Introduction, Augmentation and Conservation ii. Use of Hormones and Pheromones. iii. Autocidal control - Sterile male technique, male confusion technique, genetic technique	5	5
3		**Beneficial Insects**	**15**	
	3.1	**Industrial Entomology:** Apiculture & Sericulture. Lac insects and Black Soldier Flies **ACTIVITY**: Set up a waste management unit involving Black Soldier Fly and submit report with geotagged photos.	8	4
	3.2	Importance of insect Pollinators with example- honey bee, wasp, butterfly Edible insects & human nutrition	2	4
	3.3	**Forensic Entomology**: Brief mention of Common insects of Forensic importance - Order Diptera-Calliphoridae, Sarcophagidae & Muscidae Order Coleoptera - Staphylinidae, Histeridae, Silphidae, Dermestidae & Cleridae	3	4

		Steps involved: i) Collection of entomological evidence during a death investigation. ii) Temperature and climatic records, iii) collection, preservation and handling of insects/maggots from the crime scene. iv) Analysis of entomological evidence and estimating PMI (Post Mortem Index) using Maggot age and Insect succession.		
4		**Medical Entomology**:	**15**	
	4.1	Pests of man and their management: Mosquitoes- *Anopheles, Culex, Aedes*, houseflies, bed bugs, head lice, house dust mites. Diseases caused by insects.	8	1,4
	4.2	Pests of domestic animals and their management: cattle, poultry, pet animals:- (bird louse, *Hypoderma*, screwworms, *Gasterophilus*) Diseases caused.	7	1,4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lectures, virtual tours to observe and identify insect pests.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Viva, Test Papers, Submission of pest box, Submission of report with geotagged photo of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks; Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks.

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	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**LIVESTOCK AND POULTRY MANAGEMENT**					
Type of Course	**DCE A**					
Course Code	**MG7DCEZIM401**					
Course Level	**400**					
Course Summary	Livestock & Poultry Management focus on the basic techniques for rearing Cattle, Goat, Pig and Rabbit and poultry. Its emphasis on the shelter breeding, feeding and management of livestock and poultry.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practicum	Others	
		4	---	--	---	60
Prerequisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Identify common breeds and diseases of rabbits, pigs, Indian goat poultry, quail, and ducks.	U	1,2
2	Differentiate the housing and nutritional requirements of rabbits, pigs, Indian goats, poultry, quail, and ducks.	A	1, 2,3
3	Select breeding stock for livestock, poultry, quail, and duck.	A	1, 2
4	Demonstrate skills in cuniculture, poultry, quail, duck, piggery, and dairy farming.	C	1, 2, 3, 6
5	Create health care plans for rabbits, pigs, poultry, quail, Indian goats, and ducks in order to prevent diseases.	C	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		**Poultry Husbandry**	**15**	
	1.1	Introduction, Morphology of chick. Poultry breeds in India, Broilers and layers, Poultry Housing and Equipment. Poultry feed and its composition, mixing of feeds, different mills used (Hammer, mixture, pellet); premix preparation, raw materials, feed mill operation). Importance of egg production, Nutritive value of eggs and meat. Diseases and their control.	7	1, 2, 3,4, 5
	1.2	Quail farming (Coturnix coturnix) Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs. Health care, use of quail egg and meat. Sources of quality chicks.	5	1, 2, 3,4, 5
	1.3	Duck farming Husbandry of ducks – Breeds in India, Advantages of duck rearing. Housing, feeding and management of ducks.	3	1, 2, 3,4, 5
2		**Dairy farming**	**19**	
	2.1	Definition and importance of cattle farming, Breeds of cattle.	3	1,3
	2.2	Housing for dairy cattle, Management of cross breed cows, Health management, Milk production	8	2,3,4, 5
	2.3	Introduction and Breeds of Indian Goat. Medicinal importance of goat milk. Avoidance of goatery odour in milk.	2	1,4
	2.4	Breeding Management- Fitness of purchase for first breeding – methods of detection of heat – Natural Service and artificial insemination – Care of the pregnant Animals – Breeding stock –Use of teaser – Culling.	3	3,4
	2.5	Feeding Management- Feeding habits of Goats, Nutritional requirement of goat, Housing, care of kids.	1	2

	2.6	Health Management- Management in the prevention and control of diseases, Deworming, Dipping, and spraying.	2	5
3		**Piggery (Pig Farming)**	**11**	
	3.1	**Piggery** : Piggery development in India, Breeds of Pigs, Advantages and disadvantages of swine keeping. Selection of quality adults, mechanism of reproduction, and management.	5	1,3
	3.2	Housing and Feeding Sanitation and hygiene of Pigs, Nutrition and Digestion in pigs.	4	2
	3.3	Diseases and prevention	2	5
4		**Cuniculture**	**15**	
	4.1	**Cuniculture** : Breeds of Rabbit: Common Breeds of rabbits (For wool production: Angora: For meat/Fur skin production (New Zealand white, White Californian, Soviet Chinchilla) For fancy/hobby purposes (Polish, Palmino, Havana, Beveren, New Zealand, Red, English Spot white, Dutch) Importance of rabbit for meat and fur production.	7	1
	4.2	**Rabbit production - Housing and Breeding** :	5	2,3,4,
	4.3	Health care and Management of young rabbits, managing broiler rabbits, managing wool rabbits, Feeding of rabbits.		5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos, Farm visits..
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, Seminar, Assignment
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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MAHATMA GANDHI UNIVERSITY
KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**AQUAFARMING**					
Type of Course	**DCE A**					
Course Code	**MG7DCEZIM402**					
Course Level	**400**					
Course Summary	Course will help the students to understand the various aspects of Aqua farming					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	---	-----	-----	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the different aquaculture systems.	U	2
2	Demonstrate skills in advanced aquaculture technologies, aquarium management, breeding of ornamental fish, seed production of common cultivable species, and aquaponics.	U, S	2
3	Explain nutritional requirements and the processing and preservation of farming products.	A	2
4	Analyse the symptoms, diagnosis, and prevention/control of aquatic animal diseases.	An	2
5	Explain the effects of aquaculture methods on the environment.	A	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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Aquaculture**	**18**	
	1.1	Definition, scope, importance & types. Fin fish & shellfish culture. Different aquaculture systems: Pond, embankment pond, cage, pen, running water/race ways, extensive, intensive and semi-intensive culture systems, Integrated Multi trophic Aquaculture (IMTA)	3	1
	1.2	Pond preparation & management (Soil & Water quality management), Breeding & nursery rearing. Hatchery management. Prawn culture. Mussel culture - raft, pole.	10	1,2
	1.3	Nutritional requirements, Probiotics used in aquafarming. Types of feed, Methods and techniques involved in the formulation of fish feed. Processing & preservation of farming products **ACTIVITY** 1. Identify live fish food organisms & culture any one organism. 2. Survey of different feeds used in different hatcheries.	5	3
2		**Aquarium management, Integrated farming & Aquaponics**	**14**	
	2.1	Aquarium - water quality management, biological filter & aeration. Breeding of ornamental fishes - Angel, Gourami, Fighter and Guppy (live bearer), rearing, brood-stock management & transport	7	2
	2.2	Integrated farming: Fish-cum-livestock/poultry farming, paddy-cum-fish farming, Sewage-fed fish culture	5	1
	2.3	Aquaponic systems **ACTIVITY** Construct aquaponics systems at home & report submission (attach Geo-tagged photos)	2	2

3		**Advanced technologies and Health management practices in aquaculture**	**15**	
	3.1	Recirculating Aquaculture System (RAS) for the sustainable development of Aquaculture	3	2
	3.2	Monosex culture or Neo-female technology, GIFT (Genetic Improvement of Farmed Tilapia), Biofloc Technology	4	2
	3.3	Bio security & quarantine.	2	4
	3.4	Diseases (Viral, bacterial, fungal & parasitic) of fin fish & shellfish, treatment & prophylactic measures	5	4
	3.5	Predators **ACTIVITY** A survey of nearby aquaculture systems and report different diseases/parasites observed from farm	1	4
4		**Environmental impact of Aquaculture**	**13**	
	4.1	**Positive**: Utilization of waste from other farming systems in aquaculture Utilization of derelict water bodies for aquaculture. Weed control	3	5
	4.2	**Negative**: Environmental consequences related to hyper-nutrification, leaching of chemicals/ drugs into the environment, misuse of productive land. Introduction of exotic pathogens / diseases into the environment through indiscriminate/clandestine movement of fish seeds Remedial measures	5	5
	4.3	Aquacultural wastes and new developments in waste minimization. Enforcement of rules & regulations for sustainable aquaculture	5	4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Classroom, videos of reputed farmers/institutions/processing units, success stories of aqua farmers.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total=30 marks -** Quiz, Test Papers, one activity from module 1, report submission of activity from module 3
	B. End Semester Examination **Theory Total 70 marks, Duration - 2 hrs** Short Essays 8 out of 10 x4=32 marks; Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**SOLID WASTE MANAGEMENT**					
Type of Course	**DCE A**					
Course Code	**MG7DCEZIM403**					
Course Level	**400**					
Course Summary	Principles, practices, and challenges associated with the management of solid waste, generation, collection, transportation, treatment, disposal, recycling and the environmental and public health implications of improper waste management, and the regulatory frameworks governing waste disposal. Students explore the importance of adopting sustainable waste management practices to minimize environmental pollution, conserve natural resources, and promote public health. They also examine the social, economic, and cultural factors influencing waste generation and management decisions.					
Semester	**VII**	**Credits**			**4**	**Total Hours**
Course Details	**Learning Approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		4	**--**	**--**	**--**	**60**
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the types, sources, composition, and characteristics of solid waste, including hazardous and non-hazardous materials.	**U**	**2,3**
2	Describe waste management techniques, including waste reduction, recycling, composting, and landfill management, and the benefits and limitations of each approach.	**U**	**2,3**

3	Demonstrate skills in composting and thermal conversion methods.	**A,S**	**2**
4	Acquire skills in developing comprehensive and sustainable waste management plans tailored to specific contexts, considering factors such as waste generation rates, local regulations, community needs, and available resources.	**A,S**	**2,8**
5	Analyse landfill design, construction, operation, and closure procedures to determine their environmental impacts and propose mitigation measures for environmental sustainability.	**An**	**1,8**
***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**			

