Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

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Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Bio Sciences

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
MG1DSC UBS101	Cell and its constituents	4	3	1	Foundation (100-199)	Major
MG1DSC USB121	Science of inheritance	4			"	Minor-A
MG1DSC USB141	Pandemics and infectious diseases	4			"	Minor-B
MG1MDC USB101	Biosciences in everyday life	3			"	MDC
	AEC (Eng)	3			"	AEC
	AEC (Mal)	3			"	AEC
SEMESTER II						
MG2DSC UBS101	Ecology and Evolution	4			"	Major
MG2DSC USB121	Molecules of life	4			"	Minor A
MG2DSC USB141	Functional Biology	4			"	Minor B
MG2MDC USB101	Philosophy of science	3			"	MDC
	AEC (Eng)	3			"	AEC
	AEC (Mal)	3			"	AEC
SEMESTER III						

MG3DSC UBS201	Principles of Genetics	4	3	1	Intermediate (200-299)	Major
MG3DSC UBS202	Animal Diversity	4			"	Major
MG3DSC UBS203	Plant Diversity	4			"	Major
MG3DSC USB221	Economic importance of microorganisms	4			"	Minor
MG3MDC USB201	DNA Forensics	3			"	MDC
MG3VAC USB201	Healthy gut and happy life	3			"	VAC
SEMESTER IV						
MG4DSC UBS201	Human Physiology	4	3	1	"	Major
MG4DSC UBS202	Plant Physiology	4			"	Major
MG4DSC UBS203	Immunology	4	3	1	"	Major
MG4DSC USB221	Microbial Biotechnology	4			"	Minor
MG4SEC USB201	Basic Microbiology Techniques	3			"	SEC
MG4VAC USB201	Vitamins and hormones	3			"	VAC
MG4INT	Internship/Fieldwork	2				

USB200						
SEMESTER V						
MG5DSC UBS301	Biomolecules	4	3	1	Higher (300-399)	Major
MG5DSC UBS302	Fundamentals of Microbiology	4	3	1	"	Major
MG5DSC UBS303	Molecular Biology	4	3	1	"	Major
MG5DSC UBS304	Biophysics and Biostatistics	4	3	1	"	Major
MG5SEC USB301	Animal cell culture	3			"	SEC
MG5VAC USB301	IPR	3			"	VAC
SEMESTER VI						
MG6DSC UBS301	rDNA Technology	4	3	1	"	Major
MG6DSC UBS302	Metabolism and Bioenergetics	4	3	1	"	Major
MG6DSC UBS303	Food microbiology	4	3	1	"	Major
MG6DSE UBS304 **MG6DSE UBS305** **MG6DSE UBS306**	1.Bioinformatics 2.Molecular Microbiology 3.Toxicology	4			"	Major (E)

MG6DSE UBS307 **MG6DSE UBS308** **MG6DSE UBS309**	1.Health and nutrition 2.Microbes and Environment 3.Forensic Medicine	4			"	Major (E)
MG6SEC USB301	Plant tissue culture	3			"	SEC
Total Credits		**133**				

SEMESTER VII						
MG7DSC UBS401	Bioinstrumentation	4	3	1	Advanced (400-499)	Major
MG7DSE UBS402 **MG7DSE UBS403**	1.Environmental Biotechnology 2.Techniques in diagnostic microbiology	4	3	1	"	Major (E)
MG7DSE UBS404 **MG7DSE UBS405**	1.Advances in cellular processes 2.Molecular Endocrinology	4	3	1	"	Major (E)
MG7DSC USB421	Life style diseases	4			"	Minor A/B

MG7DSC USB422	Probiotics	4			"	Minor A/B (E)
MG7DSC USB423	Plant-Microbe interactions	4			"	Minor A/B (E)
SEMESTER VIII						
MG8DSC UBS401	Enzymology	4	3	1	"	Major
MG7DSE UBS402 **MG7DSE UBS403** **MG7DSE UBS404**	1.Pharmaceutical Biochemistry 2.Human Virology 3.Animal Biotechnology	4	3	1	"	Major (E)
MG8RPH UBS400	Research Project	12			"	Research Project
MG8DSC UBS405	1.Medical Biochemistry	4	3	1	"	Major*
MG8DSC UBS406	2.Industrial Biotechnology	4	3	1	"	Major*
MG8DSC UBS407	3.Industrial Microbiology	4	3	1	"	Major*
Total Credits		**44**				
SEMESTER IX						
MG9DSC UBS501	Biological Techniques	4			PG Level (500-599)	Major
MG9DSC	Research Methodology	4			"	Major

UBS502						
MG9DSC UBS503	Research Ethics	4			"	Major
	Specialization -Biochemistry					
MG9DSC UBS504	a) Clinical Biochemistry b) Plant Biochemistry	4	3	1		
MG9DSC UBS505		4	3	1		Major-1 & 2
	Specialization -Microbiology					
	a) Medical Microbiology b) Agricultural Microbiology					
MG9DSC UBS506		4	3	1		
	Specialization – Biotechnology					
MG9DSC UBS507	a) Bioprocess technology b) Plant Biotechnology	4	3	1		
MG9DSC UBS508		4	3	1		
MG9DSC UBS509		4	3	1		
SEMESTER X						
MG10RPH UBS500	Research Project	20			"	Research Project
		4			"	Major**
		4			"	Major**

		4			“	Major**
		4			“	Major**
		4			“	Major**
Total Credits		**40**				

*Only for 4-Years Honours Students
**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation (100-199	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Cell and its Constituents**		
Course Type	**Major**		
Course Level	100-199		
Course Code	*MG1DSCUBS101*		
Course Overview	Cell and its constituents: The major course for Bioscience Graduate & Honours comprises the study of Basic unit of life, different types of cells & cellular constituents. The course contents deal with the structure and functions of cell and cellular components as well as the event of cell division and multiplication. By understanding the structure of cell and its components students should able to acquire a basic knowledge regarding the functioning of each components of cell and their coordination for the growth, development & multiplication a cell.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	50	10	
Pre-requisite			

	Basics of Cell Biology in the 11th and 12th standard

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Explain the scope of cell biology, explain principles of cell theory & Understand different types of cells	Remember, Understand	
2	Deep understanding of structure and functions of cell and its organelles. Explain different models of cell membrane and different mode of cell permeability	Understand, Apply	
3	Understand the structure and function of Nucleus, types of chromatin and levels of chromatin organization. Analyse the processes of cell cycle & cell division,	Understand, Analyse	
4	Develop skill in use of microscope, evaluate and understand different stages of cell cycle and cell division	Skill, Evaluate, Understand	
5	Communicate effectively about a relevant topic in Cell & its constituents both verbally and in writing	Analyse, Create	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1-Introduction to Cell Biology	Hours	CO No
History and scope of Cell Biology, Cell as basic unit of life, Cell theory, Board classification of Types of cells: Prokaryotes, Eukaryotes (animal cell & plant cell), Actinomycetes, Mycoplasma, Virus, Virion, Viroid and Prion	**10**	
Module 2 -Structure and Function of Cell & Cell Organelles		
Structure & Function of Cell wall &Cell membrane, Molecular models of cell membrane - Sandwich model, Unit membrane model, Fluid mosaic model. Cell permeability - Diffusion, Osmosis, Passive transport, Active transport. Cell Organelles-Structure and Functions: Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Peroxisomes, Proteosomes,	**20**	

Mitochondria, Plastids, Chloroplast, Centrioles and Basal bodies. Cytoskeleton - Microtubules, microfilaments, intermediate filaments		
Module 3 -Nucleus, Cell Cycle & Cell Division		
Nucleus: Structure of nucleus, nuclear membrane, pore complex, Nucleolus -Structure and functions, Chromatin - euchromatin and heterochromatin, different levels of chromatin organization, Chromosome - structure of 23 a typical metaphase chromosome; giant chromosomes, polytene chromosomes, lamp brush chromosomes; endomitosis Cell Cycle & its check points: G1, S, G2 and M phases. Cell Division: Mitosis – Stages. Meiosis – Stages	**20**	
Module 4- Practicum		
1. Study of microscope - parts of a compound microscope, use and maintenance of a microscope. 2. Study of prokaryotic cells - (Staining and Microscopic Observation) 3. Eukaryotic cells - Plant and Animal cell (Staining and Microscopic Observation) 3. Laboratory Record	**10**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. De- Roberti's E.D. and De Roberti's Jr.E.M.F 2002. Cell and Molecular Biology (Lea & Febiger/Info-Med)
2. Cell and Molecular Biology by Gerald Karp,7th Edition,
3. Cell and Molecular Biology by De Roberti's E.D.P, 8th Edition
4. Karp. G., 1996. Cell and Molecular Biology, Concepts and Experiments
5. Powar C.B. 1983. Cell Biology (Himalaya Pub. Company) 5. Rastogi S. C. 1998. Cell Biology. Tata McGraw Hill Publishing Co., New Delhi
6. The Cell-A Molecular approach, Fifth edition, Geoffrey M Cooper and Robert E. Hausman ASM Press, Washington DC

