THE MAHATMA GANDHI UNIVERSITY

UNDERGRADUATE PROGRAMMES

(HONOURS) SYLLABUS

MGU-UGP (Honours)

(2024 Admission Onwards)

Faculty: Science

BoS: Biochemistry

Programme: Bachelor of Science (Honours) Biochemistry

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

Contents

Preface

Biochemistry is a multidisciplinary science that investigates the chemistry of living organisms and the molecular mechanisms underlying changes in living cells. It is the most comprehensive of the basic sciences, encompassing various subspecialties such as neurochemistry, bioorganic chemistry, clinical biochemistry, physical biochemistry, molecular genetics, biochemical pharmacology, and immunochemistry. Recent advancements in these areas have forged connections between technology, chemical engineering, and biochemistry. By employing methods from chemistry, physics, molecular biology, and immunology, biochemistry examines the structure and behavior of complex molecules in biological material, studying how these molecules interact andcommunicate within and between cells and organs. Biochemists aim to understand the functions of specific molecules like proteins, nucleic acids, lipids, vitamins, and hormones in biological processes.

Biochemistry has provided insights into the causes of many diseases in humans, animals, and plants, often suggesting methods for treatment or cure. It also delves into the intricate chemical reactions in various life forms, laying the groundwork for practical advances in medicine, veterinary medicine, agriculture, and biotechnology. Biochemistry encompasses and underpins emerging fields like molecular genetics and bioengineering.

The new curriculum for the Undergraduate Programme in Biochemistry (B.Sc. Biochemistry Honours) offers a focused, outcome-based syllabus at the Honours level, providing structured teaching and learning experiences tailored to student needs. The curriculum includes Foundation courses, Discipline-Specific Courses, and Discipline-Specific Capstone courses. Foundation courses comprise Ability Enhancement Courses, Skill Enhancement Courses, Value Addition Courses, and Multi-disciplinary Courses.

The approved curricular framework by the Higher Education Department, Government of Kerala, and Kerala State Higher Education Council in accordance with the UGC guidelines 2023, aims to provide students with a comprehensive understanding of the fundamentals, practical training, and application of subject knowledge in various areas of Biochemistry, equipping them with the necessary knowledge, skills, and personality traits.

Board of Studies in Biochemistry (UG & PG) & External Experts in the Scrutiny Committee

Sl.No.	Name	Position
01	**Dr. Sandhya.C.** Associate Professor Department of Biochemistry Kuriakose Elias College, Mannanam, Kottayam	Chairperson
02	**Smt. Remya. A.S.** Assistant Professor of Biochemistry Sree Narayana College for Women, Kollam	Member
03	**Dr. Vibin. M.** Assistant Professor Department of Biochemistry St. Alberts College (Autonomous), Banerjee Road, Ernakulam	Member
04	**Prof.(Dr.) M.S.Latha** Professor (Retd.) School of Biosciences Mahatma Gandhi University, Kottayam	Member
05	**Dr. Mini.S.** Professor Department of Biochemistry University of Kerala, Kariavattom, Thiruvananthapuram	Member
06	**Dr. B.S. HarikumaranThampi** Professor Department of Life Sciences University of Calicut	Member
07	**Dr. Deepa.C.S.** Assistant Professor Department of Chemistry Devaswom Board College, Thlayolaparambu, Kottayam	Member
08	**Dr. Sholly Clair George** Assistant Professor Department of Chemistry St.Mary's College, Manarcad	Member
09	**Dr. Biju.A.R.** Assistant Professor Department of Chemistry Sir Syed College Taliparamba, Karimbam(P.O), Taliparamba,Kannur	Member
10	**Smt. Indu.G.** Associate Professor Department of Chemistry Al - Ameen College, Edathala, Aluva	Member

11	**Dr. Sona.A.** Associate Professor S.A.S SNDP Yogam College, Konni Pathanamthitta 689691	Member
	External Experts in the Scrutiny Committee	
1.	**Dr.Anie Y.** Associate Professor School of Biosciences, Mahatma Gandhi University, Kottayam- 686560	Expert from Mahatma Gandhi University, Kottayam
2.	**Dr.P.G. Biju** Assistant Professor Departmentof Biochemistry University of Kerala Kariavattom Campus Thiruvananthapuram -695581	Expert from University of Kerala, Thiruvanan thapuram

This Syllabus is the result of a collaborative effort of the participants in the FYUGP Workshop held at Bishop Kurialacherry College for Women, Amalagiri, Kottayam from 13/11/2023 to 17/11/2023