Course Contents

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction**	**15**	
	1.1	Definition, overview of solid waste management, types of solid wastes, sources of solid wastes, properties of solid wastes, Factors affecting the type and quality of waste, causes of solid waste generation, associated risks of solid wastes, Physical and chemical composition of municipal solid waste, hierarchy of waste management options.		1,4
2		**Solid waste management**	15	
	2.1	Key components of solid waste management, Generation, storage (containers), collection, transportation (human powered, animal powered and motorized) and disposal (Landfills, composting, incineration and pyrolysis), Recycling and resource recovery. Lay out of routes. Methods of handling and processing of solid wastes: separation, screening, size reduction, densification, baling, cubing, compaction, and pelleting.		2
3		**Landfilling**	**15**	

	3.1	Site selection criteria, landfill layout, landfill sections, Occurrence of gases and leachate in landfills: composition and characteristics, generation factors, initial adjustment phase, transition phase, acid formation phase, methane formation phase, maturation phase of gases and leachate, advantages and disadvantages.		5
4		**Composting and thermal conversion methods**	**15**	
	3.1	Composting: definition, types, process description, design and operational consideration of aerobic composting; process description, design and operational consideration of anaerobic composting. Vermicomposting: species of earthworms used. Black soldier flies for waste decomposition, Thermal conversion methods: incineration/combustion, pyrolysis and gasification, energy recovery system. **ACTIVITY**: Prepare a vermicomposting unit and submit report along with geo-tagged photos		3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 30 marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 10 x4 =32 marks Short questions 14 out of 16 x2 =28 marks Fill in the blanks 10x1 =10 marks

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Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**FOOD PROCESSING, PRESERVATION & PACKAGING TECHNOLOGY**					
Type of Course	**DCE B**					
Course Code	**MG7DCEZIM404**					
Course level	**400**					
Course Summary	Food processing transforms raw ingredients into food or other intermediateproducts, and preservation is the process of handling and treating food to control its spoilage by stopping the attack and growth of food borne diseases causing microbes, avoiding oxidation of fats (rancidity), and maintaining thenutritional quality.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline a deep coverage on processing of fruits and vegetables.	U ,K	1,2,3
2	Discuss an exhaustible coverage on all major aspects offood preservation.	K,U	1,2,3,4,5
3	Explain various and advanced packaging technology usedin food industry and determine the importance of various processing techniques used in the field of food science	A,An	1,2,3,4,5
4	Illustrate mechanism involved in aseptic packaging of food	A,An	2,3,4,5,10
5	Evaluate structure and chemical characteristics of additives added to the food	An,E	2,3,4,5,10
6	Justify various methods to detect adulterant present In food	An,E	2,3,4,5,10
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		**Processing of fruits and vegetables**		
	1.1	Peeling (knife peeling, lye peeling, flash steam peeling, abrasion peeling and flame peeling), Slicing / dicing.	4	1
	1.2	Blanching – factors influencing blanching, method of blanching (hot water blanching, steam blanching individual quick blanching blanching with hot water and steam system, vacuum steam blanching in can blanching, microwave blanching and bio gas blanching) and nutritional quality of blanched food.	7	1
	1.3	Canning - Definition, history, principle, canning of fruits and Vegetables, Steps involved. Retention of canned fruits and Vegetables	4	1
2		**Types of Preservation**		
	2.1	Pasteurization, Types, Water bath pasteurization, continuous steam or water spray pasteurization, long hold or vat pasteurization, High temperature short time pasteurizers, ultra-high temperature pasteurizers, Thermal death time relationship: D value, F value and Z value, 12D concept.	6	2
	2.2	Preservation at low temperature Refrigeration: Principles of refrigeration, mechanism of refrigeration, Change occurring during refrigeration. Chilling injury Freezing process: principlesof freezing, freezing methods: direct contact systems and Indirectcontact systems. Cryogenic freezing, freeze drying,	5	2
	2.3	Preservation by Removal of Moisture Drying-Classification of drying. Drying curve, factors affecting drying, Thermal drying of foods: Air drying and Low air environment drying.	4	2
3		**Introduction to Packaging Technology**		
	3.1	Packaging: Primary, secondary and tertiary packaging of foods. Paper board, packaging. Shear strength and compression properties of corrugated cartons, Transportation tests and stacking tests. Packaging materials: tin, tin free steel, aluminum, glass, thermoforming & thermosetting plastics, paper and metal laminations. Packaging material used for dairy products, baked goods, dehydrated foods & fruit juices.	8	3

	3.2	Microwave oven safe packaging (susceptron). Aseptic packaging of foods and the developing technology. Tests for packaging. Migration, retorting, Active Packaging, intelligent, shrink and stretch packaging MAP and CAP packaging. Biodegradable packaging materials: their advantages and disadvantages.	7	4
4		**Food additives & Food Adulteration**		
	4.1	Functionality of food additives, Objectives of additives. Natural and synthetic additives. Health and safety aspects of food additives. Generally Recognized As Safe (GRAS) and Acceptable Daily Intake	6	3
	4.2	Additive numbering system; Permitted food colours- natural and artificial. Food flavours – natural and artificial. Sweeteners- natural and artificial. Antimicrobials, Antistaling agent, clouding agents, Curing agents, Clarifiers, Emulsifiers, Fat replacers, Gelling agents, Leavening agents, Stabilizers, tenderizers, thickeners, antioxidants, chelating agents, flavor enhancers		
	4.3	Food adulteration: definition, methods of adulteration, methods of detection		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -30 Marks -** Quiz/Test Paper/Seminars
	End Semester Examination **Theory Total -70 Marks Duration -1.5 hrs** Short Essay 8 out of 10 x 4 = 32 Marks Short Questions 14 out of 16 x 2 = 28 Marks Fill in the blanks 10x1 = 10 Marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**GENETICS AND GENETIC COUNSELING**					
Type of Course	**DCE B**					
Course Code	**MG7DCEZIM405**					
Course Level	**400**					
Course summary	This course covers the foundational aspects of Genetics, offering a comprehensive understanding of inheritance, molecular mechanisms,genetic variation, and their practical applications.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre- requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Discuss Mendelian principles of inheritance and gene interactions; apply these to predict the outcome of genetic Crosses	U, A, An	1,2,3
2.	Understand and analyze genetic recombination, linkage and sex determination, and solve problems related to these phenomena.	U, An	1, 2, 3,4,5
3.	Distinguish characteristic features of physical and chemical mutagens	A,An	2,3,,4, 5
4.	Evaluate the mechanism of mutation and generate awareness about the impact of various chemicals and drugs used in day- to-day life	E, A	1,2,3, 4,5,10
5.	Comprehend the scope of human genome project, genetic counseling and genetic screening	U, An	2,3,4, 5.10
6.	Evaluate and familiarize with genetic diseases and analyze their pattern of inheritance	An,E	3,,4,5, 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		**Introduction to Genetics**		
	1.1	Mendel's Experiments- Monohybrid cross, dihybrid cross tes cross, back cross, reciprocal cross, Homozygous heterozygous Phenotype, Genotype, Dominant, Recessive gene& Alleles Principle of Dominance, Principle of segregation, Principle of Independent assortment.		1
	1.2	**I**ncomplete dominance, Co-dominance, Complementary, Supplementary genes, epistasis, Polygenes, pleiotropism, Lethal genes. Multiple allelism - ABO Bloodgroup system, Rh group and its inheritance in human, Erythroblastosis fetalis. Pseudo autosomal genes, sex-limited, sex-influenced, sex-linked genes and holandric genes. Mitochondrial inheritance (Brief account only).	7	1
	1.3	Linkage and recombination of genes based on Morgan's work in Drosophila (Complete and incomplete linkage).Recombination mapping using two point test cross.	3	2
2		**Sex Determination& Mutation**		
	2.1	**Basics of sex determination:** Chromosome theory of sex determination (sex chromosomes And autosomes), Chromosomal mechanism (XX-XO,XX-XY, ZW-ZZ). Genic balance theory. Sex determination in Honey bees, Drosophila (Intersex) and Man. Hormonal influence & Environmental influence on sex determination.	5	2
	2.2	Barr bodies, Dosage compensation and Lyon hypothesis, gynandromorphs, sex mosaics, Hermaphroditism- Freemartin		2
	2.3	Mutation, Types of Mutation, Transition, Transversion, Frame shift, Silent, Missense & Nonsense Mutation, Induced Mutation, Physical and chemical Mutagens, Spontaneous Mutations.	6	3.4
3		**Human Genome project, Genetic counseling & Geneticscreening**		
	3.1	The genome project- history, organization and goals of human genome project; mapping strategies, current status of various maps; human genome diversity; Organization of human genome. Mitochondrial genome, gross base composition of nuclear genome, gene density.	3	5

	3.2	Scope of genetic counseling- methods of genetic counseling educating the counselee, presenting the risks and options and guiding. Social, ethical and legal issues. Patterns of inheritanceand risk assessment, chromosomal disorders autosoma dominant and recessive disorders, X- linked disorders, multifactorial-polygenic disorders. Reproductive failures, consanguinity	8	5
	3.3	Scope of genetic screening- Prenatal Amniocentesis Chronic Villous sampling, Ultrasonography, fetoscopy maternal blood sampling) and Post natal screening (chromosoma abnormalities, cytogenetic disorders and molecular methods). Population screening for genetic diseases, family screening.	4	4
4		**Genetic Disorders**		
	4.1	Nucleus & chromosome structure, Nucleosomes, Giantchromosomes (Polyteneand Lamp brush chromosomes), Karyotyping -Normal human chromosome complement	5	5
	4.2	Human chromosomal anomalies: Autosomal (Down syndrome, Edward's syndrome and Cri du chat syndrome).Sexchromosomal anomalies (Klinefelter syndrome, and Turners syndrome), Single gene disorders - Sickle cell anemia, cystic fibrosis, Tay Sachs disease	5	5
	4.3	Inborn errors of metabolism: Genetic basis of Phenylketonuria, Albinism. Alkaptonuria Multifactorial disorders - Cleft lip and cleft palate.Pedigree Analysis (Brief account only) – Pedigree symbols and construction of Pedigree	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching & Learning Approach	**Classroom Procedure (Mode of transaction):** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion,Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -30 Marks:** Quiz/Test Paper/Seminars
	End Semester Examination **Theory Total -70 Marks Duration -1.5 hrs** Short Essay 8 out of 10 x 4 =32 Marks Short Questions 14 out of 16 x 2 =28 Marks Fill in the blanks 10x1 = 10 Marks