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand Cell as the basic unit of life and how cellular components coordinate the function of a cell as well as process of cell cycle and mechanism of cell division.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Science of inheritance**		
Course Type	**Minor**		
Course Level	**100-199**		
Course Code	*MG1DSCUSB121*		
Course Overview	This course on Genetics deals with the frontier areas of basic biology The objective of the course content is to create a preliminary understanding about how genes behave in individuals and populations.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Basics of genetics in the 11th and 12th standard.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand how heredity and variation is transmitted	R	

	through generations and the practical applications of principles of genetics		
2	Understand how genes behave in populations	R,U	
3	Understand how gene exchange happens in microbes	U	
4	Analyze the different stages of mitosis and meiosis	An	
5	Communicate effectively about a relevant topic in ecology/ evolution both verbally and in writing	An, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Classical Genetics: Genetics, the evolution of the subject through pre mendelian, Mendelian and post Mendelian Peroids. Mendelism – the basic principles of inheritance, gene interactions – allelic and no allelic. Environment and gene expression, penetrance and expressivity. Multiple alleles and polygenic inheritance, Heritability and genetic advance	**15**	
Module 2		
Deviation to Independent assortment, Organelle Genetics: Linkage and linked genes with special reference to inheritance, Concept of Chromosome mapping with three - point test crosses. Organelle Genetics and cytoplasmic inheritance.	**15**	
Module 3 Populaion genetics and Medical genetics Population Genetics – types of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations-an introduction . Medical genetics - an introduction	**15**	
Module 4		
Genetic System in Microbes, Yeast and Neurospora: Plasmids & bacterial sex. Types of plasmids. Plasmids copy number and incompatibility, Replication of plasmid. Plasmid as a cloning vector. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, 2µm plasmids. Gene mapping in Bacteria. Bacteriophage genetics-Plaque formation & phage mutants, genetic recombination in lytic cycle. Genetic system in Yeast & Neurospora.	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:**

	Lab based activities
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings **Semester End examination – 60 marks**

Learning Resources

1. Strickberger M W (2015) Genetics 3rd Edition, Pearson
2. Genetics a conceptual approach. 6th edition. Benjamin Pierce, Macmillan Learning, New York
3. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand how genes behave in populations and individuals for transmitting heredity and variation.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Biosciences		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Pandemics and Infectious Diseases**		
Course Type	Minor		
Course Level	100-199		
Course Code	*MG1DSC USB141*		
Course Overview	This course on pandemics and infectious diseases deals with an overview on the scientific and social impact of diseases. As the society has already been experienced the severity of Covid-19 pandemic, a basic understanding on related topic is of much academic, scientific and social relevance. The objective of this course is to generate awareness among students to motivate them to contribute in this area which is highly essential for the existence of human.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	

	60	0
Pre-requisite	Basics of Biology in 11th and 12th standard	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the basics of diseases, causative agents and mode of transmission	U	
2	Understand the history of pandemic and will enable them to think about its impact and future challenges	U/An	
3	Get an overview on treatment methods in pandemic by considering Covid-19 as an example	U/A	
4	Get an insight into the relevance of course with respect to India and Kerala and which will motivate them to think innovatively for the management of emerging infectious diseases	U/An/E	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Infectious Diseases: Different types- endemic, epidemic, pandemic and prosodemic, An over view on common etiological agents- Bacteria, fungi, viruses, prions, and parasites. Mode of transmission. Methods for control	**15**	

Module 2 **Pandemic** : History of pandemics, Pandemic and public health, Major pandemics- plague, cholera, Spanish flu, SARS, MERS and COVID-19, COVID-19 : Origin and spread, transmission, diagnostic methods and treatment, role of quarantine and isolation protocols for COVID management, Health education and promotion in containment , Future challenges with pandemics	**15**	
Module 3 **Covid-19 Management:** Drugs used for the treatment of Covid-19, Immunoprophylaxis, Vaccines developed for Covid-19, types and mode of action, Covid-19 vaccines used in India, Challenges with Covid-19 vaccine, Covid-19 impact on society	**15**	
Module 4 **Emerging and Re-emerging Diseases**: Factors responsible for the Emerging and Re-emerging Diseases, Risk factors, Disease transmission from animals to humans, public health emergency infections, Indian and Kerala scenario of infections, Communicable disease programmes under the national health mission	**15**	

Mode of Transaction	**Classroom activities:** Lectures, teaching, learning through online resources, interactive discussion, assignments, seminars, discussion and interaction with experts from community medicine and infectious disease units of hospitals **Field activities:** Hospital visit, data collection **Lab based activities:**
Mode of Assessment	Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings Semester End examination – 60 marks

Learning Resources

1. **C. K Joseph**, G Madhukumar, Jacob Thomas, Chronicles of internationally acclaimed Covid 19 preventive measures of Kerala government, Holding Hands in Peril (Kerala Model), 2022 .Don Books,Kottayam.

2. **Harrison's** Infectious Diseases, Third Edition (Indian Edition) Paperback, 2016

3. **Andrej Spec** & Gerome V. Escota & Courtney Chrisler & Bethany Davies Comprehensive Review of Infectious Diseases, 1st Edition, 2019

Relevance of Learning the Course/ Employability of the Course
This is a fundamental course meant to give awareness on the scope and opportunities of this area both in research and biopharma industry. This is also meant to make the students to think and contribute for the benefit of society for a better and healthy life

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Biosciences in everyday life**		
Course Type	**MDC**		
Course Level	**100-199**		
Course Code	*MG1MDCUSB101*		
Course Overview	This course gives the student an overview of major areas of Biosciences and how our life is intertwined with the influence of biosciences. The course provides a preliminary idea of how diseases are caused and managed, how foods are preserved and are produced, and a general idea about the importance of DNA analyses. This would help the student to comprehend the matters concerned with the abovementioned areas in their daily life.		
Semester	1	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45	0	
Pre-requisite	Basic 10th standard level biology knowledge		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explain the major fields in biosciences	U	
2	Understand the basics of human health and fitness and analyse the different dietary and other options available for better nutrition and fitness	U, A	
3	Comprehend the deviations from normal health, its causes and laboratory results connected with common life style diseases and infections	U, A	
4	Understand the science behind food preservation and agricultural practices and can apply the knowledge when they indulge in such day-to-day activities	U, A	
5	Understand the basics of DNA analyses and its importance in diseases as well as forensics	U	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Biosciences: Different areas in Biosciences- Biochemistry, Microbiology, Biotechnology, Biophysics, Animal and Plant Sciences, Pharmacology, Toxicology.	**5**	
Module 2		
Human nutrition, health and fitness: Food groups and balanced diet, nutritional requirements for different age groups. Digestion of food, calorie values of different food, body mass index, Dietary supplements. Understanding dietary planning and management in health, fitness and disease. **Disease prevention, management and diagnosis** - Life style diseases- Causes, types and symptoms. Monitoring blood sugar and blood pressure, Control of bacterial and viral diseases- antibiotics and vaccines	**20**	
Module 3		

Food preservation and agricultural practices: Science behind food preservation, Fermentation of food, microorganisms involved in fermentation, wine production and beer manufacturing, beneficial microorganisms, yeast and probiotics, improved nutritional and functional quality of foods- genetically modified foods, food waste management and water purification. Organic farming, pesticide-free vegetables. **DNA analysis and forensics:** Introduction to DNA fundamentals, DNA evidence collection from biological samples to identify individuals involved in cybercrimes, Extraction of DNA from biological samples and analysis, DNA finger printing, DNA testing services including paternity testing.	**20**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Lectures and classroom teaching, E-learning, interactive and active co-operative learning, Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student **Field activities:** Small projects involving surveys and interviews **Lab based activities:** Demonstration /observation of key elements related to the subjects
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** - Tests of maximum 20 marks 2. Seminar Presentation – a related topic is to be discussed and presented as seminar - Maximum marks 5 3. Assignment - Write a detailed report on a given topic based on available literature - Maximum marks 5 **Semester End examination –45 marks**

Learning Resources

1. Nutritional Biochemistry (2017) Sharma D. C ISBN-13- 978-8123925271
2. Introduction to Bioscience by Dr. O.N. Pandey (2013) ISBN-13- 978-9350143247
3. Food Facts & Principles" by Shakuntala Manay (2001) New Age International, ISBN 8122413250, 9788122413250
4. Text Book on Food Microbiology. (2020) Rajeswari Anburaj ISBN: 978-81-947191-6-8, 978-81-947191-7-5
5. Food Science" by Norman Potter: fifth edition (2007) ISBN-13- 978-8123904726
6. Text book of nutritional in health and diseases by kaveri chakrabarty and chakrabarty (2020)- ISBN-13- 978-9811509612
7. DNA science by David A Micklos. Second edition (2003) ISBN-13978-1936113170

Relevance of Learning the Course/ Employability of the Course
The course will help the student to comprehend bioscience-related problems or matters in their daily life and equip them to act accordingly in a meaningful way.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Ecology and evolution**		
Course Type	**Major**		
Course Level	**100-199**		
Course Code	*MG2DSCUBS101*		
Course Overview	This is an interdisciplinary course that involves studying biological processes that range from single cells to bigger ecosystems, also studies focus on factors that are key to understand the evolution of organisms, how biodiversity is generated and maintained, how organisms work, and how organisms interact with their environment		
Semester	2	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Basics of ecology and evolution in the 11th and 12th standard.		