Sl. No.	Official Address of the Participants
1.	Ms. Sivaprabha. T.S. Assistant Professor Department of Biochemistry Sree Sankara College, Mattoor, Kalady
2.	Ms. Shalet Varghese Assistant Professor Department of Biosciences MES College, Marampally
3.	Ms. Lina Anil Assistant Professor Department of Biosciences MES College, Marampally
4.	Ms. Aswathy Vijay Assistant Professor Department of Biosciences MES College, Marampally
5.	Ms. Anju George Assistant Professor Department of Biotechnology M.A. College, Ramapuram
6.	Dr.Ratheesh M. Assistant Professor Department of Biochemistry St.Thomas College, Palai
7.	Dr.Sholly Clair George Assistant Professor Department of Chemistry St.Mary's College, Manarcaud
8.	Dr.Jyothilekshmi S. Associate Professor Department of Biochemistry U.C.College, Aluva
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13.	Dr.Asha S. Mathew Associate Professor Department of Biochemistry B.K.College, Amalagiri
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15.	Ms.Neelima T.K. Assistant Professor Department of Biosciences MES College, Marampally
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19.	Ms.Anu Scaria Assistant Professor Department of Bioscience Indira Gandhi College of Arts and Science, Nellikuzhy
20.	Dr.Sona A Associate Professor Department of Biotechnology SAS SNDP Yogam College, Konni
21.	Ms.Athira K.M. Assistant Professor Department of Bioscience Indira Gandhi College of Arts and Science, Nellikuzhy
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27.	Ms.Shema Jacob Assistant Professor Department of Microbiology and Biochemistry St. Berchmans College, Changanacherry
28.	Ms. Indu G Associate Professor Department of Chemistry Al Ameen College, Edathala, Aluva
29.	Ms.Arya Rameshan Assistant Professor Dept of Biochemistry Presentation College of Applied Science, Puthenvelikara
30.	Dr.Lijy Jacob Assistant Professor Department of Biotechnology St. Berchmans College, Changanassery
31.	Dr.Julie Jacob Assistant Professor Department of Biochemistry Mar Athanasius College Kothamangalam
32.	Ms.Anitha P George Assistant Professor Department of Biochemistry St.Mary'S College for Women Thiruvalla

Programme Outcomes

The outcomes described in qualification descriptors are attained by students through learning acquired on completion of a programme of study. The term 'programme' refers to the entire scheme of study followed by learners leading to a qualification. Individual programmes of study will have defined learning outcomes which must be attained for the award of a specific certificate/ diploma/ degree.

PO 1 : Critical thinking and Analytical reasoning

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

PO 2 : Scientific reasoning and Problem solving

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO 3: Multidisciplinary/ interdisciplinary/ transdisciplinary Approach

Acquire interdisciplinary/ multidisciplinary/ transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/ interdisciplinary/ transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills

Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO 5: Leadership Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 6: Social Consciousness and Responsibility

Ability to contemplate of the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior.

PO 9: Networking and Collaboration

Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

PO 10: Lifelong Learning

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Syllabus Index

Name of the Major: **Biochemistry**

Semester: 1

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG1DSCBCH100	Biochemistry-The Science of Life	DSC A	4	5	3	-	2	-
MG1MDCBCH100	Sports Biochemistry: The Science of Exercise and Human Performance	MDC	3	4	2	-	2	-

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

Semester: 2

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG2DSCBCH100	Essentials of Biochemistry : Vitamins, Hormones, Enzymes and Neurotransmitters	DSC A	4	5	3	-	2	-
MG2MDCBCH100	Biochemistry in Entrepreneurship	MDC	3	4	2	-	2	-

Semester: 3

CourseCode	Title of the Course	Type of the Course DSC,MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG3DSCBCH200	Computational Techniques in Biochemistry	DSC A	4	5	3	-	2	-
MG3DSCBCH201	Quality Control in Food and Pharmaceutical Industry	DSC A	4	5	3	-	2	-
MG3DSEBCH200	Human Physiology	DSE*	4	4	4	-	0	-
MG3DSEBCH201	Applied Nutritional Biochemistry		4	4	4	-	0	-

MG3DSCBCH202	Techniques in Biochemistry and ForensicScience	DSC B	4	5	3	-	2	-
MG3MDCBCH200	Food as Medicine	MDC	3	3	3	-	0	-
MG3VACBCH200	Microplastics and Environment	VAC	3	3	3	-	0	-

***One Course can be chosen from this DSE Bunch**

Semester: 4

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG4DSCBCH200	Enzymology	DSC A	4	5	3	-	2	-
MG4DSCBCH201	Bioenergetics and Metabolism	DSC A	4	5	3	-	2	-
MG4DSEBCH200	Life style Diseases	DSE*	4	4	4	-	0	-
MG4DSEBCH201	Endocrinology		4	4	4	-	0	-
MG4DSCBCH202	Metabolism of Carbohydrates, Proteins and Lipids	DSC C	4	5	3	-	2	-
MG4SECBCH200	Biochemical Tests in Disease Diagnosis	SEC	3	3	3	-	0	-
MG4VACBCH200	Narcotic Drugs and Psychotropic Substances (NDPS)	VAC	3	3	3	-	0	-

***One Course can be chosen from this DSE Bunch**

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG4INTBCH200	Internship	INT	2					

Semester: 5

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG5DSCBCH300	Molecular Biology	DSC	4	5	3	-	2	-
MG5DSCBCH301	Clinical Biochemistry	DSC	4	5	3	-	2	-
MG5DSEBCH300	Bioinformatics	DSE*	4	4	4	-	0	-
MG5DSEBCH301	Pharmacological Biochemistry		4	4	4	-	0	-
MG5DSEBCH302	Advanced Cell Biology		4	4	4	-	0	-
MG5DSEBCH303	Plant Biochemistry		4	4	4	-	0	-
MG5DSEBCH304	Membrane Biochemistry		4	4	4	-	0	-
MG5SECBCH300	*In silico* drug designing	SEC	3	3	3	-	0	-