References

1. Gupta, P.K. (2010). Cytogenetics. Rastogi Publications, Meerut, India
2. Hartl, L.D. and E.W.Jones. (2009). Genetics: Analysis of Genes and Genomes (7thedn)Jonesand Barlett Publishers Inc, USA.
3. Klug, W.S and Cummings, M.R. (2011). Concepts of Genetics (7th edn). PearsonEducation Inc.India.
4. Pierce, B. A. (2012). Genetics: a conceptual approach. Macmillan publication.
5. Roberts, K., Alberts, B., Johnson, A., Walter, P., & Hunt, T. (2002). Molecular biology ofthecell.New York: Garland Science.
6. Shirly, A.O., Sampath Kumar S., and Jinsu Varghese (Editors). (2012). GenetoGenome. Zoological Society of Kerala, Kottayam.
7. Singh, B. D. (2022). Fundamentals of Genetics (6th edn). Kalyani Publishers, New Delhi.
8. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons
9. Thomas, A. P (Editor), (2012). Genetics and Biotechnology- The Fundamentals. GreenLeaf Publications, TIES, Kottayam.
10. Vijayakumaran, N. K. (2017). Cell Biology, Genetics and Molecular Biology.Academica, Trivandrum.

Suggested Reading

1. Benjamin, L. (2004). Gene VIII. Oxford University Press

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**INTERMEDIARY METABOLISM**					
Type of Course	**DCE B**					
Course Code	**MG7DCEZIM406**					
Course Level	**400**					
Course Summary	This course aims to foster a profound comprehension of the biochemical mechanisms underlying energy production and utilization in living organisms. It encompasses intake, utilization, transport, breakdown and formation of different biomolecules which themselves are interconnected to each other through a complex metabolic web.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Summaries fundamental concepts of bioenergetics & metabolism	U, E	1,2,3
2	Describe various pathways involved in carbohydrate metabolism andits regulatory mechanisms	K, U, An	1,2,3, 4
3	Investigate how lipids are synthesized & metabolized to generate energy	U, An, E	1,2,3, 4,5
4	Describe the pathways of amino acid and nucleic acid metabolism & its regulation	U, An	2,3,4, 5
5	Evaluate enzymatic catabolism of purines and pyrimidines and their regulatory mechanism to maintain cellular homeostasis	E, An,	2,3, 4,5
6	Explain biosynthesis of nucleotides, their significance and metabolic disorders associated with nucleic acid metabolisms.	A, 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 transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Bioenergetics and CarbohydrateMetabolism**		
	1.1	Introduction to bioenergetics. High energy compounds (ATP, phosphocreatine, phospho enol pyruvate). Exergonic and endergonic reactions. Glycolysis (structure of intermediates required) – aerobic and anaerobic and the energy yield. Gluconeogenesis (structure required). Reciprocal regulation of glycolysis and Gluconeogenesis	5	1
	1.2	Substrate level phosphorylation. Electron transport chain, oxidative phosphorylation Chemiosmotic hypothesis. Inhibitors and uncouplers of electron transport chain. Pentose phosphate pathway (structure not required). Krebs cycle (structure of intermediatesrequired)and energetics	5	2
	1.3	Glycogen metabolism- glycogenesis and glycogenolysis and its regulation Glycogen storage diseases – Type I, Type II, Type III, Type IV and Type V	5	2
2		**Lipid Metabolism**		
	2.1	Beta oxidation of saturated and unsaturated fatty acids(structure of intermediates required)–activation of fatty acids and transport to themitochondrion via carnitine shuttle. Energetics of beta oxidation	6	3
	2.2	Biosynthesis of saturated fatty acids (palmiticacid). Fatty acid synthase complex. Desaturases andelongases. Ketogenesis –over production during uncontrolled diabetes andstarvation	5	3
	2.3	Biosynthesis and fates of cholesterol. Lipid storage diseases – Tay-Sachs disease, Gaucher's disease, and Niemann-Pick disease	4	3
3		**Amino acid Metabolism**		
	3.1	Overview of biosynthesis of amino acids glycine, Phenyl alanine, Tyrosine, Serine, Methionine and Threonine (without structure) Metabolic fates of amino groups.Transamination (detailed study required), Decarboxylation, Deamination (oxidative and nonoxidative).	5	4
	3.2	Nitrogen excretion and Urea cycle, significance and itsregulation. Glucogenic and ketogenic amino acids. Inborn errors of metabolism Albinism, Alkaptonuria, Homocystinuria and Phenylketonuria	5	5

4		**Nucleic Acid Metabolism**		
	4.1	Biosynthesis and regulation of Purines and Pyrimidines, Denovo and Salvage pathways.	6	4
	4.2	Catabolism of Purines and Pyrimidines.	3	5
	4.3	Biosynthesis of deoxy ribonucleotides, ribonucleotides and thymidylate synthesis and their significance Disorders of nucleic acid metabolism (Gout, Lesch Nyhan syndrome	6	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos Indirect session: Group discussion, seminar presentation Practical: Hands on learning, real world application, problem solving
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -30 Marks -** Quiz/Test Paper/Seminars
	End Semester Examination **Theory Total -70 Marks Duration -1.5 hrs** Short Essay 8 out of 10 x 4 =32 Marks Short Questions 14 out of 16 x 2 =28 Marks Fill in the blanks 10 x1 = 10 Marks

References

1. Botham, K., Mc Guinness, O., Weil, P. A., Kennelly, P., & Rodwell, V.(2022).Harper's Illustrated Biochemistry. McGraw-Hill Education.
2. Grisham, C., & Garrett, R. (2016). Biochemistry. Brooks/Cole.
3. Jain, J. L., Jain S., & Jain, N. (2016). Fundamentals of Biochemistry. S Chand.
4. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., & Bretscher, A. (2021).MolecularCellBiology. W H Freeman & Co
5. Nelson, L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry 7th edition.WHFreeman & Co.
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7. Sawhney, S. K., & Singh, R. (2005). Introductory PracticalBiochemistry. Alpha Science International Ltd.
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Analysis.KalyaniPublishers.

9. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Voet's Principles ofBiochemistry.Wiley.

Suggested Readings

1. Berg, J. M., Gatto Jr, G, J., Hines, J., Tymoczko, J. L., & Stryer L. (2023).Biochemistry (International Edition). W.H. Freeman & Co Ltd.
2. Devlin, T. M. (2010). Textbook of Biochemistry with ClinicalCorrelations. Wiley-Liss.
3. Ferrier, D. (2017). Lippincott Illustrated Reviews: Biochemistry (Lippincott Illustrated Reviews Series). Wolters Kluwer India Pvt. Ltd.
4. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2019). TextBook of Biochemistry for Medical Students. Jaypee Brothers

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MARINE AND FISHERY MICROBIOLOGY**					
Type of Course	**DCE B**					
Course Code	**MG7DCEZIM407**					
Course Level	**400**					
Course Summary	The study of marine microbiology involves research of fundamental issues such as the phylogenetic relationships, the functioning of marine food webs,biogeochemical cycles, climate change, the fate of pollutants and bioremediation, the biodiversity of the ocean and microbial diseases.					
Semester	VII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	--	--	--	60
Pre-requisites, ifany						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Outline introduction to oceanography and marine microbial physiology	U ,K, A	1,2,3
2	Describe Marine coastal pollution, eutrophication andbiomonitoring	U, A, An,E	1,2,3, 4,5
3.	Illustrate the mechanism involved to control algal blooms	A,An	2,3,5
4	Distinguish characteristics features of different types of fishes, shellfishes and other coastal aquatic and marinelivingresources present in Indian Ocean, ArabianSeaand Bay of Bengal.	U,An	1,2,3
5	Give an account on types of bacteria present in fish andothershell fishes	U,A, An	1,2,3, 4,5, 10
6	Explain human bacterial Pathogens and marine bacteriophage associated with fishes	U, A, E	2,3,4, 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		**Introductionto Oceanograhy and Marine Microbial Physiology**		
	1.1	Introduction to oceanography: the oceans and seas, propertiesof seawater, physico-chemical factors in the marine environment such as temperature, density, nutrients, salinity,dissolved gases,waves, tides, oceanic currents.	5	1
	1.2	Marine microbial habitats: estuaries, mangroves, salt marshes,beach and coastal ecosystems, coral reefs, water column, sediments.	5	1
	1.3	Physiology of marine microbes: metabolic diversity and energy yielding processes: microbial loop; marine snow; phototrophy and primary productivity fermentation, aerobic respiration, anaerobic respiration denitrification, sulphate reduction methanogenesis) nitrification annamox, sulphur oxidation, methanotrophy; carbon microorganisms in biogeochemical cyling: carbon, nitrogen, phosphorous, sulphur,iron,manganese.	5	1
2		**Marine and coastal pollution and Biomonitoring**		
	2..1	Marine and coastal pollution - effects on living organisms. Water pollution – microbial changes induced by inorganic and organic pollutants, industrial effluents and domestic sewage. Impact of bioaccumulation and biomagnifications ofmercury, cadmium, lead, etc. in fishes, role of microbes.	5	2
	2.2	Eutrophication, biomagnification, biofouling, bio adhesion, biocorrosion. Biological pollution: Algal blooms and environmental microflora, their effect on fish production, biological and chemical control of algal bloom, Microbial toxins, Nitrogen balance in aquatic ecosystem.	**5**	3
	2.3	Effect of marine pollution (toxicity) on phytoplankton (primary producers), zooplankton, fishes, coral reefs, barnacles, crabs, mussels, humans. Minamata, itai itai diseases, neurological disorders, reproductive disorder, carcinogenesis and teratogenic effects.	**3**	2
	2.4	Biomonitoring : Bioindicators (bioindicator bacteria),biotracers and biosensors	2	2
3		**Bacteria associated with fish and Shellfish**		