COURSE OUTCOMES (CO)

CO	Expected Course Outcome	Learning	PSO No.

No.		Domains	
	Upon completion of this course, students will be able to;		
1	Explain the processes, laws, and theories related to inheritance and evolution	R	
2	Students will be able to understand and communicate the sustenance of natural biological systems on the earth effectively	R, U	
3	Acquire skills in explaining all kinds of interrelationships in natural biological systems	U	
4	Students will be able to understand the significance of biodiversity and its conservation in the sustenance of natural ecosystems	U	
5	Communicate effectively about a relevant topic in ecology/ evolution both verbally and in writing	An, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Ecology and different ecological objects: Basic concept of the environment – components of the environment, the definition of ecology, ecological things. Autecological and Synecological concepts: **A. Population Ecology (Autecological concepts)**: **(a)** Characteristics of populations **(b)** Genecology - ecads, ecotypes, ecospecies, coenospecies; k-selection and r-selection populations **B. Synecological concepts(a)** Ecological processes of community formation, ecotone, edge effect. Classification of communities - criteria of classification, dynamic system of classification by Clement **(b)** Special plant communities - quantitative, qualitative, and synthetic characteristics of plant communities**, (c)** Dynamic community characteristics - cyclic replacement changes and cyclic no-replacement changes	**15**	
Module 2		
Ecological succession -(a) The concept – autogenic and allogenic succession, primary and secondary, autotrophic and heterotrophic **(b)** Retrogressive changes or the concept of degradation, concept of climax or stable communities, resilience of communities, ecological balance and survival thresholds **Biosphere and Ecosystem** - **(a)** Significance of habitat, biodiversity, ecological niche, trophic level, primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and nutrient cycles **(b**) Comparative study of the significant world ecosystems: Different aquatic and terrestrial ecosystems concerning their productivity, 0.5 57 biodiversity, energy flow, food chains and trophic levels	**15**	
Module 3		

Natural Resources: Soil, water and air Resources – soils and parent materials – ecology of soil fertility; Fresh water and marine resources – global distribution of water resources – surface and groundwater resources – water conservation – prevention of marine pollution – conservation of marine resources; Atmospheric resources – the structure of atmosphere – climate and weather – climatic factors – precipitation, wind temperature, aerosols. **Conservation of natural resources**	**15**	
Module 4		
Evolution: Origin of the universe and origin of life; concept of Oparin, Miller-Urey Experiments; Evolution of Prokaryotes - origin of eukaryotic cells - Margulis Endosymbiotic theory; **Geological Timescale:** Tools and techniques in estimating evolutionary time scale; **Theories of evolution of life**: Pre-Darwinian concepts – Lamarkism, Darwinism – major concepts - variation, adaptation, struggle, fitness and natural selection, Neo-Darwinian theories – theories of speciation – allopatric and sympatric speciation - Rose Mary and Peter Grant (Molecular evolution in Darwinian finches) - Neutral Theory of Molecular Evolution.	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:**
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings Maximum marks 10 **Semester End examination – 60 marks**

Learning Resources

1. MC Dash (1993) Fundamentals of Ecology, Tata McGraw Hills
2. Odum EP 3rd Edition (1991) Fundamentals of ecology, Saunders and Com
3. Jonathan B (2016) Principles of Evolution, Garland Science, Taylor and Francis

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to make ecological discourses and analyse the current issues

in and global ecosystems to interfere fruitfully.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Molecules of Life**		
Course Type	**Minor**		
Course Level	**100-199**		
Course Code	*MG2DSCUSB121*		
Course Overview	This course gives the student a clear idea about the structure and functions of different molecules present in biological systems, help them to differentiate between different types of biomolecules based on their structure, and help them to appreciate the importance of these molecules in the various biochemical processes in life. The course makes the student aware of the biological importance of vitamins and hormones, daily requirement of vitamins and the natural dietary sources, and how the altered levels of hormones and vitamin causes diseases.		
Semester	2	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45	15	
Pre-requisite	10^{th} standard level biology and chemistry knowledge		

COURSE OUTCOMES (CO)

CO	Expected Course Outcome	Learning	PSO No.

No.		Domains	
	Upon completion of this course, students will be able to;		
1	Identify and differentiate the structural and functional features of biomolecules such as proteins, nucleic acids, lipids and carbohydrates	U, An	
2	Understand the higher order structural organisation of proteins, nucleic acids and carbohydrates	U	
3	Explain the role of vitamins in maintaining health and related deficiency disorders	U	
4	Explain the role of hormones in health and diseases associated with their altered levels in the body	U	
5	Develop basic skill for analysing the presence of carbohydrates, proteins and lipids in biological samples	S	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Carbohydrates: Classification of Carbohydrates with examples- monosaccharides, disaccharides and oligosaccharides; their structure and functions. Anomers, epimers and enantiomers, Reducing and nonreducing sugars. Polysaccharides - structure and functions of homoglycans- starch, glycogen, cellulose, structure and functions of heteroglycans –glycoaminoglycans (An example). Glycolipids and Glycoproteins. **Lipids:** Classification of lipids with examples; their structure and functions. Simple lipids- Triacyl glycerol, waxes, Compound lipids- phospholipids, Glycolipids and lipoproteins - structure and functions., Derived lipids- Fatty acids, cholesterol.	**15**	
Module 2		
Proteins: Amino acids- Structure and properties**,** Classification of proteins on the basis of shape. Structural organisation of proteins- Primary structure, Secondary, tertiary and quaternary structures of proteins. Forces that stabilize protein structure.	**15**	

Nucleic Acids: Components of nucleic acids**,** Watson -Crick model of DNA structure. Higher order organization of DNA. RNA Structure: Types of RNA; structure of mRNA, tRNA and rRNA.		
Module 3		
Vitamins: -water soluble -thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-source, functions, and deficiency diseases; fat soluble -vitamin A, D, E, K, -source, functions and deficiency diseases. Hormones: endocrine gland, Major hormones of hypothalamus, pituitary gland, thyroid gland, parathyroid glands, pancreas, adrenal glands, testes and the ovaries -their biological role and related disorders.	**15**	
Module 4		
Laboratory identification of carbohydrates- General reactions of fructose, lactose, and starch, Laboratory identification of protein- Albumin or Casein, Qualitative analysis of fats	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Lectures and classroom teaching, E-learning, interactive and active co-operative learning, Seminar, Assignments, Library work and Group discussion, Presentation by individual student **Field activities:** **Lab based activities:** Hands on laboratory training, demonstration, Case-based discussions
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests -maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar- Maximum marks 10 3. Assignment- Write a detailed report on a given topic - Maximum marks 10 **4. Semester End examination – 60 marks**

Learning Resources

1. Biochemistry 10th Edition by Jeremy M.berg, Gatto Jr. Gregory, Hines Justin (2023) Publisher:W.H.Freeman & Co Ltd;Pvt.Ltd ISBN-10:1319498507 ISBN-13: 978-1319498504

2. Lehninger Principles of Biochemistry, 8th edition, (2021) Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; ISBN-13: 978-1319228002 ISBN-10: 1319228003
3. Fundamentals of Biochemistry, 6th Edition, Donald Voet, Stephen Woski, Judith G. Voet, Charlotte W. Pratt, Destin Heilman, (2024) Publisher: Wiley, ISBN: 978-1-119-90348-2

Relevance of Learning the Course/ Employability of the Course
The course equips the students to identify the major molecules present in the living beings. Understanding the importance of these molecules will be useful in their own life and also, will be helpful in the deeper understanding of allied subjects.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4+1 Integrated UG and PG Programme**		
Course Title	**Functional Biology**		
Course type	**Minor**		
Course Level	**100-199**		
Course code	MG2DSC USB141		
Course Overview	In Functional Biology , students will be introduced to the fascinating field of physiology, which is the study of how living body functions. This course will explore how the overall functional properties of an individual depend on the operation of its organs, and how the function of these organs is governed by cellular and molecular systems. Physiologists seek to answer two fundamental questions: What is the mechanism by which a function is accomplished? How did that mechanism evolve? To address these questions, students will learn to integrate knowledge from chemistry and physics with biological principles. This interdisciplinary approach is essential for understanding the complex processes that sustain life. Moreover, the study of physiology is critical for comprehending the health and disease of both non-human animals and humans. By the end of this course, students will have gained insights into the functioning of organs, cells, and molecules, and how these interactions contribute to maintaining health and developing treatments for diseases. This knowledge is vital for improving the well-being of all living creatures.		
Semester	2	Credit	4
Total student Learning time	Instructional hours for theory	Instructional hours for practical/ lab work/ field work	
	60	NIL	
Pre-requisite	NIL		

COURSE OUTCOMES (CO)

CO NO.	EXPECTED OUTCOME	LEARNING DOMAINS	PSO NO
	Upon completion of this course, students will be able to;		
1	Understand the Hierarchy of Structural Levels	U	
2	Master the Concepts of Homeostasis	R	

3	Recognize the Organization and Regulation of Body Systems	A	
4	Identify and Describe Organ Systems	E	
5	Integrate Knowledge from Multiple Disciplines	A	
6	Apply Physiology to Health and Disease	A	