***Three courses can be chosen from this DSE Bunch**

Semester: 6

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG6DSCBCH300	Immunology	DSC	4	5	3	-	2	-
MG6DSCBCH301	Molecular basis of infectious human diseases	DSC	4	5	3	-	2	-
MG6DSEBCH300	Forensic Biochemistry	DSE*	4	4	4	-	0	-
MG6DSEBCH301	Nanotechnology Biomedical Application		4	4	4	-	0	-
MG6DSEBCH302	Biochemical Toxicology		4	4	4	-	0	-
MG6DSEBCH303	Biochemistry of cell signalling		4	4	4	-	0	-
MG6DSEBCH304	Marine Biochemistry		4	4	4	-	0	-
MG6SECBCH300	Forensic Impression Analysis	SEC	3	4	2	-	2	-
MG6VACBCH300	Environmental Biochemistry and Human Rights	VAC	3	3	3	-	0	-

***Two Courses can be chosen from this DSE Bunch**

Semester: 7

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG7DCCBCH400	Research Methodology	DCC	4	4	4	-	0	-
MG7DCCBCH401	Biostatistics	DCC	4	4	4	-	0	-
MG7DCCBCH402	Genomics	DCC	4	5	3	-	2	-
MG7DCEBCH400	Cancer Biology	DCE*	4	4	4	-	0	-
MG7DCEBCH401	Xenobiotics and Antioxidants		4	4	4	-	0	-
MG7DCEBCH402	IPR and Bioethics		4	4	4	-	0	-
MG7DCEBCH403	Food Safety and QualityControl		4	4	4	-	0	-

***Three Courses can be chosen from this DCE Bunch**

Semester: 8

CourseCode	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
					L	T	P	O
MG8DCCBCH400	Proteomics	DCC	4	5	3	-	2	-
MG8DCCBCH401	Genetic Engineering	DCC	4	5	3	-	2	-
MG8DCEBCH400	Computer-aided drug design	DCE	4	5	3	-	2	-
MG8DCEBCH401	Bioanalytical Techniques	DCE	4	5	3	-	2	-
MG8DCEBCH402	Pharmacognosy &Phytochemistry	DCE	4	5	3	-	2	-
MG8DCEBCH403	Biochemistry of specializedtissues	DCE	4	5	3	-	2	-
MG8PRJBCH400	Project (Research / Honours)		12	-	-	-	-	-

SEMESTER 1

Mahatma Gandhi University, Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Biochemistry-The Science of Life**					
Type of Course	**DSC A**					
Course Code	**MG1DSCBCH100**					
Course Level	**100-199**					
Course Summary	The primary objective of this course is to establish a strong foundation in biochemistry for students, with a focus on essential molecular components. Additionally, the course covers fundamental procedures within a biochemistry laboratory and the qualitative analysis of biomolecules.					
Semester	I	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1.	Acquire an understanding of the nature of cells, water,buffers and the scope of Biochemistry	K, U, I	2, 3, 4, 6, 10
2.	Demonstrate the structure and functions of carbohydrates	K, U, E	1, 2, 3, 4
3.	Describe the general structure of amino acids and structural organisation of proteins	K,U, E	1,2,3,4
4.	Evaluate the chemical nature of lipids and nucleic acids.	U, E, An	1, 2, 3, 4
5.	Demonstrate laboratory safety practices and preparation of solutions.	An, E, Ap	2, 5, 8,10
6.	Employ appropriate biochemical tests to identify unknown biomolecules	U, A, C, S	2, 8,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

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

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

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

References

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

Suggested Readings

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

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Sports Biochemistry: The Science of Exercise and Human Performance**					
Type of Course	**MDC**					
Course Code	**MG1MDCBCH100**					
Course Level	**100-199**					
Course Summary	The course on sports biochemistry delves into the complex interplay among sports, exercise, and biochemistry. The students will acquire an understanding of the biochemical mechanisms during physical activity, theimpact of exercise on the body's systems, and the ways in which biochemistry shapes both athletic performance and overall well-being.					
Semester	1	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

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

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Fundamentals of Sports Biochemistry	1.1	Introduction Definition and scope of sports biochemistry. Importance in the field of sports science and medicine.	2	1
	1.2	Fuel utilization and Importance of hormones in Sports Fuel utilization in different sports. Role of hormones in Exercise: Adrenaline and noradrenaline,Insulin and glucagon, Cortisol, Growth hormones	4	3
	1.3	Muscle Biochemistry & Adaptations Overview of muscle tissue types (skeletal, smooth, cardiac) with focus on skeletal muscle in the context of sports biochemistry. Role of muscle in energy production during exercise. Overview of Cellular adaptations, Metabolic adaptation, Enzyme and Hormonal Adaptations, Strength and Power Adaptations, Neural adaptations, Endurance Adaptations.	3	3
	1.4	Sports Nutrition Macronutrients and Micronutrients. Hydration: Significance of maintaining proper fluid balance during exercise. Pre-Exercise Nutrition: Timing and composition of pre-exercise meals for optimizing performance. During-Exercise Nutrition: Importance of maintaining energy and hydration during prolonged exercise. Use of sports drinks, gels, and other supplements during activities. Post-Exercise Nutrition: Nutrient timing and composition for post-exercise recovery. Protein intake to support muscle repair and glycogen replenishment.	3	2
	1.5	Ergogenic Aids Definition and Types Legal and Illegal Substances Caffeine: Effects of caffeine on performance and endurance. Recommended dosage and timing for optimal benefits. Creatine: Role of creatine in enhancing strength, power, and muscle recovery. Safe and effective usage guidelines. Nitric Oxide Precursors: Substances that enhance nitric oxide production for improved blood flow and oxygen delivery. Beta-Alanine: Buffering capacity and its role in reducing muscle fatigue.	3	4
2. Diseases, Recovery, Practical Applications	2.1	Sports Injuries Types of Sports Injuries: sprains, strains, fractures, and overuse injuries Biochemical Markers of Injury: Identifying and monitoring Specific biochemical markers (e.g., creatine kinase, cytokines) associated with tissue damage. Using biomarkers to assess the severity and progression of injuries.	3	5