	3.1	Type of fishes, shellfishes and other coasta aquatic and marine living resources present in Indian Ocean, Arabian Sea and Bayof Bengal concept of aquaculture and marine culture o fishes.	8	5
	3.2	Commensals and pathogens; Classification of diseases; Methods of disease prevention; Detailed study of bacteria pathogenic to fin fish and shellfish with emphasis on morphology, Pathogenesis, treatment and control: *Flavobacterium, Edwardsiella, Pseudomonas, Vibrio, Aeromonas, streptococcus,Yersinia,* and *Mycobacteria.*	7	5
4		**Human bacterial pathogens and Marine viruses**		
		Human bacterial Pathogens associated with fishes and their products - *Aeromonas* spp., *Clostridium botulinum, Clostridium perfringens, Listeria* spp, *Salmonella* spp., *Staphylococcus aureus, Vibrio cholera, Vibrio parahaemolyticus, Vibrio vulnificus* and common *Enterobactereacea*	5	6
	4.1	Marine phages and their host: Archaea,bacteria and cyanobacteria, phytoplanktons, algae. Marine viruses and their hosts: fish and shrimp; Giant marine Virus	5	6
	4.2	Bacteriophage life cycles - lysogenic (latent) and lytic (virulent). Viral pathogens of fish: Lymphocystis virus, Infectious pancreatic necrosis virus (IPNV), Nervous necrosis virus (NNV)	5	6
5		**Teacher specific Module**		

EVALUATION AND ASSESSMENT

Teaching & Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -30 Marks: -** Quiz/Test paper/Seminars
	End Semester Examination **Theory Total -70 Marks Duration -1.5 hrs** Short Essay 8 out of 10 x 4 =32 Marks Short Questions 14 out of 16 x 2 =28 Marks Fill in the blanks 10x1 = 10 Marks

References

1. Oliver, J. D. (1982) Taxonomic scheme for the identification of marine bacteria by DeepSeaResearch Part A. Oceanographic Research Papers, 29 (6): 795 -798.
2. Naik, M.M. and Dubey, S.K. (2013) Lead resistant bacteria: Lead resistance mechanisms, their
3. applications in lead bioremediation and biomonitoring. Ecotoxicology & Environmentalsafety.98:1-7..
4. Movement of Viruses between Biomes (2004). E. Sano, S. Carlson, L.Wegley and F. Rohwer.ApplEnvironMicrobiol 70: 5842–5846.
5. Viruses of Fish: An Overview of Significant Pathogens (2011) M. Crane and A.HyattViruses3:2025–2046.
6. Viruses in Shellfish (2010) A. Bosch and S.F. Le GuyaderFood EnvironmVirol 2: 115-116

Suggested Reading

7. Principle diseases of marine fish and shellfish by Carl J. Sindermann.
8. Bacteria from Fish and Other Aquatic Animals: A Practical Identification Manual(CabiPublishing)byNicky B. Buller and John A. Plumb

Semester-VIII

	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ADVANCED IMMUNOLOGY**					
Type of Course	**DCC A**					
Course Code	**MG8DCCZIM400**					
Course Level	**400**					
Course Summary	Covers concepts in immunogenetics, immunotherapy and the molecular basis of immune-related diseases. Students gain a deep understanding of cutting-edge research, including the role of immunology in cancer, autoimmunity, and infectious diseases. Practical applications in advanced areas such as vaccine development and emerging immunotherapies are also discussed. Overall, this course equips students with a comprehensive knowledge of advanced immunological principles and their relevance in modern biomedical research					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe fundamental understanding of Antigens and Antibodies, Antigen- Antibody reactions and their clinical applications, structure of Immunoglobulins, Hypersensitivity reactions	U	1
2	Assess the role of MHC and Complement system in immunological mechanisms	E	2
3	Differentiate autoimmune diseases and immunodeficiency disorders	An	3
4	Appraise the recent trends in vaccine production immunotherapy and transplantation immunology	E	3
5	Develop skills in performing immunological tests	S & I	4

Remember (K), Understand (U), Apply (A), Analyze (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		**Antigen, Antibody & Antigen-Antibody Interaction**	**17**	
	1.1	Antigens: Types - Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes).	2	1
	1.2	Immunoglobulins: fine structure, classes and functions. Antigenic determinants of immunoglobulin – Isotype, Allotype and Idiotype. Mechanisms of antibody diversity (V(D)J recombination).	3	1
	1.3	Hybridoma technology. Monoclonal antibodies and clinical uses. Novel antibody engineering techniques	2	1
	1.4	Strength of antigen-antibody interaction- antibody affinity and avidity.	2	1
	1.5	Types of antigen-antibody reactions - Cross-reaction, Precipitation, Agglutination and Flocculation	2	1
	1.6	Immunological Techniques - ELISA, RIA, Immunoprecipitation, Widal, Coombs, VDRL and Radio-allergosorbent Test (RAST). Flow cytometry and fluorescence. Immunoelectron microscopy and Immunofluorescence.	6	1
2		**Complement system and MHC**	**8**	
	2.1	The Complement system and its activation pathways- Classical, Alternate and Lectin Pathways. Terminal sequence of complement activation (MAC).	2	2
	2.2	Regulation of complement activity and complement deficiencies.	3	2
	2.3	General organization and inheritance of MHC. MHC genes - HLA Complex in humans. MHC-peptide interaction. Expression of MHC molecules on different cell types. Biological significance of MHC.	3	2
3		**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity**. **&** **B. Vaccines and Transplantation Immunology**	**20**	
	3.1	**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity** Congenital immunodeficiency diseases. A brief account on SCID, Wescott-Aldrich Syndrome (WAS), Ataxia, Chronic Granulomatous Disease (CGD), Leukocyte Adhesion Deficiency (LAD). Acquired Immunodeficiency Disease (AIDS).	3	3
	3.2	Autoimmunity. Organ- specific autoimmune diseases (Hashimoto's thyroiditis) and Systemic auto-immune diseases (Pernicious Anemia).	2	3

	3.3	Acute and Chronic Inflammation. A brief account on Role of Chemokines and cytokines in immune system. Hypersensitivity. A brief account on different types with example. IgE- mediated (type- I) hypersensitivity (Anaphylaxis). Antibody- mediated cytotoxic (type- II) hypersensitivity (Transfusion reaction). Immune complex- mediated (type- III) hypersensitivity (Arthus reaction). Delayed type (type- IV) hypersensitivity (Mantaux test). Stimulatory (type V) hypersensitivity (Grave's diseases)	4	1
	3.4	B. **Vaccines and Transplantation Immunology** Types of Vaccines - Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, DNA, and mRNA vaccines. Synthetic peptide vaccines, Multivalent subunit vaccines. Therapeutic cancer vaccines.	3	4
	3.5	Vaccine Development Process - Preclinical research and animal testing, Clinical trial phases (I, II, III), Regulatory approval and post-marketing surveillance. Ethical aspects of vaccine research and distribution: Public perception and vaccine hesitancy, Balancing individual rights and public health	5	4
	3.6	Transplantation Immunology: Different types of Transplantations. Immunologic basis of graft rejection. Clinical manifestation of graft rejection. General and specific immunosuppressive therapy for transplant recipients.	3	4
4		**Practicals**	**30**	
	1	Differential leucocyte and total leucocyte count		5
	2	Histological study of Bone marrow, Thymus, Spleen and lymph nodes through slides/ Photographs		
	3	Principle and procedure of separation of lymphocytes from whole blood, showing videos of the experiment		
	4	Principle and procedure of separation of T and B lymphocytes, showing videos of the experiment		
	5	Virtual lab/Demonstration/Lab visit/ Short video of WIDAL Test, Western Blotting, ELISA, VDRL Test		
	6	Single diffusion in one dimension (Oudin test)		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, videos, Interactive discussions and case studies
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks,**Lab performance, Record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks, Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Differential leucocyte count – 15 marks Separation of T and B lymphocyte/ Oudin test – 4 marks Spotter identification from module 2 & 5 (one each)– 6 marks

REFERENCES

1. Abbas, Abul K., Pillai, Shiv, Lichtman, Andrew H. (2013). Basic immunology: functions and disorders of the immune system (4th). Philadelphia: Elsevier Saunders.
2. Delves, Petter J., Martin, Seamus J., Burton, Dennis R., Roitt, Ivan M.. (2017). Roitt's Essential Immunology (13). London: Wiley Blackwell.
3. Ford P.J. (2010). Immunological techniques: ELISA, flow cytometry, and immunohistochemistry. Methods in molecular biology (Clifton, N.J.), 666, 327–343.
4. Gratzinger, D., Jaffe, E. S., Chadburn, A., Chan, J. K., de Jong, D., Goodlad, J. R., Said, J., & Natkunam, Y. (2017). Primary/Congenital Immunodeficiency: 2015 SH/EAHP Workshop Report-Part 5. American journal of clinical pathology, 147(2), 204–216.
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6. Janeway CA Jr, Travers P, Walport M, et al.: Immunobiology: The Immune System in Health and Disease (2001). New York: Garland Science.
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9. Punt J, et al. Kuby Immunology. (2019)8th ed. New York, NY: W.H. Freeman and Company;
10. Types and phases of clinical trials: What are clinical trial phases? American Cancer Society. (2020, August 18). https://www.cancer.org/cancer/managing-cancer/making-treatment-decisions/clinical-trials/what-you-need-to-know/phases-of-clinical-trials.html

MAHATMA GANDHI UNIVERSITY
KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ANIMAL SYSTEMATICS**					
Type of Course	**DCC A**					
Course Code	**MG8DCCZIM401**					
Course Level	**400**					
Course Summary	Covers principles of classification, evolutionary relationships, and the development of taxonomic systems. Students learn to identify and classify organisms based on morphological, molecular, and ecological characteristics. Emphasis is placed on understanding phylogenetic relationships &the hierarchical structure of taxonomy, from species to higher taxonomic levels.Students explore the history of taxonomy, current methods, and the impact of technology on modern systematics. Practical aspects include fieldwork and specimen collection for species identification.					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	----	75
Pre requisites if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1.	Understand the principles of taxonomy, Principles and application of Zoological nomenclature	U	1,10
2.	Appreciate the role of taxonomy in biodiversity conservation and its significance in understanding and preserving natural ecosystems.	Ap	6
3.	Identify and classify organisms using taxonomic keys, molecular techniques and morphological characteristics.	E	2
4.	Understand the principles of phylogeny, recent trends and its applications	U	1,2
5.	Analyze and interpret phylogenetic trees to understand the evolutionary relationships among different species and their common ancestors.	An	1