MODULE 1	HOURS	CO
Exploring Life and Science, hierarchy of structural levels in biological organization, homeostasis, negative feedback, positive feedback, organization and regulation of body systems, histology, general features of the four major classes of tissues, Identify the organ systems, their functions, and the major organs in each system	15	
MODULE 2		
Skeletal System- general functions of the skeletal system, Cardiovascular System-functions and major components of the cardiovascular system, heart, pulmonary and systemic circuits, systole and diastole, blood, blood groups, blood pressure and heart rate, Respiratory System-Identify the main structures of the respiratory system and state their functions, Trace the flow of air from the nose to the pulmonary alveoli, mechanisms of transporting O_2 and CO_2	15	
MODULE 3		
Muscular System- structure and functions of muscles, stimulation of muscle fibre, isotonic and isometric contraction, Nervous System-function of the nervous system, anatomical and functional subdivisions of the nervous system, communication within a neuron and between neurons, reflex, mechanism of sensory perception, Endocrine System-hormones and major organs of the endocrine system, hyposecretion and hypersecretion	15	
MODULE 4		
Digestion and nutrition-structures of the digestive system and functions, basic processes underlying digestion, vitamins and minerals, Osmoregulation and mammalian kidney, Reproduction and development-fundamental biological distinction between male and female, oogenesis with spermatogenesis, fundamental processes involved in ovulation and menstruation, process of fertilization, implantation and pregnancy	15	

COURSE CONTENT

Mode of transaction	Class room activities- Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Mode of assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Vander's Human Physiology- The mechanism of body function. Widmaier, Raff & Strang
2. Textbook of Medical Physiology. Arthur.C. Guyton& John.E. Hall
3. Physiological basis of Medical Practice. John.B. West
4. Endocrinology- Mac E Hadley

Relevance of Learning the Course/ Employability of the Course
Learning Functional Biology is crucial for grasping the complexities of living organisms and their systems. This course equips students with essential knowledge and skills, enhancing their employability across various fields. By understanding how animal bodies function and how physiological mechanisms have evolved, students gain a comprehensive foundation that prepares them for diverse and impactful careers in healthcare, research, education, and beyond. This solid grounding in physiology not only opens up opportunities in medicine and veterinary sciences but also paves the way for roles in environmental conservation, biotechnology, agriculture, and science communication.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Philosophy of Science**		
Course Type	**MDC**		
Course Level	**100-199**		
Course Code	*MG2MDCUSB101*		
Course Overview	This course on Philosophy of science deals with the history of science and its philosophical interpretation. The objective of the course content is to create an understanding about the important milestones in the structure of scientific revolutions		
Semester	2	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45	0	
Pre-requisite	Basic exposure to science and social science		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		

1	Understand how science got evolved into the present form	R	
2	Evaluate important milestones in the scientific developments	R, U	
3	Understand the significance of ethics in scientific research	U	
4	Analyze the progressive impact of science on society	A	
5	Communicate effectively about important milestones in scientific development and its social significance	A, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Module I: The History of Science Ancient civilization in India, china, Babylon, Egypt, Greece, Rome, Origin of science, Socrates, Plato, Aristotelian views, Archimedes, The Copernican revolution, Contributions of Galileo, Keppler, Louis Pasteur, Newton, Einstein, Linus Pauling, Development of science, Science in the 21 st century	**15**	
Module 2		
Module II : Philosophical Perspective Ancient Philosophy, Philosophers of science- Immanuel Kant, Karl Popper, Will Durant, Thomas Kuhn , Imre Lakotte., Argumentation analysis, Types- Rhetorical and Dialogue, Positivism, Relativism, Realism. Factors affecting scientific interaction, Positivist perspective, Proximate ultimate causation, Pseudoscience. Improving reasoning, Critical thinking, Affective strategies, Cognitive strategies,	**15**	
Module 3	**15**	
Module III: Science and society Scientific outlook, Verifiability and reproducibility, Plagiarism, IPR, Cyberlaws, Internet security, Media role, Science and knowledge, Beliefs, Justification ,Need of Environmental Education, Social perspective, Ethical dilemmas ,Ethics in science, Kantian ethics ,Literature and science		

Module 4		
Module IV: Current Trends in Science Latest developments in various branches of science and technology, Importance of Nobel Prizes, Science education, Scientific research, Science literacy, how science is changing the world, Artificial Intelligence in science, Science in future, Challenges and prospects	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities**
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar - Maximum marks 5 3. Write a detailed report on a given topic based on research findings - Maximum marks 5 **Semester End examination –45 marks**

Learning Resources

1. Science in history, 1-4 Volumes ,J D Bernal, MIT Press,Cambridge,1971.
2. The Story of Civilization, Will Durant, Simon and Schuster Publishers, United States, 1975
3. The Scientific Outlook, Bertrand Russell, Routledge Classics
4. Science and Society, John Scales Avery, World scientific
5. The New Physics, C.V. Raman, Literary Licensing LLC, Wisconsin
6. Evolution of the Philosophy of Science-Literary Perspectives, K. Sujatha, and S. Kurien, Ane Books Pvt. Ltd, 2011.
7. One, two, three…infinity ,George Gammow, Dover Publications, INC, NewYork,1974
8. Science and society: Scientific thought and education for 21 st centaury, Peter S .Daempfle,

Jones &Bartlett Learning, Burlington

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand the structure of scientific revolutions

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Principles of Genetics**		
Course Type	**Major**		
Course Level	**200- 299 Intermediate**		
Course Code	**MG3DSCUBS201**		
Course Overview	This course on Genetics deals with the frontier areas of basic biology The objective of the course content is to create a preliminary understanding about how genes behave in individuals and populations.		
Semester	3	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	20	
Pre-requisite	Basics of Genetics in the 11th and 12th standard.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to**;**		
1	Understand how heredity and variation is transmitted through generations and the practical applications of	R	

	principles of genetics		
2	Understand how genes behave in populations	R,U,	
3	Understand how gene exchange happens in microbes	U,	
4	Analyse the practical applications of principles of genetics	An	
5	Communicate effectively about a relevant topic in Principles of Genetics both verbally and in writing	An, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1 Mendelian Genetics	**Hours**	**CO No**
History of genetics Pre-mendelian, Mendelian and post mendelian era. Mendel's Experiments and laws of inheritance. Multiple alleles, Allelic and non-allelic interactions, Environment and gene expression with special relevance to phenocopy, Penetrance and expressivity, Pleotropism and polygenic inheritance, Heritability and genetic advance. Sex linked, sex limited and sex influenced genes, Pseudo-autosomal genes	**10 hrs**	**1,5**
Module 2 Deviation to Mendelian principles	**Hours**	
Linkage deviation to independent assortment:- theory of Linkage, Types of linkage- complete and incomplete, Two point & Three point cross, Factors affecting Linkage and recombination of genes based on Morgan's work on Drosophila, Linked genes, Linkage groups, Chromosome Crossing over and its significance, Interference & Coincidence, Linkage and Chromosome mapping. Extrachromosomal inheritance deviation to law of segregation:- Uniparental inheritance, organellar inheritance, Maternal inheritance, maternal effects, Infectious particle inheritance, genomic imprinting with examples, Genetics of chondriome and plastome.	**10 hrs**	**1,5**
Module 3 Microbial and Human genetics Bacterial Genome, Recombination in Bacteria- Transformation. Transduction, Conjugation, F-mediated sexduction. Resistance Transfer Factor (RTF), Mechanism of drug resistance in Bacteria. Transposable genetic elements in Bacteria and transposition in Bacteria. Genetics of Viruses and Bacteriophages. Sex determination mechanisms in plants and animals, Sex chromosomes and autosomes, Human Karyotyping - Characterization of chromosomes using various banding techniques. Autosomal and sex chromosomes aneuploidies, Single gene disorders and in born errors of metabolism. Poly genic disorders	**10 Hrs**	**1.3. 5**
Module 4 Population genetics Genes and alleles in population, Finding variability, Hardy Weinberg Equilibrium, Assumptions, and deviations of HW equilibrium, applications of HW equilibrium,	**Hours** **10**	**3.5**
Module V: Practising principles of genetics Analyzing Mono hybrid, dihybrid and trihybrid crosses, and Gene interactions, Three-point crosses and genetic mapping, Understanding extrachromosomal inheritance and population	**20**	

genetics		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities**
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings **Semester End examination – 60 marks**

Learning Resources

1. Strickberger M W (2015) Genetics 3rd Edition, Pearson
2. Genetics a conceptual approach. 6th edition. Benjamin Pierce, Macmillan Learning, New York
3. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
4. Sinnut Dunn & Dobzhansky 1959, Principles of Genetics (T.M.H. New Delhi)
5. Sobti & Sharma 2008. Essentials of Modern Biology Ane's Student Edition
6. Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)
7. Verma P.S and Agarwal V.K. 1998 Genetics (S. Chand and Co. New Delhi)
8. Genetics Robert F Weaver and Philip W Herdick, 2014, Bio green Books

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand how genes behave in populations and individuals for transmitting heredity and variation. They may further their career by higher studies in genetics, genetic conselling and genetic data interpretation