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

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

References

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Suggested Readings

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SEMESTER 2

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Essentials of Biochemistry: Vitamins, Hormones, Enzymes and Neurotransmitters**					
Type of Course	**DSC A**					
Course Code	**MG2DSCBCH100**					
Course Level	**100-199**					
Course Summary	This comprehensive course delves into the fundamental biochemical aspects of vitamins, hormones, enzymes, and neurotransmitters, exploring their roles in maintaining physiological balance and supporting essential cellular functions.					
Semester	2	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the fundamentals of vitamins	K,U	1,2,3,4
2	Describe the general features of hormones and their receptors.	U, E	2,3,4
3	Describe the classification, functions, mechanism of action and deficiency disorders of hormones	U, E, A	1,2,3,4
4	Evaluate neurotransmitter and its mechanism of action	A, E	1,2,3,4
5	Analyse the mechanism of enzyme catalysis, kinetics and specificity	U, An, E	1,2,3,4
6	Demonstrate proficiency in enzyme and vitamin extraction and quantification from various sources	U, A, S, Ap	1,2,3,4 ,10
7	Demonstrate the mechanism of action of hormones/neurotransmitters through presentations	A,S,C, I	2,3,4,6 ,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Vitamins	1.1	Vitamins- General introduction	3	1
	1.2	Classification and nomenclature of vitamins	4	1
	1.3	Fat soluble vitamins (types, biochemical and physiological functions, deficiency diseases) Vitaminsas coenzymes	3	1
	1.4	Water soluble vitamins (types, biochemical and physiological functions, deficiency diseases)	5	1
2. Hormones & Neurotransmitters	2.1	History of endocrinology	1	2
	2.2	Concept on target gland, negative and positivefeedback, characteristics and transport of hormones	3	2
	2.3	Hormone receptors and its classification	3	2
	2.4	Outline study of hypothalamic, pituitary, thyroid,parathyroid, adrenal, pancreatic and gastro intestinal hormones (types of hormones, physiological and biochemical role, deficiency diseases)	3	3
	2.5	Mechanism of action of peptide and steroid hormones	3	3
	2.6	Neurotransmitters-definition, classification, types of receptors, role in synaptic transmission	3	4
	2.7	Molecular mechanisms of action - Acetylcholine, biogenic amines, catecholamines, serotonin, amino acids. Neuroactive peptides as transmitters.	4	4
3. Enzymes	3.1	Classification of enzymes- six major classes of enzymes with one example each.	2	5
	3.2	Cofactors and coenzymes	1	5
	3.3	Elementary study of the factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH	2	5
	3.4	Michaelis-Menten equation (without derivation). Kmand its significance, Lineweaver Burk plot.	2	5
	3.5	Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes.	3	5

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

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

References

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7. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi
8. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi
9. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), KalyaniPublishers, Ludhiana

Suggested Readings

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

Mahatma Gandhi University Kottayam

Programme						
Course Name	**Biochemistry in Entrepreneurship**					
Type of course	**MDC**					
Course code	**MG2MDCBCH100**					
Course level	**100-199**					
Course summary	The "Biochemistry in Entrepreneurship" course is designed to equip students with a multifaceted understanding of the intersection between biochemistry and business. The course then transitions to the practical aspects of the nutraceutical industry, covering business strategies, regulatory frameworks, and essential marketing principles.					
Semester	2	Credits			3	Total hours
Course details	Learning approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Acquire a comprehensive understanding of nutrition and herbal food supplements, emphasizing their benefits for daily nutrition and preventive care.	K, U, A	2,3, 6,10
2	Attain an understanding of the nutraceutical business landscape, encompassing dietary supplements, functional foods,and phytochemicals.	U, A, An	2,3,4, 6
3	Develop expertise in the regulatory aspects of nutraceuticals, including NPD activities, GMP requirements, and quality management systems	U, An, E	2,3,4, 5,8
4	Examine marketing terminology in the nutraceutical industry, emphasising food safety standard labelling, claims, expiration dates, and gluten-free labelling, in order to make well-informed decisions.	K, U, E, Ap	2,3,6, 8,10
5	Explain the foundational concepts of biochemical entrepreneurship, exploring the transformative power of technological innovations.	U, A, E, I	1,2,3, 6,10
6	Develop an understanding of target audiences, marketneeds, and trends, fostering strategic product development.	A,C, S, Ap	2,3,5, 9 ,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

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

4.Teacher specific content/ Teacherfacilitated activities

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

References

1. Adams, K. R. (1989). Biochemical Education, 17, 26-28.
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3. DeFelice, S. (2007). The Foundation for Innovation in Medicine. http://www.fimdefelice.org.
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Suggested Readings

1. Adebowale, A. O., Liang, Z., & Eddington, N. D. (2000). Nutraceuticals, a call forquality control of delivery systems: a case study with chondroitin sulfate and glucosamine. J. Nutraceut. Funct. Med. Foods, 2, 15–30.
2. Amenta, M., Cascio, M. T., Fiore, P. D., & Venturini, I. (2006). Diet and chronic constipation. Benefits of oral supplementation with symbiotic zir fos (Bifidobacterium longum).
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SEMESTER 3