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 taxonomy and systematics**	**12**	
	1.1	Taxonomy and Systematics – Definition, Significance. Linnaeus and taxonomy. Hierarchical system of taxonomy-taxon, category, taxonomic rank, stages in taxonomy.	5	1
	1.2	Species concept - types, sub species, deme and other intra specific categories, Polytypic and monotypic species (Brief account).	3	1
	1.3	Principles and applications of Zoological nomenclature: Zoological nomenclature - International Commission for Zoological Nomenclature - features, principles and rules, structure of ICZN code. Zoobank	**3**	1
	1.4	Scientific name - uninomial, binomial and trinomial.	1	1
2		**Taxonomic tools and techniques**	**20**	
	2.1	Taxonomic procedures: collection, preservation, curation and process of identification.	3	2
	2.2	Zoological type: Definition and significance of Holotype, Paratype, Allotype, Neotype, Syntype, Lectotype.	2	3
	2..3	Taxonomic keys: Different types of taxonomic keys - single access keys, synoptic keys, dichotomous, polytomous keys and computer aided keys. Merits and demerits of keys.	4	3
	2.4	Taxonomic publications: Types of taxonomic publications - atlas, catalogue, checklist, field guide, field book, hand book, manual. (Brief account). Encyclopedia of Life (EOL).	3	2
	2.5	**Modern trends in Taxonomy:** Approaches in taxonomy – Morphological, embryological, ecological, behavioural, cytological, biochemical, numerical, molecular approaches in taxonomy. e-taxonomy, Cybertaxonomy, Integrative taxonomy	**5**	4
	2.6	DNA Barcoding: steps involved in barcoding and applications of barcoding. Barcoding of life. International Barcode of Life (iBOL).	3	5
3		**Phylogenetics and Cladistics**	**13**	

	3.1	Phylogenetics: Phylogenetic tree - types (cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram), Molecular phylogeny – DNA markers (mitochondrial markers- Cyt b, Cyt C oxidase; nuclear markers – 16S rRNA, ITS, microsatellite repeats) (Brief description only). Molecular clock hypothesis. Phylocode. Tree of life.	8	2
	3.2	Cladistics: Clade (monophyletic, paraphyletic, polyphyletic) Phenotypic trait, ancestral versus derived characters - Plesiomorphy, apomorphy, synapomorphy and autapomorphy.	5	4
4		**Practicals**	30	
	1	Study of museum specimens - 25 invertebrates and 25 vertebrates.		1
	2.	Preparation of dichotomous key of 4 specimens up to family/order (Insects/Spiders/ Fishes/ Snakes - any three taxa).		
	3.	Comparative study across different species to identify similarities and differences (Mosquito, Ant, Butterfly, Moth, Honeybee, Earthworm, Prawn, Spider, Crab – minimum two species each from any five taxa).		
	4	Preparation of Cladogram based on the specimens provided (based on at least five museum specimens).		
	5	Visit to a Zoology Museum.		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecture, museum visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks -** Quiz, Test Papers, seminar **Practical Total =15 marks -** Lab performance, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total -= 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Dichotomous key preparation for 2 specimens – 14 marks; Cladogram – 6 marks; spotter identification – 5 marks

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	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**AQUATIC BIOLOGY**					
Type of Course	**DCE A**					
Course Code	**MG8DCEZIM400**					
Course Level	**400**					
Course Summary	Explores the biological principles governing life in freshwater and marine environments. Students delve into the diversity of aquatic organisms, their interactions with each other and their environment, and the ecological processes that shape aquatic ecosystems.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain of Aquatic Ecosystems, knowledge of the diverse range of aquatic habitats, their interconnectedness, and the processes that sustain life within them.	U	1,3
2	Infer the importance of preserving aquatic biodiversity by monitoring the basic standards of water.	U	1,2, 3
3	Evaluate the anthropogenic interventions affecting the aquatic ecosystems .	E	2,3
4	Apply ecological principles to conserve aquatic environments, including nutrient cycling, energy flow, and trophic interactions.	A	2,3,4, 6
5	Understanding of the physical and chemical characteristics of aquatic environments, such as water chemistry, hydrodynamics, and the effects of physical processes on aquatic organisms	A	6,7, 11
***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		**Aquatic Biomes**	15	1
	1.1	Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs		
2		**Freshwater and Marine Biology**	15	
	2.1	**Freshwater Biology** **Lakes**: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes. **Ponds**	8	1,2
	2.2	**Marine Biology** Major divisions of marine environment; Physical properties of seawater - Thermal properties of seawater1 Chemical properties of seawater : Concept of chlorinity , salinity and density of seawater; Primary and Secondary Productivity of the coastal environment; Phytoplankton and Zooplankton - Classification, distribution, their role in coastal ecosystems and adaptations. Primary production and factors affecting primary production. Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	7	
3		**Management of Aquatic Resources**	15	
	3.1	Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Water pollution acts of India, Sewage treatment Water quality assessment BOD & COD		1,4

4		**Practicals**	**30**	
	1	Determine the area of a water body using graphimetric method.		5
	2	Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.		
	3	Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body		
	4	Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.		
	5	Field study: Visit to a Sewage treatment plant/Marine bioreserve/Fisheries Institutes and submission of report		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks:** Lab performance-, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 5 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Zooplankton identification, counting and graphical representation of abundance/ Oxygen estimation/ Carbon dioxide estimation – 12 marks Determination of area of a water body from the scaled map provided /Calculation of turbidity (providing values) – 8 marks Field study report – 5 marks

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	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOINFORMATICS & COMPUTATIONAL BIOLOGY**					
Type of Course	**DCE A**					
Course Code	**MG8DCEZIM401**					
Course Level	**400**					
Course Summary	Applies computational methods to analyze large collections of biological data,to make new predictions or discover new biology. Familiarize with biological databases & construction of phylogenetic trees using appropriate software. Principles of conventional drug designing & computer aided drug designing introduced. Scope of AI in Biology is discussed.					
Semester	VIII	Credits			4	Total Hours
Course Details	**Learning approach**	**Lecture**	**Tutorial**	**Practical**	**Others**	
		3	**-**	**1**	**--**	**75**
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basics of biological databases & sequence analysis.	**U**	**1,2**
2	Discuss genomics and proteomics System Biology & Computational Biology	**U, I**	**3,10**
3	Apply bioinformatics tools to analyze molecular sequences	**A, An**	**1,2,10**
4	Understand different approaches in computational biology and the basic principles of computer aided drug design	**U**	**2,3**
5	Appreciate the role of Artificial Intelligence in Biology	**Ap**	**3,6**
***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)**			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1		**Biological Databases & Sequence Analysis**	**20**	
	1.1	Scope of Bioinformatics. Bioinformatics Resources - NCBI, EBI, ExPASy, RCSB, DDBJ.	**2**	**1**
	1.2	**Biological Databases** Classification of biological databases: Primary databases: Nucleotide sequence databases - GenBank, EMBL, DDBJ; Protein sequence databases – PDB, SWISS-PROT, TrEMBL, PIR; Secondary Databases: Pfam, PROSITE, UniProt K, CATH; Composite Databases – NDB, OWL. Sequence file format: FASTA, GenBank format.	**5**	**1**
	1.3	Genome Databases : Viral genome database - ICTV ; Bacterial Genome database - GOLD; Organism specific database - OMIM/OMIA, FlyBase; Sequence submission tool – BankIt, sequin.	**3**	**1**
	1.4	**Sequence Analysis** Basic concepts of sequence alignment; Pairwise sequence alignment: BLAST, types of BLAST - blastn, blastp, blastx, tblastn, tblastx; Global and local alignment. Multiple sequence alignment: CLUSTAL W and CLUSTAL Omega. Significance of sequence alignment.	**4**	**1**
	1.5	Phylogenetics: Distance based methods - UPGMA, NJ and Minimum Evolution methods, Character based methods - Maximum Parsimony (MP), Maximum Likelihood. Construction of phylogenetic tree – PHYLIP, MEGA. Bootstrapping.	**6**	**1**
2		**Genomics and Proteomics**	**7**	
	2.1	**Genomics**- Introduction, Structural, functional and comparative genomics. **Proteomics** – Introduction.	**3**	**2**
	2.2	**Protein modelling:** - Homology modelling; Threading, *ab initio* prediction, structure evaluation.	**4**	**2**
3		**Systems Biology & Computational Biology**	**18**	
	3.1	Fundamentals of Systems Biology, Definition and principles, Historical perspectives.	**2**	**2**
	3.2	Metabolomics, Metabolic pathway database - KEGG, Gene network, Synthetic Biology.	**4**	**2**
	3.3	Computational Biology - Introduction, Scope and Application.	**2**	**2**

	3.4	Artificial Intelligence**:** Applications and challenges of AI in Biology. Role of AI in Bioinformatics. Algorithms for Bioinformatics prediction: HMM (Hidden Markov Models) and Neural Network.	**4**	**5**
	3.5	Drug designing: Principles of Pharmacokinetics and Pharmacodynamics - ADME.	**3**	**4**
	3.6	High-throughput screening (HTS), Computer aided drug design (CADD). Molecular docking - Autodock.	**3**	**4**
4		**Practicals**	**30**	
	1	Data base search and data retrieval-using NCBI, PDB and Expasy		**1,2,4**
	2	Pairwise sequence alignment –BLAST		
	3	Multiple sequence alignment - Clustal W		
	4	Construction of phylogenetic tree using MEGA		
	5	Protein structure visualization using RASMOL		
	6	Secondary structure prediction of protein - Chou-Fasman method		
		Protein motif & domain analysis: eMOTIF& Pfam		
		Homology modeling - SWISS-MODE		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, virtual classes, You -tube videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total=25 marks -** Quiz, Test Papers, seminar **Practical Total = 15 marks -** Lab performance, record, viva
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** **Experiment for Pairwise/ multiple sequence alignment – 12 marks** **Construction of phylogenetic tree – 8 marks** **Visualization of molecular model – 5 marks**