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Animal diversity**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG3DSCUBS202**		
Course Overview	The course examines the development of multicellularity, body plans including body layers,cavities and symmetry of animals as well as their adaptations to environments and life styles.		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	50	10	
Pre-requisite	Basic knowledge in Cell Biology		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

	Upon completion of this course, students will be able to;		
1	Explaining the body organization of animals and key concepts of Taxonomy	Remember (R), Understand (U)	
2	Indepth knowledge of the general characters, classes, of members of Kingdom Protista with reference to pathogenic organisms and their pathogenicity	Remember (R), Understand (U), Analyze (An)	
3	Understand the distinguishing characteristics and classification of the major vertebrate and non vertebrate phyla and compare the adaptations and complexities of model organism	Understand (U), Analyze (An)	
4	Examine the anatomy, morphology and osteology of vertebrates and non vertebrates, Apply taxonomic keys in classification of vertebrates and non vertebrates	Analyze (An), Evaluate (E), Skill (S)	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module I: Animal Taxonomy & Animal Body Oganization	**Hours**	**CO No**
Brief history, Concepts and definition, Importance of classification, International Code of Zoological Nomenclature (ICZN), Importance principles of ICZN, Five Kingdom ClassificatioN. Symmetry – Asymmetry, Spherical, Radial, Biradial and Bilateral. Coelom–Acoelomates, Pseudocoelomates and Eucoelomates, Schizocoelom and Enterocoelom, Protostomia and Deuterostomia, An overview of Animal diversity	**10**	**1**
Module II: Kingdom Protista		
Introduction, general characters, classification with brief account on examples of each phylum. Study of important human Protist pathogens.	**20**	**2**
Module III: Kingdom Animalia – Non Chordata and Chordata (Only brief account on examples)		
Outline classification of Kingdom Animalia. Three branches – Mesozoa, parazoa, Eumetazoa, Salient features and life cycle of model organism of the following; **1. Non Chordata** Phylum Porifera, Coelentrata, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata **2. Chordata** (a) Protochordata (Lower Chordata) – (Sub phylum Urochordata,Cephalochordata) (b) Craniata (Higher Chordata) –(Sub Phylum Vertebrata- Division Agnatha and Division Gnathostomata- Anamniota (Super Class Pisces) and	**20**	**3**

Amniota (Super class tetrapoda-Amphibia, Reptilia, Aves, Mammalia)		
Module IV:Practicals		
General identification of the following animals (two representatives from each) by their scientific names. Protists, sponges, coelenterates, flat worms (free living & parasitic), parasitic nematodes, economically important crustaceans, insect vectors/pests, economically important molluscs, echinoderms, common food fishes of Kerala (marine & fresh water), common amphibians of Kerala, snakes of Kerala (Nonpoisonous & Poisonous), rodents. 2. Study the beak and feet modifications in the following birds - duck, parrot. 3. Taxonomic identification using keys (five specimens each):- a. Identification of insects up to the level of order b. Identification of fishes up to the level of order. c. Identification of snakes up to family. 4. Scientific Drawing – a. Make scientific drawings of 10 locally available specimens (5 invertebrates + 5 vertebrates) belonging to different phyla. 5. Study the following using temporary/permanent slides Cockroach - Salivary glands Fish scales – Placoid,cycloid,ctenoid 6. Laboratory Record	**10**	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Zoological Society of Kerala Study material. Animal Diversity 2002
2. Kotpal R.L. 2020, Modern Text Book of zoology, Vertebrates, Rastogi Publications,Meerut
3. Kotpal R.L. 2020, Modern Text Book of zoology, Invertebrates, Rastogi Publications,Meeru

4. Lisa Urry ,Michael Cain, Steven Wasserman, Peter Minorsky , Jane Reece.,2021 Campbell Biology by Published by Pearson 2021

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand diversity of the animal kingdom and how they are adapted to the environmenr, their relevance and need for balancing ecosystem.

	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Plant diversity**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG3DSCUBS203**		
Course Overview	The course examines the classification and evolutionary history of plants, their anatomy, structure, function as well as their physiology, development, growth, reproduction and their importance to the ecosystem		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	50	10	
Pre-requisite	Basic knowledge in Cell Biology		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explaining the concepts of Taxonomy, origin and diversity of plants	Remember (R), Understand (U)	
2	Indepth knowledge and comparison of the general characters, classes, of members of Kingdom Plantae-Cryptogamae with reference to their economic and ecological importance	Remember (R), Understand (U), Analyze (An)	
3	Indepth knowledge and comparison of the general characters, classes, of members of Kingdom Plantae-Phanerogamae with reference to their economic and ecological importance	Remember (R), Understand (U), Analyze (An)	

4	Examine the anatomy, morphology of different plant families using floral diagrams	Analyze (An), Evaluate (E), Skill (S)	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module I: Systematic Botany and Evolution of Plants	**Hours**	**CO No**
Aim, scope and significance, Uninominal, Binomial, & Trinomial nomenclature, ICN, Origin and Diversification of Plants	**10**	**1**
Module II: Kingdom Plantae-Sub kingdom Cryptogamae		
Introduction, General Characters, Economic importance evolution and alternation of generation in Algae, Fungi, Lichens, Bryophytes, Pteridophytes with life cycle of model organisms, Classification of Fungi by Ainsworth (1973).	**20**	**2**
Module III: Kingdom Plantae-Sub kingdom Phanerogamae		
Introduction, General Characters, Economic importance evolution and alternation of generation in Gymnosperms and Angiosperms with life cycle of model organisms, Classification of Angiosperms by Bentham and Hooker.	**20**	**3**
Module IV:Practicals		
I. Identify the following types by making suitable micropreperations and make labelled sketches. 1. Spirogyra, 2. Rhizopus, 3. Puccinia, 4. Riccia, 5. Pteris, 6. Cycas **II.** Family Studies 1. Annonaceae, 2. Malvaceae, 3. Leguminosae, 4. Rubiaceae, 5. Compositae,6. Ascipediaceae, 7. Euphorbiaceae,8. Poaceae III. Herbarium preparation Laboratory Record	**10**	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Lisa Urry ,Michael Cain, Steven Wasserman, Peter Minorsky, Jane Reece.,2021 Campbell Biology by Published by Pearson 2021
2. P.D Sharma., Fungi and Allied Organisms,Alpha science Publications
3. Phycology

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand diversity of the animal kingdom and how they are adapted to the environmenr, their relevance and need for balancing ecosystem.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**
Programme	**4 +1 integrated UG and PG programme**

Course Title	**Economic Importance of Microorganisms**		
Course Type	**Minor**		
Course Level	**200-299**		
Course Code	**MG3DSCUSB221**		
Course Overview	Economic Importance of Microorganisms: The minor course for Bioscience Graduate & Honours comprises the understanding of microorganisms and the impact of microbes on soil fertility, nitrogen fixation, pest control, and biofertilizer production. The course contents deal with the significance of microorganisms in food and beverage industries and their role in healthcare and pharmaceuticals, including antibiotics, vaccines, and biotechnology. This course will highlight the benefits and challenges associated with microbial use in various industries. By the end of the course, students will gain insights into how microorganisms shape industries and contribute to economic growth.		
Semester	3	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**		
	60		
Pre-requisite	Basics of Biology in the 11th and 12th standard		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	To provide a broad understanding of the economic roles of microorganisms in various industries	Understand	
2	To illustrate how microorganisms contribute to human well-being, environmental health, and industrial growth	Skill,Analyse, Evaluate	
3	To highlight the importance of microorganisms in sustainable practices and technological advancements	Understand, Apply	
4	To Evaluate the medical importance of microorganisms	Evaluate	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1- Introduction to Microorganisms	**Hours**	**CO No**
Basic Overview of Microorganisms-Types of microorganisms: bacteria, fungi, algae, viruses. General characteristics and their presence in nature.	**10**	**1**
Module 2 - Microorganisms in Agriculture		
Soil Fertility and Nitrogen Fixation. Contributions to sustainable agriculture. Biopesticides and Biofertilizers- Use of beneficial microorganisms to control pests and diseases. Impact of biopesticides in reducing reliance on chemical pesticides. Microbial action in composting. Economic benefits of composting in waste management	**10**	**3**
Module 3 - Microorganisms in Food Industry		
Fermentation in Food Production-Principles of fermentation. Role of yeast and bacteria in the production of bread, alcohol, dairy products, etc. Probiotics and Functional Foods-Health benefits of probiotic microorganisms. Food Preservation and Safety-Microbial methods in food preservation: fermentation, pickling, and refrigeration. Role of microorganisms in preventing foodborne illnesses.	**15**	**2**
Module 4- Microorganisms in Medicine		
Discovery and development of antibiotics; Mechanisms of action; Antibiotic Resistance- Economic impact of antibiotic resistance. Microbial production of vaccines; Recombinant DNA technology and production of insulin, growth hormones; Phage therapy.	**10**	**4**
Module 5- Industrial and Environmental Applications	**15**	**2**
Microbial production of biofuels, biogas, enzymes, and vitamins. Biodegradation and Bioremediation- mechanisms of cleaning up pollutants from the environment (e.g., oil spills, waste management). Microbial treatment of sewage and industrial waste; Emerging technologies- Green technology and Microbial consortia. Economic Impacts of Microorganisms: Transforming Industries and Environmental Sustainability		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Joanne Willey, Kathleen Sandman, Dorothy Wood (2022) Prescott's microbiology, 12th edition, Mcgraw-Hill Education, New York, ISBN – 13: 978-1265123031
2. William C Frazier, Dennis C Westoff, K N Vanitha (2013) Food Microbiology, 5th edition, Mcgraw-Hill Education, New Delhi, ISBN- 9339203224, 9789339203221
3. N.S. Subba Rao (2020) Agricultural Microbiology, 3rd Edition, Medtech, NewYork, ISBN: 9789388716956