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Computational Techniques in Biochemistry**					
Type of Course	**DSC A**					
Course Code	**MG3DSCBCH200**					
Course Level	**200-299**					
Course Summary	This course aims to offer comprehensive insights into fundamental bioinformatics tools, an extensive exploration of alignment tools, and an in-depth study of biological databases. The course adopts an integratedapproach to foster a thorough understanding of both the theoretical principles and practical applications of bioinformatics.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Acquire an understanding of computers and information technology	U, An, I	2, 3, 4, 6, 9, 10
2	Examine the theory, concepts, and terminology of bioinformatics	U, A, E,	1, 2, 3, 4
3	Develop a detailed understanding on data submission and retrieval tools	U,E,A	1, 2, 3, 4
4	Evaluate the significance of data mining tools.	E, An, A	1, 2, 3, 4
5	Explain various databanks and utilization of biological databases in molecular docking, computer simulations, and conformational analysis.	U,C, Ap	2,3,4,6,10
6	Apply practical knowledge of bioinfomatic tools.	U, E, C, I	1, 2, 8, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Information Technology	1.1	Overview of information technology	2	1
	1.2	Introduction to Computer, structural organization of computer	2	1
	1.3	Different types of software; hardware	2	1
	1.4	Flow chart, operating system, different type of operating system	3	1
	1.5	Programming languages, Internet	3	1
	1.6	TCP/IP address, WWW, HTTP, HTML & URLs	3	1
2. Basic Bioinformatics	2.1	Introduction to bioinformatics, importance, and scope	2	2
	2.2	Pattern recognition and prediction	3	2
	2.3	Data submission tools (Webin, Sequin, Bankit) and data retrieval tools (DBGET, BioRS).	3	3
	2.4	Data mining of biological databases - NCBI, DDBJ, EMBL, PDB, KRGG	3	4
	2.5	Basic Local Alignment Search Tool (BLAST)	2	4
	2.6	MSA ClustalW), Scoring matrices	2	4
3. Databanks	3.1	Detailed study of Biological databases.	4	5
	3.2	Primary and secondary sequence databases	3	5
	3.3	Databases of drugs: drug bank, Cambridge Structural database (CSD).	3	5
	3.4	NCBI, EMBnet, Genbank, EMBL, DDBJ, PDB and KEGG	2	5
	3.5	Application of bioinformatics-docking, Molecular docking, Homology modeling, and structure-based drug designing.	3	5
4. Practical	4.1	Internet basics- Introduction to NCBI Web sites	6	6
	4.2	Introduction to Data bases, Sequence alignment and analysis	4	6
	4.3	BLAST, flavors of BLAST& FASTA, Alignment of sequences of amino acids using BLAST	15	6
	4.4	Alignment algorithms, tools for alignment of sequences. Alignment of sequences of amino acids using alignment programme uniport.	5	6
5.Teacher specific content/ Teacher facilitated activities				

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

References

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7. Jones, N. C., & Pevzner, P. A. (2004). *An introduction to bioinformatics algorithms*.MIT press.

Suggested Readings

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2. Diniz, W. J. D. S., & Canduri, F. (2017). Bioinformatics: an overview and its applications. *Genet Mol Res*, *16*(1), 17.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Quality Control in Food & Pharmaceutical Industry**					
Type of Course	**DSC A**					
Course Code	**MG3DSCBCH201**					
Course Level	**200-299**					
Course Summary	This course offers a comprehensive understanding of quality control principles and procedures within the food and pharmaceutical sector. It covers various aspects, such as quality assurance, compliance with regulatory standards, analytical methodologies, and the implementationof measures to uphold the safety and effectiveness of products.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate the fundamental principles of quality control within the food and pharmaceutical industry.	K, U	1,2,3,4
2	Examine and apply regulatory frameworks that oversee quality assurance in both the food and pharmaceutical sectors.	U, E, Ap	1,2,3, 4, 6
3	Explain the principles and significance of sampling in the context of food and pharmaceutical industries.	U, An, A	1,2,3, 4,6,8
4	Describe the various analytical techniques employed in quality control practices.	U, A, An	1,2,3,6
5	Develop insights into contemporary issues and emerging trends inthe field of quality control	U, I, Ap	1,2,3,4
6	Acquire the skills to implement and effectively manage quality control processes in relevant industries.	An, E, C	1,2,3, 6,8, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Quality Control	1.1	Definition and importance of quality control	2	1
	1.2	Distinction between quality control and quality assurance	4	1
	1.3	Historical perspective and evolution of quality control in food and pharmaceuticals	5	1
	1.4	Food & drug administration (FDA) US department of Agriculture (USDA) and other regulatory bodies	4	2
2. Quality Assurance in Food and Pharmaceuticals	2.1	Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP), International standards (ISO, ICH) in the food and pharmaceutical industry	8	2
	2.2	Principles of quality assurance, Quality policy, quality objectives, and quality manual	7	2
3. Analytical Techniques in Quality Control	3.1	Sampling techniques in food and pharmaceutical industries	7	3
	3.2	Physical, chemical, and microbiological analysis, Instrumental methods: chromatography, spectroscopy, and microscopy, Validation of analytical methods	3	4
	3.3	Statistical methods in quality control, Testing procedures and protocols	5	5
4. Practical	4.1	Proximate analysis of food samples (Determination of carbohydrate, fat, protein, moisture content, fibre content)	6	6
	4.2	Determination of chemical constituents of food (Titrable acidity, Total soluble solids, ascorbic acid, mineral, phenolic compounds)	6	6
	4.3	Determination of Adulterants in spices	3	6
	4.4	Determination of pH & acidity of juices	3	6
	4.5	Determination of Iodine Number of oils and fats	3	6
	4.6	Determination of food additives in food	3	6
	4.7	Detection of Adulterants in food	3	6
	4.8	Estimation of toxins & pesticides in food	3	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos, virtuallab Indirect session: Group discussion, seminar presentation, laboratory sessions