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	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**DEVELOPMENTAL BIOLOGY**					
Type of Course	DCE A					
Course Code	**MG8DCEZIM402**					
Course Level	**400**					
Course Summary	Explore the fundamental concepts and mechanisms that regulate animal development from fertilization of the egg to formation of the adult organism. Encompasses the biology of regeneration, metamorphosis and growth and differentiation of stem cells.					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Discuss the genetic, cellular, and tissue control of development	*U*	1,6
2	Explain the sequence of events and the mechanism of fertilization in invertebrates and vertebrates.	*U, An*	2
3	Compare and contrast early developmental strategies of model organisms.	*An, E*	4
4	Understand integrated processes that transforms an amorphous mass of cells into a complete organ in the developing embryo	*U, An*	6
5	Analyse the different developmental stages of organisms like drosophila chick embryo and frog through the techniques like sectioning staining etc.	*U, An*	8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**PATTERNS AND PROCESSES OF ANIMAL DEVELOPMENT**	**10**	
	1.1	**Levels of commitment** **Specification**-mechanism of developmental patterning Autonomous, Conditional and Syncytial specification **Determination**-mechanism of cell differentiation Differential gene expression and gene transcription Selective nuclear RNA processing Selective messenger RNA translation Differential protein modification	4	1
	1.2	**Cell-to-cell communication-mechanism of morphogenesis** Induction and competence **Paracrine signaling**: Morphogen gradients, Fibroblast growth factors, RTK pathway and JAK-STAT pathway, Hedgehog pathway, Wnt pathway, TGF-β superfamily and Smad pathway **Juxtacrine Signaling** :The Notch pathway: Juxtaposed ligands and receptors for pattern formation Brief account only	4	1
	1.3	**Stem cells:** Embryonic stem cells; adult stem cells; medical applications and ethical issues.	2	1
2		**FERTILIZATION & EARLY DEVELOPMENT**	18	
	2.1	**External Fertilization in Sea Urchins** Biochemical and molecular aspects of fertilization Species-specific sperm-egg recognition. Polyspermy: fast block and slow block	4	2
	2.2	**Internal Fertilization in Mammals** Translocation and capacitation Hyperactivation, thermotaxis, and chemotaxis The acrosome reaction and recognition at the zona pellucida Gamete fusion and the prevention of polyspermy Activation of the mammalian egg	4	2
	2.3	**Early development of Drosophila** Egg, cleavage, mid-blastula transition, gastrulation. Gene action in development of drosophila:- Maternal effect genes, zygotic genes, gap genes, pair rule genes, segment polarity genes; homeotic genes Anterior- posterior patterning in Drosophila; Dorsal-Ventral patterning; Left-right patterning.	5	3

		Dorsal protein gradient.		
	2.4	**Early development of Amphibia** Fertilization, Cortical Rotation, and Cleavage The mid-blastula transition: Preparing for gastrulation; Amphibian Gastrulation The dorsal-ventral and anterior-posterior axes formation Primary embryonic induction; Molecular Mechanisms of Amphibian Axis Formation Organizer and its functions; Nieuwkoop centre Molecular basis of mesoderm induction Neural induction and its regional specificity. Left-Right Axis formation	5	3
3		**ORGANOGENESIS & POST EMBRYONIC DEVELOPMENT**	17	
	3.1	**Vulva formation in *Caenorhabditis elegans*** Generation of vulval precursor cell Vulval cell induction and differentiation RTK pathway, Notch-delta and lateral induction Anchor Cell invasion Vulval morphogenesis	4	4
	3.2	**Tetrapod limb development** Limb Anatomy and Limb Bud formation Hox Gene Specification of Limb Outgrowth: Generating the Proximal-Distal Axis of the Limb The apical ectodermal ridge Specifying the Anterior-Posterior Axis Generating the Dorsal-Ventral Axis Cell Death and the Formation of Digits and Joints	4	4
	3.3	**Metamorphosis in Insects** Types, Hormonal control and molecular mechanism of insect metamorphosis	3	5
	3.4	**Amphibian Metamorphosis** Changes associated with amphibian metamorphosis Hormonal control of amphibian metamorphosis Regionally specific developmental programs	3	5
	3.3	**Regeneration** Types and histological processes Polarity and metaplasia in regeneration Lens regeneration in amphibians	3	5
4		**Practicals**	30	
	1	Developmental stages of Drosophila – Culturing method and larval instar identification		5
	2	Developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill) using permanent slides/Diagrams		
	3	Serial sections of embryo (tadpole/chick).		

	4	Vital staining of early gastrula of chick and tracing the development of stained parts - Window method.		
	5	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.		
	6	Preparation of permanent slides of blastoderm of chick embryo- at least one (18hr, 24hr, 33 hr, 48 hr or 72 hr)		
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning approach	**Classroom Procedure (Mode of transaction)** Lecturing, videos, practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 25 marks -** Quiz, Test Papers, Seminar **Practical Total = 15 marks:** Lab performance-, record, Lab Test
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 5 x4 =20 marks; Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Blastoderm mounting and age determination/ Larval instar identification – 15 marks, Vital staining – 4 marks, spotter identification – 6 marks

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SUGGESTED READING

https://web.as.uky.edu/Biology/faculty/cooper/Population%20dynamics%20examples%20with%20fruit%20flies/08Drosophila.pdf

	MAHATMA GANDHI UNIVERSITY KOTTAYAM

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOLOGICAL SPECIMEN PREPARATION TECHNIQUES**					
Type of Course	DCE A					
Course Code	**MG8DCEZIM403**					
Course Level	**400**					
Course Summary	Helps to acquire knowledge on preparation of laboratory specimens for display in Biology museums for study purpose and also as an entrepreneurship. Develops research aptitude by introducing frontier areas of biological science such as historic genetic analysis- a valuable tool for study and application of Conservation Genetics- of endangered species.					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	---	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	Describe different animal collection techniques and their application	**U**	1,2
2	Explain the methods of skeleton preservation blood and smear preparation	**U**	1,2
3	Apply the knowledge acquired in preserving the specimens	**An**	9,10
4	Formulate innovative ideas to taxidermize a dead specimen	**C**	1,10
5	Demonstrate skills in Alizarin preparation.	**S,C**	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		**Importance and applications of the specimen preparation techniques**	**10**	
		Introduction: importance and applications of the specimen preparation techniques – laboratory/ study purpose; museum display; entrepreneurial. Probable application in DNA extraction, Conservation Genetics.		1,3,5
2		**Collection and Preservation of animals**	**15**	
		Collection techniques for insects, fishes, and birds. Preservation methods for animals belonging to various taxa		1,2
3		**Preparation of museum specimens, permanent slides and blood smear**	**20**	
	3.1	Preparation of museum specimens, Display methods: - wet & dry.	4	2,4
	3.2	Skeletal techniques: - Articulated skeleton, general methods- Clearing- fleshing, maceration, boiling, degreasing, mounting. Staining techniques (alizarin preparations). Taxidermy	9	
	3.3	Preparation of permanent slides- whole mounts, various tissues, sections, stages of cell divisions	5	
	3.4	Preparation of thick and thin blood smear, & its significance	2	
4		**Practicals**	**30**	
	1	Whole mount preparation of small animals, tissues and sections of animals	10	2
	2	Alizarin preparation of small invertebrates and vertebrate skeletal system	5	
	3	Preparation of articulated skeletons	6	
	4	Demonstration of Taxidermy	9	
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Hands on training, demonstration
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total =25 marks -** Quiz, Test Papers, seminar **Practical Total = 15 marks -** Lab performance, record, Submission of alizarin preparation
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 marks Short questions 10 out of 12 x2 =20 marks Fill in the blanks 10x1 =10 marks **Practical Total = 35 marks Duration 2 hrs** **Record 10 marks, Examination 25 marks:** Whole mount preparations - submission of 5 slides. 5 slides-10 marks; Principle and procedure for the preparation – 6 marks, Alizarin preparation submission – 5 marks, Taxidermy Steps – 4 marks

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	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY**					
Type of Course	**DCE B**					
Course Code	**MG8DCEZIM404**					
Course Level	**400**					
Course Summary	Microorganisms underpin every environment on Earth. In this course, students learn of the vital role of microbes in marine, freshwater, and terrestrial ecosystems by exploring the dynamic interactions that take place between microbial communities, the surroundings, and higher organisms.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, ifAny						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	State different types of ecosystems and energy flow	K,U	1,2,3,
2	Explain food chain, food web and ecological pyramids.	U,A	2,3,4, 5
3	Competently explain various aspects of solid and waste management and their impact on environment	A,An	1,2,3, 4,5
4	Illustrate various source of surface & ground water pollution and begin to evaluate the significance of liquid waste treatment plants .	A,An,E	1,2,3, 4,5
5	Understand the significance of pollution monitoring & control	U , E	1,2,3, 4,5
6	Develop practical skill in various aspect to assessquality of water	S	1,2,1 0
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 & Ecological Pyramids**		
	1.1	Types of ecosystem: forest, grassland, lentic, lotic, estuarine marine, desert, wetlands, Ecosystem structure and function abiotic and biotic components of ecosystem; ecosystem boundary; ecosystem function; ecosystem Metabolism	**6**	1
	1.2	Primary production and models of energy flow; secondary production and trophic efficiency. Food chain, food web; detritus pathway of energy flow and decomposition processes	4	2
	1.3	Ecological efficiencies; ecological pyramids: pyramids of number, biomass, and energy, ecosystem input of nutrients.Biotic accumulation; ecosystem losses; nutrient supply and uptake	5	2
2		**Solid& Liquid Waste Management**		
	2..1	Solid & industrial waste management: Sources, generation of solid waste, their classificationand chemical composition. Characterization of municipal solid waste; hazardous wasteand biomedical waste Impact of solid waste on environment, human and plant health, different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste). landfill; thermal treatment (pyrolysis and incineration) of waste material; stack emission control and emission monitoring;effluent treatment plant and sewage treatment plant	7	3
	2.2	Sources of surface and ground water pollution; water quality parameters and standards; organic waste and water pollution. Eutrophication; COD, BOD, DO; effect of water contaminantson human health (arsenic, cadmium, mercury). Marine resources and their importance; sources of marine pollution;oil spill and its effects	5	4
	2.3	Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment. Treatment and safety of drinking (potable) water, thermal pollution and its effects	3	4
3		**Pollution Monitoring and Control**		
	3.1	Introduction to Pollution, Pollution Control and Monitoring. Natural and anthropogenic pollution. Role of government and public in pollution control..Brief account on bioremediation and biodegradation.	6	5