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand the fundamental types and roles of microorganisms in nature and will gain insights into the broad economic potential of microorganisms and their significance in various global sectors.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**
Programme	**4 +1 integrated UG and PG programme**
Course Title	**DNA Forensics**
Course Type	**MDC**
Course Level	**200- 299 Intermediate**
Course Code	**MG3MDCUSB201**
Course Overview	This course on DNA forensics deals with the practical applications of DNA studies

	The objective of the course content is to create a preliminary understanding about how DNA studies are linked to everyday life.		
Semester	3	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	nil	
Pre-requisite	No prerequisite.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will have an idea about		
1	The basic principle of DNA analysis.	U	
2	The forensic significance of DNA typing.	U,	
3	The importance of short tandem repeats and restriction fragment length polymorphism in DNA technique.	U,A	
4	Role of DNA typing in person identification.	An	
5	Communicate effectively about a relevant topic in Principles of Genetics both verbally and in writing	An, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
DNA as biological blueprint of life. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis.	**15 hrs**	**1,5**
Module 2	**Hours**	
Forensic DNA Typing: Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci. Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA.	**15 hrs**	**1,3,5**
Module 3: Parentage Testing Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mendelian laws of	**15 Hrs**	**1,4, 5**

parentage testing. Mathematical basis of parentage identification. Missing body and personnel cases		
Module 4: Report Writing: Role of DNA typing in identifying unrecognizable bodies. Allele frequency determination. Hardy-Weinberg law. Probability determination in a population database. Reference populations and databases, Genealogy Databases, DNA phenotyping-case studies	**Hours 15**	**1.4,5**
	60	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, , Library work and Group discussion, Presentation by individual student/ Group representative
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings **Semester End examination – 60 marks**

Learning Resources

1. J.M. Butler, Forensic DNA Typing, Elsevier, Burlington (2005).

2. K. Inman and N. Rudin, An Introduction to Forensic DNA Analysis, CRC Press, Boca Raton (1997).

3. H. Coleman and E. Swenson, DNA in the Courtroom: A Trial Watcher's Guide, GeneLex Corporation, Washington (1994).

4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand how DNA technology has revolutionised Forensic science. They may further their career by higher studies in Forensic Science and get employed in private and public forensic labs.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Healthy gut and Happy life**		
Course Type	**VAC**		
Course Level	**200-299**		
Course Code	**MG3VACUSB201**		
Course Overview	This course on Healthy gut and Happy life deals with how our Gut influences our Health. Gut is known as our second brain as well as considered as an organ. The course will help to understand the structure, physiology, function and factors which influence the gut health and get an idea how can we improve our gut and maintain a good health.		
Semester	3	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45	0	
Pre-requisite	Basic exposure to science		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

	Upon completion of this course, students will be able to;		
1	Understand the structure and function of Gastrointestinal system	R	
2	To Study the nutrients and nutritional requirements for a balanced diet	R, U	
3	To study how can we maintain a healthy gut and how imbalance of gut influence our health.	U	
4	Analyze how life style influence our health and understand lifestyle diseases and their management.	An, U	
5	Communicate effectively about important milestones in scientific development and its social significance	A, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Module I: Introduction to Gastrointestinal system General Introduction. Anatomy and Physiology of GIS and associated organs -Mouth, pharynx, oesophagus, stomach, liver, gall bladder, Pancreas, small intestine and large intestine. Phases of digestion and absorption	**10**	
Module 2		
Module II : Diet for a Healthy Gut Types of nutrition and nutritional requirements. Chemical composition of food - Carbohydrates, proteins, lipids, vitamins and minerals - characteristics, sources, physiological and biochemical functions, Daily requirements, Recommended Dietary Allowance (RDA). Balanced diet formulations, Nutraceuticals-Fibres, Prebiotics and probiotics, Fermented foods etc	**10**	
Module 3	**13**	
Module III: **Balance and Imbalance Gut** Gut Homeostasis, contribution of digestive system to overall body functioning, Gut -axis to different organs, Gut microbiome- composition, factors affecting gut microbiome. Functional aspects of normal gut microbiota (metabolic, protective, structural and neurological). Disorders due to unbalanced gut microbiota. Defects of modern food habits: Acid reflex. Heartburn, Obesity, Anorexia, Acidity and ulcers, flatulence. Malnutrition-Protein Energy Malnutrition (PEM)		
Module 4		
Module IV Lifestyle Habits and diseases General introduction, Lifestyle, healthy habits, Regular exercise and its impact on gut motility, Lifestyle diseases- Atherosclerosis, Hypertension & Stroke, Diabetes and obesity, Cancer, Nephritis, Liver diseases, irritable bowel syndrome- symptoms, characteristics, causes, diagnosis, prevention and management. Body mass index (BMI) determination and	**12**	

significance. Importance of lifestyle factors in preventing disease development- diet, exercise, alcohol, smoking etc.		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities**
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar - Maximum marks 5 3. Write a detailed report on a given topic based on research findings - Maximum marks 5 **Semester End examination –45 marks**

Learning Resources

Guyton, A.C. (2021). Text book of Medical Physiology, W.B. Saunders Co, 14th edition

Karp (), Cell and Molecular Biology, John wiley and Son publication, 9th edition

Kumar R. (2004) Guide to Prevention of Lifestyle Diseases

Leininger, Albert L. (2021) *Leininger Principles of Biochemistry, 8th edition*

Satyanarayana, U. *Biochemistry, 6e-E-book: Biochemistry, 6e-E-book*. Elsevier Health Sciences, 2021.

Subrahamanyam, Sarada, K. Madhavankutty, and H. D. Singh. *Textbook of human physiology*. S. Chand Publishing, 2010.

Tortora, Gerard J., and Bryan H. Derrickson. *Principles of anatomy and physiology*. John Wiley & Sons, 2018. 15th edition

Vasudevan, Damodaran M., S. Sreekumari, and Kannan Vaidyanathan. *Textbook of biochemistry for medical students*. JP Medical Ltd, 2013.

Voet, Donald, and Judith G. Voet. *Biochemistry*. John Wiley & Sons, 2010.

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand the structure of scientific revolutions

	MAHATMA GANDHI UNIVERSITY GRADUATE SCHOOL

School	SCHOOL OF BIOSCIENCES		
Programme	4+1 INTERGRATED UG AND PG PROGRAMME IN BIOSCIENCES		
Course Title	HUMAN PHYSIOLOGY		
Course type	MAJOR		
Course Level	200-299		
Course code	MG4DSCUBS201		
Course Overview	Human physiology is the science of how the human body functions in health and disease. Students examine human physiological systems from the molecular and cellular levels to the human body as a whole. This area of study uses basic science to measure human responses to internal and external stimuli, and applies this knowledge to the promotion of human health.		
Semester	IV	Credit	
Total student Learning time	Instructional hours for theory & Practical		Instructional hours for theory/ practical/ lab work/ field work
	60 HOURS	4	Theory 3 hours & Practical 1 hour/ Week
Pre-requisite	Basic Knowledge in Biology		

COURSE OUTCOMES (CO)

CO NO.	EXPECTED OUTCOME Upon completion of this course, students will be able to;	LEARNING DOMAINS	PSO NO
1	Understand and explain the normal functioning of all the organ systems	Understand	
2	Master the Concepts of Homeostasis	Remember	
3	Explain various regulatory mechanisms and their Integration	Analyse	
4	Assess the relative contribution of each organ system to the maintenance of homeostasis	Evaluate	
5	Describe the physiological response and adaptations to environment stresses and during disease process.	Apply	