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

References

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2. Andre Gordon. (2020). Food Safety and Quality Systems in Developing Countries: Technical and Market Considerations (V5). Academic Press.
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Suggested Readings

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

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Human Physiology**					
Type of Course	**DSE**					
Course Code	**MG3DSEBCH200**					
Course Level	**200-299**					
Course Summary	This undergraduate-level course offers a comprehensive exploration of the systems within the human body. Through a combination of theoretical knowledge, and practical applications, students willacquire an understanding of the fundamental principles governing human physiological processes.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre- requisites, ifany	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the human circulatory system and its functions.	K, U, An	1, 2, 3
2	Describe the events in hemostasis.	U, E	1, 2,3, 10
3	Analyse the structure of the nephron and elaborate on the role of the nephron in the filtration, reabsorption, and secretion processes within the kidney.	U, An, E	1,2,3, 4
4	Acquire in-depth knowledge about the components of the gastrointestinal tract, the intricate process of digestion	U, An, I	1,2,3,4
5	Attain a comprehensive understanding of the organization of the respiratory system, highlighting its structure, function, and the crucial role in maintaining human health.	U, A, C	1,2,3,4,6
6	Acquire knowledge on nervous system and neurotransmission.	K, U, An	1,2,3 4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Circulatory System	1.1	Brief introduction to circulatory system.	4	1
	1.2	Blood & Lymph- composition and components	4	2
	1.3	Blood types and compatibility	3	2
	1.4	Blood clotting mechanism —blood clotting factors, Intrinsic and extrinsic pathways, fibrinolysis, anticoagulants.	4	2
2. Digestive and Excretory System	2.1	Renal Physiology – structure and functions of kidney	3	3
	2.2	Nephrons- structure and function, urine formation.	5	3
	2.3	Brief introduction to gastrointestinal and hepatobiliary system – gastrointestinal tract, process of digestion, gallbladder, bile and bile duct	7	4
3. Respiratory system	3.1	Respiratory system – organization of respiratorysystem.	6	5
	3.2	Blood flow through the lungs and mechanism of gas transport.	5	5
	3.3	Gas exchange and transport-Oxygen saturation and carbon dioxide saturation curve	4	5
4. Nervous system	4.1	Introduction to the Nervous System Neurons: Structure and Function Neurotransmission: Synaptic Transmission	5	6
	4.2	Central Nervous System (CNS): Brain and Spinal Cord Peripheral Nervous System (PNS): Somatic and Autonomic Nervous Systems	5	6
	4.3	Sensory Systems: Vision, Hearing, Taste, Smell, Touch Motor Systems: Muscle Control and Movement	5	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom procedure (mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos, virtual lab Indirect session: Group discussion, seminar presentation
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)**30 marks 1. Multiple Choice Questions (15 marks) 2. Assignment- (2 marks) 3. Seminar presentation (5 marks) 4. Involvement in group discussion (5 marks) 5. Viva (3 marks)

	B. End Semester Examination Written examination for two hours (70 marks)

References

1. Barrett, K. E., Barman, S. M., Boitano, S., & Brooks, H. L. (2019). Ganong's Review of Medical Physiology.
2. Gupta, R. C., & Bhargava, S. (Eds.). (2022). Practical Biochemistry. CBSPublishers and Distributors. New Delhi.
3. Guyton, A. C., & Hall, J. E. (2011). Textbook of Medical Physiology (10th ed.).Reed Elsevier India Pvt Ltd.
4. Sherwood, L. (2015). Brooks/Cole Human Physiology: From Cell to System.
5. Widmaier, E. P., Raff, H., & Strang, K. T. (2019). Vander's Human Physiology –The Mechanism of Body Function. McGraw Hill. New York.