	3.2	Structure and formation of biofilm. Biofilms from different environments,:Impact of environment on biofilm developmentand its composition and implications of each on biofilms in water bodies ,biofouling associated microbial biofilms prosthetics associated biofilms, human associated biofilms	6	5
	3.3	Ganga Action Plan & Yamuna Action Plan	3	5
4		**Practicals**		
	4.1	Isolation of microbes (bacteria & fungi) fromsoil / rhizosphere / rhizoplane.	6	1
	4.2	Assessment of microbiological quality of water.	6	2
	4.3	Determination of COD of waste water sample	6	6
	4.4	Water analysis test – Chloride / Hardness /P^H	6	6
	4.5	Determination of BOD of waste water sample	6	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction, Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record
	Semester End examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record: 10 Marks; Examination :25 Marks, Spotter Identification-8 Marks Determine BOD/COD of given water sample -8 Marks, Water quality test Chloride/Hardness/ pH -8 Marks, Viva -1Marks

References

1. Mitchell R (1974) Introduction to environmental microbiology (Prentice-Hall,Englewood Cliffs, N.J.,)
2. Atlas RM & Bartha R (1998) Microbial ecology: fundamentals and applications, (Benjamin/Cummings, Menlo Park, Calif.; Harlow) 4th ed.
3. Campbell RE (1983) Microbial ecology (Blackwell Scientific Publications,Oxford ; Boston) 2nd ed

4. Ralph Mitchell & Ji- Dong Gu 2009. Environmental Microbiology. Wiley-Balckwell.
5. Rheinheimer G (1991) Aquatic microbiology (John Wiley and Sons) 4th ed. Dart RK (1980)Microbiological aspects of pollution control (Elsevier Scientific, Amsterdam) 2nded.
6. Alexander M (1977) Introduction to soil microbiology (Wiley, New York ; London)2nd ed.

Suggested Readings

1. Environmental Microbiology for Engineers (2016), 1st ed., Ivanov V,ISBN: 9780429109003.
2. Environmental Microbiology: From Genomes to Biogeochemistry (2015), 2nd ed.,Madsen EL, John Wiley & Sons, Inc., ISBN: 978-1-118-43963-0.34
3. Environmental Microbiology: Fundamentals and Applications (2015), 1st ed., BertrandJC, Caumette P, Lebaron, P, Matheron R, Normand P and Sime-Ngando T, Springer Netherlands,eBook ISBN: 978-94-017-9118-2, Hardcover ISBN: 978-94-017-9117-5.
4. Environmental Microbiology (2016-17), 1st ed., Sharma, PD, Rastogi Publications(India),ISBN: 978-93-5078-140-1

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MICROBIAL GENETICS & METABOLIC ENGINEERINGOF MICROBES**					
Type of Course	**DCE B**					
Course Code	**MG8DCEZIM405**					
Course Level	**400**					
Course Summary	This course will cover host range, replication, incompatibility of Plasmids, Tools of Metabolic Engineering and the mechanism of genetic exchange among microbes by recombination and the process of conjugation, transformation and transduction.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Understand the concept of central dogma of Molecular biology and DNA repair mechanism.	U,K	1,2,3
2	Employ genetics of bacteriophage and regulationof gene expression	A,An	1,2,3 4,5
3	Illustrate mechanism involved in genetic recombination of bacteria	A,An	1,2,3 4,5
4	Outline the role of transposons and plasmid in genetic engineering	U,A	2,3,4 ,5,10
5	Attain Knowledge on tools of metabolic Engineering	An,E	1,2,3 4,10
6	Develop practical knowledge of isolation of chromosomal DNA/Plasmid fromE.Coli	S	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		**Central Dogma of Molecular Biology**		
	1.1	Prokaryotic and Eukaryotic chromosomal organization. Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication. Differences in prokaryotic and eukaryotic replication. Mechanism of DNA replication. Enzymes and Proteins involved in replication. DNA repair – mechanism ofexcision repair, SOS repair and mismatch repair.	**6**	1
	1.2	Transcription: Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription.	4	1
	1.3	Translation: Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.	5	1
2		**Genetics of Bacteriophage & Regulation of gene expression**		
	2.1	General characteristics of bacteriophages, phage T4 – structure, gene expression and genome organization, λphage – replication, lytic and lysogenic cycles, transcription of phage genes, Mechanisms of repressor synthesis and its control, autoregulation, use of phages as cloningvectors.	7	2
	2.2	Regulation of gene Expression: Principles of transcriptional regulation, regulation at initiation with examples from lac and trpoperons	4	2
	2.3	Mechanisms of Genetic Exchange: Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains Transduction -Generalized transduction, specialized transduction	4	3
3		**Transposons & Tools of Metabolic Engineering**		
	3.1	Plasmids and Transposable Elements: Property and function of plasmids, Types of plasmids. Prokaryotic transposable elements – Insertion Sequences, composite and non- composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition.	5	3
	3.2	Tools of Metabolic Engineering: Classical mutagenesis, Gene shuffling, gene knockout, gene silencing, transformation with vectors,quorum sensing, stimulation by precursors, gene insertion or deletion, heterologous expression of entire gene clusters	5	4
	3.3	Enhancement of product yield and productivity – ethanol, solvents and amino acid; extension of substrate range;	5	5

		extension of product spectrum and novel products – antibiotics, vitamins, pigments and biopolymers. Improvement of cellular properties and xenobiotic Degradation		
4		**Practicals**		
	4.1	Calibration of Micropipettes	2	6
	4.2	Preparation of different Tris buffers: Tris-HCl, Trsi-EDTA and TAE	4	6
	4.3	Study of different types of DNA and RNA using micrographs and model / schematic representations.	4	6
	4.4	Study of semi-conservative replication of DNA through micrographs / schematic representations	4	6
	4.5	Study survival curve of bacteria after exposure to ultraviolet(UV) light	4	6
	4.6	Demonstration of Bacterial Conjugation, bacterial transformation and transduction	6	6
	4.7	Extraction of chromosomal DNA/Plasmid DNA from E.coli	6	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching & Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction, Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion, Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/Record
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4= 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record: 10 Marks Examination :25 Marks, Spotter Identification-12 Marks, Isolation of chromosomal DNA from E.coli -8 Marks, Study of semi-conservative replication of DNA through micrographs / schematic representations-3 Marks Viva-2 Marks

References

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing,San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams andWilkins,Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratorypress.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning

Suggested Reading

7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India 8. Klug WS, Cummings MR, Spencer, C, Palladino,M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**MICROBIAL DIAGNOSIS IN HEALTH CLINICS**					
Type of Course	**DCE B**					
Course Code	**MG8DCEZIM406**					
Course Level	**400**					
Course Summary	Provides knowledge on global & local epidemiology, clinical skills, sample collection & examination, preventive measures and know the modern method of investigation includes serological and rapid method of detections.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Acquire foundational understanding about infectious diseases and laboratory protocols	U, A	1,2, 3
2	Develop proficiency in standard operating procedure for molecular diagnostic laboratory	U, A, An	1, 2, 3,4
3	Attain an understanding on sample collection and examination	U, An, A	1,2, 3, 4,5
4	Explain serological and molecular methods for disease Diagnosis	U, E, A,	1,2,3, 4,5,10
5	Determination of minimal inhibitory concentration (MIC) of anantibiotic by serial double dilution method.	U, A, AN, E	1,2,3, 4
6	Develop practical skill to isolate and identification of different pathogens from clinical sample.	S	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 toinfectious diseases & Laboratory Protocols**		
	1.1	Classification of infectious agents (brief introduction) - bacteria, viruses, protozoa and fungi. Source, reservoir and transmission of pathogens Host parasite relationship, types of Infections associated with parasitic organisms.Infection and evasion	5	1
	1.2	Epidemiological aspects of diseases of national importance. Epidemiological aspects of Non-Communicable Diseases Emerging and Re-Emerging Diseases. Travel Medicine, Bioterrorism, National Health Programmes Related to Communicable Diseases, Critical Care, Syndromes and Exotic infections	5	1
	1.3	Protocols for Molecular Diagnostic Laboratory: Standard Operating Protocols(SOP) form molecular diagnostic laboratory, NABL standard Documentation and protocols, Log book keeping for sample processing at clinical laboratory, Quality assurance and quality control: Requirements and Importance Training in Quality Control Department.	5	2
2		**Sample Collection &Examination**		
	2.1	Importance of diagnosis of diseases: Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Basic concept of clinical Microbiology, Definition and scope, Collection of Clinical Samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage	7	3
	2.2	Examination of sample by staining – Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkeyagar, Distinct colony properties of various bacterial pathogens	8	3
3		**Serological and Molecular methods**		
	3.1	Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid-based methods - PCR,Nucleic acid probes MALDI-TOF identification of different bacterial species by Digital Droplet PCR, Next-Gen Sequencing	5	4

	3.2	Kits for rapid Detection of Pathogens: Typhoid, Dengue andHIV, Swine flu	5	4
	3.3	Testing for Antibiotic sensitivity in Bacteria, Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC)of an antibiotic by serial double dilution method.	5	5
4		**Practicals**		
	4.1	Blood Group Detection (ABO & Rh system)	3	6
	4.2	Study of growth characters of isolated pathogens on following media: Mannitol salt agar, Wilson Blair agar, Salmonella Shigella agar, Glucose azide medium, Cetrimide agar, TSI agar	4	6
	4.3	Identify pathogenic bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests	4	6
	4.4	Isolation, identification of following pathogens from clinical samples: *E. coli, Salmonella* spp., *Pseudomonas* spp. *Proteus* spp., *Klebsiella* spp., *Shigella* spp. *Staphylococcus* spp, *Streptococcus* spp	5	6
	4.5	Agglutination tests -Widal test (Slide) VDRL (slide)	5	6
	4.6	Physical, Chemical and Microscopic examination of Clinical samples – urine, stool, pus.	4	6
	4.7	Perform antibacterial sensitivity by Kirby-Bauer method	5	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments, Library work, Group discussion. Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)Theory** **Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4 = 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs**