COURSE CONTENT

MODULE 1: GENERAL PHYSIOLOGY AND ENDOCRINE SYSTEM	**15 HOURS**
Structure and function of a cell, Principles of homeostasis, Intercellular communication, Transport mechanisms across cell membranes, Fluid compartments of the body, Ionic composition, Molecular basis of resting membrane and action potential, Physiological actions and effect of altered (hypo and hyper) secretion of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, hypothalamus, thymus, pineal gland and local hormones	
MODULE 2: CARDIOVASCULAR AND RESPIRATORY SYSTEM	**15 HOURS**
Blood- Composition and functions, Hemostasis, Blood groups, Heart, Electrocardiogram, Cardiovascular regulatory mechanisms, Echocardiography, Functional anatomy of respiratory system, Mechanics of normal respiration, Lung volumes and capacities, Spirometry, Transport of respiratory gases, Physiology of high altitude and deep-sea diving, Principles of artificial respiration, oxygen therapy, acclimatization and decompression sickness, Pathophysiology- dyspnoea, hypoxia, cyanosis asphyxia; drowning, periodic breathing	
MODULE 3: NERVE AND MUSCLE PHYSIOLOGY	**15HOURS**
Organization of nervous system, Structure and functions of a neuron and neuroglia, Nerve fibers: types, functions, properties, Electrical and chemical transmission in the nervous system, Functions and properties of synapse, reflex, receptors, Electroencephalography, Special senses, Types and structure of muscle fiber, Structure and transmission across neuro-muscular junction, Neuro- muscular blocking agents, Molecular basis of muscle contraction, motor unit, Muscular dystrophy, myopathies, Electromyography	
MODULE 4: DIGESTIVE SYSTEM, EXCRETORY SYSTEM AND REPRODUCTIVE SYSTEM	**15 HOURS**
Structure and function of digestive system, Liver and gall bladder, Liver Function tests, Structure and function of kidney, Mechanism of urine formation involving processes of filtration, tubular re-absorption and secretion, concentration and diluting mechanism, Renal regulation of fluid and electrolyte, acid base balance, Artificial kidney, dialysis and renal transplantation, Renal function tests, Sex determination, sex differentiation and their abnormalities, Puberty, reproductive system, Physiological effect of sex hormones	

Mode of transaction	Class room activities- Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction:, Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative

Mode of assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings

	and literature search – 10 marks B. Semester End examination – 60 marks

Learning Resources

1. Vander's Human Physiology- The mechanism of body function. Widmaier, Raff & Strang
2. Textbook of Medical Physiology. Arthur.C. Guyton& John.E. Hall
3. Physiological basis of Medical Practice. John.B. West
4. Endocrinology- Mac E Hadley
5. Understanding Physiology by Dr. R.L. Bijlani.
6. Review of Medical Physiology by W.F. Ganong.

Relevance of Learning the Course/ Employability of the Course
After completing the course students should be able to define basic physiological concepts, understand the mechanisms of the various bodily functions and explain how the regulatory mechanisms maintain equilibrium and function following a disturbance of equilibrium in a given physiological system. The solid ground in human physiology provide a foundation to work in science, academia or medicine. With a physiology major, student can pursue careers in research, medical sales, healthcare, pharmaceuticals or teaching

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Plant Physiology**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG4DSCUBS202**		
Course Overview	The course examines physiological aspects of plant with respect to growth development and response to hormones and stressful conditions		
Semester	IV	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	

	50	10
Pre-requisite	Basic knowledge in cell biology and biomolecules	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explaining the concepts of solute transport and the various ways in which plants respond to stressful conditions	Remember (R), Understand (U), Analyze (An)	
2	Indepth knowledge of the metabolic pathways in plants and their regulations	Apply (A), Evaluate (E)	
3	To analyze the different mechanism of hormonal action in plant growth and also to understand the relevance of light in different phases of plant growth	Analyze (An), Apply (A)	
4	Examine the different aspects of photosynthetic pigments and variations in levels of photosynthesis under various conditions	Evaluate (E), Skill (S)	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module I: Transport of water, nutrients and minerals in Plants	**Hours**	**CO No**
Physical aspects of absorption, Absorption of water active & passive, Ascent of sap , Transpiration – types mechanism – theories - (starch - sugar, proton - K+ion exchange) – significance, leaf anatomy for regulating transpiration, Control of stomatal mechanism, antitranspirants, Guttation. Essential and non essential elements- macro& micro- role-deficiency symptoms. Absorption of minerals– active & passive-ion exchange, carrier concept.	**10**	**1**

Entry of minerals into roots, Plant response to environment: Mechansim of response to Biotic and Abiotic factors,stress and pathogens		
Module II: Carbohydrate and Nitrogen Metabolism		
N – cycle, N fixation processes. Biological N fixation – structure of nitrogenise complex, reduction of N, Symbiotic N fixation – nodule formation, leghaemoglobin, Nitrate and ammonium assimilation. Transport of amides and ureides. Aerobic and Anaerobic, Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylations, ATPases - chemi osmotic hypothesis-RQ –significance factors affecting respiration	**20**	**2**
Module III: Photosynthesis, Physiology of growth and development		
Photosynthetic pigments, photo exitation- Fluorescence, Phosphorescence -Absorbtion and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems, Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways- C3, C4, CAM- Photorespiration –factors affecting photosynthesis. Sensory Photobiology: mechanisms of action of phytochromes,phytochrome mediated plant responses, Photoperiodism ,circadian rhythms, Floral induction and development. Physiological effects and practical application of hormones-Auxins, Gibberillins,Cytokinins, ABA, ethylene. Physiology of flowering – phytochrome –vernalisation.	**20**	**3**
Module IV:Practicals		
Plant Physiology 1. Determination of osmotic pressure of plant cell sap by plasmolytic method. 2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes. 3. Measurement of photosynthesis by Willmott‘s bubbler/any suitable method. 4. Estimation of plant pigments by colorimeter. 5. Measurement of Photosynthesis - Hill Reaction.	**10**	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning,

	Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Robert M Devlin, 2017, Outline of plant physiology Publisher Van Nostrind
2. Taiz, L. & Zeiger, E. 2018. Plant Physiology and Development (6thEdn). Panima Publishing Corporation, N.Delhi
3. Jain,V. K. 2018. Fundamentals of Plant Physiology, S Chand and Company, Delhi

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand diversity of the animal kingdom and how they are adapted to the environmenr, their relevance and need for balancing ecosystem.

	**MAHATMA GANDHI UNIVERSITY** **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Immunology**		
Course Type	**Major**		
Course Level	**200-299**		
Course Code	**MG4DSCUBS203**		
Course Overview	This comprehensive introduction to immunological reactions, techniques, and applications. It covers topics such as types of immunity, antigen-antibody interactions, and factors affecting immunity. The course also delves into infectious diseases, their transmission, etiological agents, and a specific focus on COVID-19. Laboratory diagnostic methods, including microscopy, culture techniques, and immunological assays like ELISA and ABO blood grouping, are explored.		
Semester	4	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	50	10	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	To introduce the importance and mechanisms involved in immunological reactions	Remember, Understand	

2	To introduce techniques based on immunological reactions	Understand, Apply	
3	To introduce applications of immunology	Understand, Analyse	
4	Students will be able to get trained on basic immunological tests	Skill, Evaluate, Understand	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module No.	**Module content**	**CO**	**Hrs**
1	Immunity, Types of immunity: Innate immunity and adaptive immunity, active and passive immunity, mechanisms of innate immunity. Factors affecting immunity, Herd immunity. Basic structure and types of antigens and antibodies.	1,2	15
2	Infection- Source and methods of transmission, etiological agents-bacteria, fungi, viruses, prions, protozoan. Special focus on COVID-19, Reservoir- human, environment. Carriers- incubatory, inapparent infection, convalescent and chronic carriers.	1,2	15
3	Applications of immunology: Lab diagnosis of diseases, sample collection, sample processing microscopy, culture, immunological methods-ABO blood grouping, WIDAL test, complement fixation test, ELISA, immunofluorescence.	2,3	10
4	Infectious disease management, treatment, antibiotics- types of antibiotics, mode of action, antimicrobial resistance, antiviral, antifungal, and antibacterial agents, immunization and infectious diseases, vaccination against major infectious diseases, types of vaccines.	1,3	10
5	Serological tests for the diagnosis of microbial infections	1,6	10

	Agglutination and precipitation tests Immunodiffusion in gel ELISA		
		Total credits	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Bailey and Scott's Diagnostic Microbiology Publisher: Elsevier Health, 28 Jun 2013

2. Current Diagnosis & Treatment in Infectious Diseases, Walter R. Wilson and Merle A. Sande

3. Fundamentals of Molecular Diagnostics (1st Edition) By David Bruns Edward Ashwood Carl Burtis : Elsevier. 2007

4. Textbook of Diagnostic Microbiology Hardcover, by Mahon (Author), Publisher: Elsevier Health - US; 5 edition (18 February 2014) 4. Koneman'sColor Atlas and Textbook of Diagnostic Microbiology 7th Edition by Gary W. Procop MD MS, Elmer W. Koneman, Publisher: LWW; 7 edition (June 15, 2016).

5. Advanced techniques in Diagnostic microbiology. Yi-wei Ting, Charles W. Stratton: Springer 7. Sherris Medical Microbiology (5th edition) by Kenneth J. Ryan, C. George Ray

6. Infectious Disease: Pathogenesis, Prevention and Case Studies By Nandini Shetty, Julian W Tang, Julie. Wiley- Blackwell (April, 2009).