Suggested readings

1. Martini, F. H., & Nath, J. L. (2009). Fundamentals of Anatomy and Physiology(8thed.). Pearson Publications

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Applied Nutritional Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG3DSEBCH201**					
Course Level	**200-299**					
Course Summary	This course provides a comprehensive understanding of the biochemical aspects of nutrition and their practical implications in promoting health and addressing nutritional challenges across diverse populations. Students will acquire knowledge applicable to fields such as dietetics, clinical nutrition, foodscience, and public health.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe nutrition and its basic concepts	K, U	1,2,3,4
2	Explain and plan a healthy, balanced diet tailored to different age groups	U, An, C	1,2,3,4,10
3	Formulate diet plans to manage lifestyle-related health conditions fostering healthier habits and lifestyles.	U, E, C	1,2, 6,10
4	Evaluate the role of functional foods and their potential health benefits	A, An, I	1,2, 4,6
5	Analyze how nutrition influences mental health, exercise, and sustainability.	An, E, Ap	1,2, 4,6,10
6	Integrate various technological platforms/gadgets as nutritional guidance tools.	S, C, I	1,2,6, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Basic concepts of nutrition	1.1	Introduction to Nutrition, Principle foods, Basal Metabolic Rate (BMR) -definition, measurement, Respiratory quotient (RQ)-definition, Factors	5	1
	1.2	Functions, requirements, digestion and absorptionof macronutrients -Carbohydrates, Lipids, Proteins	7	1
	1.3	Macro elements Ca, Mg, Na, K, P - functions andrequirements Micro elements- Fe, Zn, Cu, Se	3	1
2. Planning of a healthy diet	2.1	Healthy diet - definition Reference Nutrient Intake (RNI)- definition, dietary guidelines	5	2
	2.2	Nutritional needs of different age groups, Portion control	5	2
	2.3	Steps involved in planning a healthy diet	5	2
3. Dietary management of diseases	3.1	Dietary Management - Obesity, Diabetes	5	3
	3.2	Dietary Management –Cardiovascular Diseases, Hypertension, Gastrointestinal Disorders	6	3
	3.3	Dietary Management - Cancer, Liver Diseases	4	3
4. Recent trends in nutrition	4.1	Functional foods (probiotics, prebiotics, antioxidants)	4	4
	4.2	Nutrition and mental health (impact of nutrients inmood cognition and mental health conditions), Nutrition and exercise	5	5
	4.3	Sustainability and nutrition (plant based diet)	4	5
	4.4	Technology integration -apps, wearables, digital platforms for personalized nutritional guidance	2	6
5.Teacher specific content/ Teacher facilitated activities				

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

Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** 30 marks 1. Internal test paper 15 marks 2. Assignment 5 marks 3. Seminar presentation 5 marks 4. Involvement in group discussions 5 marks
	B. End Semester Examination Written examination of two hours (70 marks)

References

1. Blank, F. C. (2007). A Handbook of Foods and Nutrition. Agrobios (India)
2. Chatterjee, G. (2000). Health, Nutrition and Diseases. Rajat Publication.
3. Coultate, T. P. (2002). Food: The Chemistry of its Components. Royal Society of Chemistry.
4. Eastwood, M. (2003). Principles of Human Nutrition. Atlantic Publishers & Distributors.
5. Joshi, S. A. (2007). Nutrition and Dietetics. Tata McGraw Hill.

Suggested Readings

1. Marwaha, K. E. (2007). Food Hygiene. Daya Publishing House.

Mahatma Gandhi University
Kottayam

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

COURSE OUTCOMES (CO)

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

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

COURSE CONTENT

Content for Classroom transaction (Units)

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

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

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

References

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

Suggested Readings

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

Mahatma Gandhi University Kottayam

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Develop an appreciation for the significance of health in fostering a high quality of life.	K,U, Ap	1,2,3,4,7, 10
2	Acquire information on energy requirements and recommended dietary allowances, facilitating a better understanding of the correlation between nutrition and overall well-being.	U, E, A	1,2,3,4,6,8
3	Attain knowledge about the roles, metabolism, and effects of nutrients.	U, A, E	1,2,3,4,6
4	Recognize the potential of different functional foods and nutraceuticals in enhancing human health.	K,U, A	1,2,3,4,6
5	Acquire knowledge about the principles of diet therapy and the application of various therapeutic diets	U, S,I	1,2,3,4,6, 10
6	Demonstrate the ability to utilize the knowledge in making informed food choices and achieving a well-balanced diet.	U, C, S	1,2,3,4,6, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Food, Nutrition and Health	1.1	Food for health promotion	2	1
	1.2	Functions of food – Physiological, psychological and socio - cultural functions, constituents of food and their functions.	3	1
	1.3	Introduction to Nutrition, BMR	2	2
	1.4	Carbohydrates, Proteins, Fats and Lipids	4	3
	1.5	Vitamins: Fat soluble and Water soluble vitamins	1	3
	1.6	Minerals: Micro minerals and Macro minerals	1	3
	1.7	Water Balance; Regulation of acid-base balance in the body	2	3
2. Functional Foods	2.1	Functional food of plant and animal origin, Probiotics, prebiotics and synobiotics	2	4
	2.2	Nutraceuticals- herbal nutraceuticals; Phytochemicals, phytosterols and other bioactive compounds	3	4
3. Dietetics and Diet Therapy	3.1	Objective of diet therapy; Principles of diet preparation and counselling.	5	5
	3.2	Therapeutic diets for disorders; Nutritional status assessment of the critically ill patients	5	5
	3.3	Diet in Allergy; Diet in febrile conditions; Diet inrelation to deficiency diseases	5	5
	3.4	Preparation of dietary charts	3	6
	3.5	Comparative chart for nutraceutical plants	2	6
	3.6	Integrative workshop on dietetics	5	6
4.Teacher specific content/ Teacher facilitated activities				

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

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

References

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

Suggested Reading

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

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the sources and types of microplastics	K, U	1,2, 3,4
2	Analyze the transport and fate of microplastics in various environmental compartments	U, An, E	1,2,3, 4,7,10
3	Evaluate impacts of microplastic pollution on aquatic and terrestrial ecosystems.	U, E, I	1,2,3, 6,8
4	Explore the effects of microplastics in food and drinking water	U, A, I	1,2,3, 6
5	Evaluate health risks along with regulatory perspectives, concerning the impact of microplastics on biological systems.	E, A	2,3,6, 8,10
6	Develop strategies for mitigating and managing microplastic pollution	U, A, Ap	1, 2,6,7, 8,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Microplastics	1.1	Overview of microplastics: definition, classification,and size range	2	1
	1.2	Sources of microplastics: primary and secondarysources	2	1
	1.3	Types of microplastics, microbeads, microfiber, Degradation	3	1
	1.4	Environmental pathways: air, water, soil	3	2
2. Fate and Transport of Microplastics	2.2	Bioaccumulation and biomagnification	5	2
	2.3	Microplastic transport in different ecosystems	5	2
3. Impact of Microplastics on biological systems and climate change & microplastic removal	2.1	Effects of microplastics on marine and freshwater ecosystems	3	3
	2.2	Impact on terrestrial ecosystems, wildlife exposure and responses	3	3
	2.3	Microplastics in food and drinking water	4	4
	2.4	Health risks and uncertainties, Regulatory perspectives	5	5
	2.5	Impact of Microplastics on climate change	5	6
	2.6	Microplastic removal strategies	5	6
4. Teacher specific content/ Teacher facilitated activities				