	Record: 10 Marks Examination :25 Marks, Spotter Identification-8 Marks, Widal test/VDRL- 8Marks, antibacterial sensitivity by Kirby-Bauer method -6, Marks , Determination of BO blood groups & Rh factor-2 Marks, Viva -1 Marks

References

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008). Prescott, Harley, Klein's Microbiology (7th ed.). McGraw Hill International Edition.
2. Mandell, G. L., Douglas, R. G., & Bennett, J. E. (2010). Principles and Practices of Infectious Diseases (7th ed.). Churchill Livingstone Elsevier. McGraw-Hill..
3. Murray, P.R., Rosenthal, K..S., & Pfaller, M..A. (2004). Medical Microbiology. Elsevier Health Sciences.
4. Devlin, T. M. (2011). Textbook of Biochemistry with Clinical Correlations (6thed.).John Wiley & Sons, Inc.
5. Sherwood, L. (2013). Introduction to Human Physiology (8th ed.). Cengage LearningBrooks/Cole.
6. Snustad, D. P., & Simmons, M. J. (2012). Principles of Genetics.
7. Cooper, G. M., & Hausman, R. E. (2009). The Cell: A Molecular Approach (5th ed.).ASM Press & Sinauer Associates.
8. Hall, J. E., & Hall, M. E. (2020). Guyton and Hall Textbook of Medical Physiology (14th ed.).

Suggested Readings

1. Ananthanarayan R and Paniker CKJ (2009) Textbook ofMicrobiology, 8thedition, Universities Press Private Ltd.

	Mahatma Gandhi University **Kottayam**

Programme	**BSc (Honours) Zoology and Industrial Microbiology (Double Major)**					
Course Name	**BIOTECHNOLOGY, TISSUE CULTURE AND GENETIC ENGINEERING**					
Type of Course	**DCE B**					
Course Code	**MG8DCEZIM407**					
Course Level	**400**					
Course Summary	Plant tissue and cell culture describes the sterile growth and multiplication of plant cells, tissues and organs invitro. Plant cells cultured with nutrient media in an artificial environment can be clonally propagated at scale, to more quickly produce mature and disease - free plants.					
Semester	VIII	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	--	1	--	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	State basic requirements and applied aspects of plant tissue culture.Itfocuses on various types plants cultures.	U, A	1,2, 3
2	Comprehend principles and strategies involved in plasmid andothercloning vector.	U, A, An	1, 2, 3,4
3	Different methods used for genetic transformation of plants, use of Agrobacterium as a vector for plant transformation, components of a binary vector system	U, An, A	1, 2, 3,4,5
4	Explain selection of recombinant gene and transgene and theirapplications in biotechnology.	U, E, A,	1,2,3, 4,5,10
5	Concepts and application of plant genetic engineering	U,A, AN, E	1,2,34
6	Comprehend the skills required to do Plant Tissue Culture	S	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		**Plant Tissue Culture**		
	1.1	Plant tissue culture: Laboratory organization, Methods of sterilization, medium composition And preparation, culture initiation and incubation of culture. Callus induction and establishment. Callus sub-culture and maintenance. Cell suspension culture characteristics.	5	1
	1.2	Somatic embryogenesis, somatic embryo development and synthetic seed production. Soma clonal variation and applications. Experimental androgenesis and gynogenesis - Factors controlling - Physical and chemical	4	1
	1.3	Micropropagation: methods - axillary and adventitious budding - advantages. Plant protoplast isolation, culture and fusion. Call wall regeneration from protoplasts - application of protoplast hybridization. Biotransformation and immobilization of plant cells. Hairy root clones. Production of secondary metabolic compounds using cell and tissue culture. Molecular farming and immuno-protective drugs.	6	1
2		**Biotechnology**		
	2.1	Biotechnology - Scope, potentialities and constrains, host-controlled restrictions, gene cloning vectors - Plasmids, Phages, Cosmids, Primary vectors and plasmids, expression vectors.	4	2
	2.2	Enzymes in genetic engineering exonucleases, endonucleases, restriction endonucleases, S I nucleases, DNA ligases, reverse transcriptase and alkaline phosphatase, Recombinant DNATechnology	4	3
	2.3	Selection of genes, Gene libraries, Genomic and cDNA library - Gene transfer methods, Genetic organization of Ti plasmids, Ti plasmid mediated transfer - Agrobacterium tumifaciens, DNA mediated transfer. Calcium phosphate, PEG, DEAE, via liposomes –Microinjection - Microinjection, microprojectile, and electroporation,- Selection of clones, marker and reporter genes in screening method	7	3
3		**Selection of recombinants**		

	3.1	Selection of recombinants - direct selection - selection forcorrect promoter sequence - CATsystem - Importance of promoters for the programmed expression of alien genes Indirect screening - Immunological techniques - hybridization techniques, gene addition and subtraction approach in genetic engineering Expression of eukaryoticgene in E. coli Antisense RNA. Selection of transgenics– selectable markerand reportergenes (Luciferase,GUS, GFP).	7	4
	3.2	Applications of Plant Genetic Engineering – crop improvement, herbicide resistance insect resistance, virus resistance. 2. Genetic modification – transgenic plants for pest resistant (Bt-cotton); herbicide resistance (RoundUp Ready soybean); improvedagronomic traits - flavrSavr tomato, Goldenrice); Improved horticultural varieties	8	5
4		**Practicals**		
	4.1	Preparation of MS medium.	2	6
	4.2	Demonstration of in vitro sterilization methods and inoculation methods using leaf and nodal explants of Tobacco/ Datura/Brassica etc	4	6
	4.3	Study of embryo and culture, micro propagation of Banana, somatic embryogenesis, artificial seeds through photographs.	4	6
	4.4	Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, and micro projectile bombardment.	4	6
	4.5	Different steps involved in genetic engineering for production of Bt.cotton, Golden rice, Flavr Savr tomato through photographs.	4	6
	4.6	Isolation of plasmid DNA	6	6
	4.7	Field visit to a lab involved in Tissue culture	6	6
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, Explicit Teaching, E learning, Interactive instruction, Group assignments,Library work, Group discussion. Presentation by individual students.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **Theory Total -25 Marks -** Quiz/Test Paper/Seminars **Practical Total 15 Marks -** Lab performance/ Record
	End Semester Examination **Theory Total -50 Marks Duration -1.5 hrs** Short Essay 5 out of 7 x 4= 20 Marks Short Questions 10 out of 12 x 2 =20 Marks Fill in the blanks -10x1 = 10 Marks **Practical Total -35 Marks Duration -2 hrs** Record: 10 Marks; Examination :25 Marks, Spotter Identification-8 Marks, In vitro sterilization methods and inoculation methods using leaf / nodal explant s-8Marks, Isolation of Plasmid DNA-4 Marks, Submission of field report -4 Marks &Viva-1

References

1. Trigiano, R.N., D.J. Gray (Eds) 2010. Plant tissue culture, development andbiotechnology,CRCPress, London, UK
2. Razdan, M. K. (2004). Introduction to Plant Tissue Culture. 2nd ed. Oxford &IBHPublishingCo.Pvt. Ltd., New Delhi
3. Hammoond, J., McGarvey, P. and Yusibov, V. (2000). Plant Biotechnology. SpringerVerlag,NewYork.
4. S Ignacimuthu (2006). Biotechnology: An introduction. Narosa Publishing House.
5. Edwin F George (1993)plant propagation by tissue culture part I and II Thetechnology.Exegetics ltd
6. Kalian Kumar De (2003)An introduction to plant tissue culture, New central bookagencypvt.Ltd

Suggested Readings

7. Keshavachandran R & Peter KV (2008) Plant Biotechnology: Methods in TissueCultureandGene Transfer. Orient & Longman (Universal Press)
8. S S Bhojwani, M K Razdan (1996). Plant tissue culture: Theory and Practice. Elsevier.
9. L Gamborg, G C Philips (Eds.) (2005). Plant cell, tissue and organculture:Fundamental methods. Narosa Publishing House.

SCHEME OF EVALUATION FOR INTERNSHIP

A.INTERNAL EVALUATION - 15 MARKS

Sl.No	Head	Marks
1	Content & relevance of Dissertation as evidenced from work diary	8
2	Presentation	4
3	Viva	3

B.END SEMESTER EXAMINATION - 35 MARKS

Sl No	Head	Marks
1	Content & relevance of Dissertation as evidenced from work diary	20
2	Presentation	10
3	Viva	5

EVALUATION OF PROJECT IN THE EIGHTH SEMESTER OF FOUR YEAR UNDER-GRADUATE PROGRAM

Evaluation of Project

The project should contain:

1. Title page/Front page (Certified by the HOD)
2. Declaration by the candidate
3. Certificate attested by the Supervising teacher
4. Acknowledgement, if any
5. Table of contents
6. Abbreviation, if any
7. Abstract
8. Introduction & Review of Literature
9. Methodology
10. Results and Discussion
11. Summary and Conclusion
12. References

The project report submitted must be duly attested by the Supervising Teacher and certified by the Head of the Department. There shall be a pre submission presentation and evaluation of the project in the middle of the eighth semester.

Mark for internal evaluation is 60.

Scheme for internal evaluation

Sl No	Component	Marks
1	Topic/Area selected (relevance)	5
2	Experimentation/Data collection	15
3	Punctuality	5
4	Compilation	10
5	Content	10
6	Presentation	15
	TOTAL	60

The end semester evaluation of the Project shall be according to the Scheme given below.

Sl No	Component	Marks
1	Originality of approach, Introduction & aim of the project/objectives, Organization and Precision of Printed work	10
2	Relevance of the Topic	10
3	Review of Literature	10
4	Methodology	20
5	Involvement	10
6	Result and discussion: tabulation of data, presentation of figure/graphs, clarity of explanations etc.	20
7	Bibliography in correct format	10
8	Conclusions/ Applications to the society	10
9	Presentation of Report and Viva voce	30
10	Exceptional quality of the project	10
	TOTAL	**140**