Relevance of Learning the Course/ Employability of the Course
The course equips students with skills in laboratory diagnostics such as ELISA, ABO blood grouping, and other immunological assays used in disease detection. It provides foundational knowledge about how the immune system functions, including different types of immunity (innate and adaptive) and antigen-antibody interactions.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**		
Programme	**4 +1 integrated UG and PG programme**		
Course Title	**Microbial Biotechnology**		
Course Type	**Minor**		
Course Level	**200-299**		
Course Code	**MG4DSCUSB221**		
Course Overview	1.The course describe the application of microbes in various sectors 2.The course content explains the role of microbes and its utilization/application in various sectors such as food, agricultural, environmental, industrial & pharmaceutical area. 3.The course content also illustrates the various methods & process for production of bioactive compounds & products using microbes		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Basics knowledge of microbes up to 10^{th} or 12^{th} standard level		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the history of microbial fermentation through yeast fermentation, Discovery of Penicillin was one of the most important scientific discoveries in the history of medicine.	R, U	
2	Students can describe the methods, process & production of various microbial based food and dairy products also students have able to explain microbes are food for animal and human.	U/E/A	
3	Students should explain the role of microbes in agriculture as biofertilizer, biopesticide, fungicide, and herbicide. Students have able to explain the methods and mechanism of microbes apply to protect various environmental sector	U/A/An	
4	Students can Illustrate the utilization of microbes in the production of industrial and pharmaceutical products for human welfare	A/C	
5	Communicate effectively about a relevant topic in Microbial biotechnology for human and animal welfare as well as environmental protection both verbally and in writing	An, C	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

	Hours	CO No
Module 1: An introduction to Microbial Biotechnology	**10**	
Ancient fermentation as historical perspective, Yeast fermentation for the production of food and beverages, Discovery of Penicillin, use of bacteria & fungi to produce antibiotics.		
Module 2: Microbes in food & dairy industry	**15**	
Fermented Foods-Introduction, Role & Advantages of fermented foods. Production of cheese, yoghurt.Knowledge of other fermented dairy products. Single cell proteins-algae, bacteria, fungi, yeast & actinomycetes. Alcoholic beverages-Distilled and non-distilled, Production of beer, wine & ethanol. Microbe as animal feed additives-Probiotics.		
Module 3: Microbes in Agriculture & Environment	**20**	

Nitrogen fixation; Symbiotic & Nonsymbiotic; Biofertilizers-Bacterial, Algal & Fungal; Microbial biopesticide, bio fungicide and herbicide; Mycorrhizae. Biotechnology and pollution control; Use of immobilized microbial cell & enzyme in waste water treatment. Microbial biotransformation-Steroid, Microbial degradation of Herbicides, Insecticides & Pesticides; Bioremediation & Bioleaching		
Module 4: Industrial &Pharmaceutical Applications		
Biogas Production; Bioenergy Production-Bioethanol. Biodiesel& Biohydrogen; Microbes in plastic industry - Bioplastics; Microbial biosensors- Micro oxygen electrode. Biochips. Microorganism for Bioassay & as Bio weapon.	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities**
Mode of Assessment	**Continuous Internal Assessment (CIA)** **1. Internal** Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings **Semester End examination – 60 marks**

Learning Resources

1.Biotechnology Fundamentals and Applications, S.S. Purohit and S.S. Mathur; Agro Botanical Publishers India.

2.Microbial Biotechnology, Alexander N Glazer & Hiroshi Nikaido Cambridge University Press.

3.Microbial Biotechnology, Farshad Darvishi harzevili Hongzhang Chen.CRC Press.

4. Microbial Biotechnology Principle & Applications Lee Yuan Kein.World Scientific Press.

5. Microbial Technology-Fermentation Technology Vol 1 & 11 Peppler Perinas Elsiver.

6. Biofertilizers in Agriculture, N.S.Subha Rao;Oxford & IBH Publishing Co.Pvt.Ltd New Delhi.

7. Essentials of Biotechnology, R.C.Sobti & Suparna.S.Pachauri. Ane Books Pvt.Ltd.

8. Fermentation Technology Vol I&II.

9. Soil Microbiology – N.S. Subha Rao, 1999

10.Agriculture Microbiology – Rangaswamy

11. Microbial control and pest Management – S. Jayaraj.

12.Food Microbiology – Frazier W.C and Westhoff D.C., Tata Mc Graw-Hill

13.Food Microbiology – Rose A.H. in Economic Microbiology, Academic Pr

Relevance of Learning the Course/ Employability of the Course
The course will facilitate the student to understand how microbes & microbial process are useful in various sectors. This is an industry-oriented program & help the student for the placement in biotechnological industry & pharmaceutical sector.

	**MAHATMA GANDHI UNIVERSITY** **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**
Programme	**4 +1 integrated UG and PG programme**
Course Title	**Basic Microbiology Techniques**

Course Type	**SEC**		
Course Level	**200-299**		
Course Code	**MG4SEC USB201**		
Course Overview	This microbiology course equips students with essential laboratory skills, covering sterile techniques, safety precautions, media preparation, and bacterial and fungal culturing. Students will learn to analyze the morphological, physiological, and biochemical characteristics of bacteria, as well as gain training in fundamental immunological assays.		
Semester	4	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Students will acquire skills in performing sterile and safe working practices in a Microbiology laboratory.	Remember, Understand	
2	Students will learn to prepare and sterilize media and culture bacteria and fungi in a laboratory.	Understand, Apply	
3	Students will be able to examine morphological, physiological and biochemical properties of bacteria.	Understand, Analyse	

4	Students will be able to get trained on basic immunological tests	Skill, Evaluate, Understand	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Mod No	Module Content	Course outcome	Hrs
1	Sterilisation methods, Cultivation of bacteria and fungi, Study of cultural characteristics of bacteria, Staining procedures	1,2	15
2	Microscopic examination of bacteria in living conditions, Testing of motility, Testing of disinfectants, Antibiotic sensitivity tests	1,3	15
3	Serological tests for the diagnosis of microbial infections Agglutination and precipitation tests, ELISA	4	10
	Total credits	**3**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Field activities:** **Lab based activities:** Demonstration, hands on training and recording

Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

1. Mackie & Mccartney Practical Medical Microbiology, 14e – 1996
2. Sam-Yellowe, T. Y., Sam-Yellowe, T. Y., & Sam-Yellowe, T. (2021). *Immunology: Overview and laboratory manual* (pp. 105-116). Switzerland: Springe

Relevance of Learning the Course/ Employability of the Course
The course Basic Microbiology Techniques explores the diverse roles of microbes in various environments, including their impact on human health, disease, and the environment. This understanding is vital for addressing challenges related to infectious diseases, food safety, and environmental sustainability.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Biosciences**
Programme	**4 +1 integrated UG and PG programme**

Course Title	**Vitamins and hormones**		
Course Type	**VAC**		
Course Level	**200-299**		
Course Code	**MG4VACUSB201**		
Course Overview	This VAC course equips the Graduate & Honours students to understand the role of vitamins and hormones in our normal growth and wellbeing. They get an idea about different types of vitamins and hormones, their specific biological functions and disorders associated with them.		
Semester	4	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for discussions and case studies**	
	45		
Pre-requisite	Basics Biology of 10th standard		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explain the importance of vitamins for our health, and to understand the causes and management of vitamin deficiencies.	Remember, Understand	
2	Describe the specific roles of major vitamins in our body, their required dietary allowances, dietary sources and to interpret the science behind the disorders associated with them.	Understand, Apply	
3	Explain the significance of endocrine glands, their secretions, role of hormones and their action.	Understand, Evaluate	

4	Detail the physiological roles of different types of hormones and to understand hormone disorders.	Understand, Evaluate.	
5	Communicate effectively about vitamins and hormones	Apply, analyse	

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1-Introduction to vitamins	**Hours**	**CO No**
Vitamins: Definition, classification, role of vitamins in biological processes, Interaction with other nutrients; antagonists and analogues of vitamins; Hypo and hypervitaminosis. Causes of vitamin deficiencies.	**5**	
Module 2 – Classes of vitamins		
Fat soluble - A, D, E, & K, -functions, dietary sources, daily requirements, and disorders. Water soluble vitamins –B complex (B1, B2, B6, Niacin, Folic Acid, Biotin, Pantothenic acid, Vitamin B12) and Vitamin C: functions, dietary sources, daily requirements and disorders.	**10**	
Module 3 -Introduction to endocrinology		
Introduction to endocrine glands and their secretions; Organization of endocrine system; Hormone (Definition) and its biological importance; chemical classification of hormones; General mechanism of hormone action; Hormone therapy.	**10**	
Module 4- Hormones		
Physiological roles of hormones of Hypothalamus, Pancreas, Adrenal, Gonads and Thyroid and Parathyroid glands. Introduction to Gastrointestinal hormones, Placenta, Pituitary, Pineal hormones. Endocrine disorders: Goiter, Graves disease, myxedema, Hashimoto's disease, Gigantism, acromegaly, dwarfism, Addison's disease, Cushing syndrome (Causes, symptoms and treatment).	**15**	

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning, Library work and Group discussion, Presentation by individual student/ Group representative **Lab-based activities:** Demonstration, hands on training and recording
Mode of Assessment	A. Continuous Internal Assessment (CIA) 1. Internal Tests of maximum 20 marks 2. Seminar Presentation – a theme is to be discussed and identified to prepare a paper and present in the seminar Maximum marks 10 3. Write a detailed report on a given topic based on research findings and literature search – 10 marks B. Semester End examination – 60 mark

Learning Resources

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Relevance of Learning the Course/ Employability of the Course
The course will help the student to understand the importance of vitamins and hormones in our overall wellbeing.