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

References

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

Suggested Readings

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

SEMESTER 4

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Enzymology**					
Type of Course	**DSC A**					
Course Code	**MG4DSCBCH200**					
CourseLevel	**200-299**					
Course Summary	This undergraduate-level course in enzymology provides a comprehensive introduction to the study of enzymes and their pivotal role in biochemical processes. The course is also designed to equip students with hands-on proficiency in conducting enzyme assays and utilizing laboratory techniques.					
Semester	4	Credits			4	Total Hours
CourseDetails	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre- Requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No.
1	Describe the fundamental concepts of enzymes, catalytic mechanisms, specificity	K,U	1,2,3,4
2	Interpret principles of enzyme kinetics- Michaelis-Menten and Lineweaver-Burk plots.	U, E, An	1,2,3,4
3	Differentiate between various types of enzyme inhibition andanalyzethe mechanisms by which enzymes are regulated- allosteric regulation and feedback inhibition.	U, E, Ap	1,2,3,4
4	Discuss a comprehensive understanding of the industrial and clinical applications of enzymes	U, An, I	1,2,3,4,10
5	Develop basic skills in enzyme extraction, assays, and associated experimental techniques.	U,C,S,	1,2,3,4,10
6	Develop critical thinking skills to evaluate experimental results and derive conclusions based on enzymology principles.	U, S, I	1,2,3,4,10

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Enzymes- Introduction	1.1	Interaction between enzyme and substrate- Lock and Key model, induced fit model, transition state stabilization, enzyme specificity	4	1
	1.2	Coenzymes and their functions- FAD, NAD, FMN, TPP, PLP, classification and nomenclature of enzymes.	6	1
	1.3	Definition of IU, katal, enzyme turnover number and specific activity	5	1
2. Enzyme kinetics	2.1	Factors affecting the velocity of enzyme-catalyzed reaction (explanation with graphical representation)	4	2
	2.2	Derivation of Michaelis- Menten equation, Vmax, Km value and its significance.	7	2
	2.3	Lineweaver - Burk double reciprocal plot, allosteric enzymes (in brief)	4	2
3. Enzyme Inhibition, regulation & Application	3.1	Enzyme inhibition- Introduction, Reversible and irreversible, Reversible- Competitive, non-competitive and uncompetitive, Feedback inhibition.	6	3
	3.2	Zymogen activation, Isoenzymes – LDH and CPK, Covalent modification — Adenylation and Phosphorylation (in brief)	4	3
	3.3	Industrial and clinical applications of enzymes.	5	4
4. Practical	4.1	Enzyme extraction and assay -(acid phosphatase,beta amylase& urease)	15(5hr each)	5
	4.2	Factors affecting enzyme activity-pH, temperature, substrate concentration, enzyme concentration	10 (2hr each)	6
	4.3	Determination of Km value.	5	6
5.Teacher specific content/ Teacher facilitated activities				

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

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (4 marks) 2. Record (2 marks) 3. Laboratory involvement (1.5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Palmer, T., & Bonner, P. (Year of Publication). Enzymes: Biotechnology, Clinical Chemistry (2nd ed.). Horwood Publishing Limited.
2. Price, N. C., & Stevens, L. (Year of Publication). Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins. OxfordUniversity Press.
3. Voet, D., & Voet, J. G. (Year of Publication). Biochemistry. John Wiley & Sons Inc.

Suggested Readings

1. Nelson, D. L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry. W. H. Freeman

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Bioenergetics and Metabolism**					
Type of Course	**DSC A**					
Course Code	**MG4DSCBCH201**					
Course Level	**200-299**					
Course Summary	This course aims to foster a profound comprehension of the biochemical mechanisms underlying energy production and utilization in living organisms. The course provides a robust groundwork for future exploration in the fields of biochemistry, molecular biology, and related disciplines.					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarise the fundamental concepts of bioenergetics and metabolism	U, E	1, 2,3,4
2	Describe the various pathways in carbohydrate metabolism and its regulatory mechanisms	K, U, An	1, 2,3,4
3	Investigate how lipids are synthesized and metabolised to generate energy	U, A, E	1,2, 3, 6
4	Describe the pathways of amino acid metabolism and its regulation	U, An	1, 2,3,4
5	Analyse the conditions resulting in various metabolic disorders	E, An, I	1,2, 3, 10
6	Investigate various metabolic pathways and their interconnectedness in maintaining cellular homeostasis	A, An	1,2, 3,6,10
7	Develop laboratory skills, analyse experimental data and effectively communicate experimental observations	S, Ap	1,2,3, 4,5, 6

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Bioenergetics and Carbohydrate Metabolism	1.1	Introduction to bioenergetics. High energy compounds (ATP, phosphocreatine, phosphoenol pyruvate). Exergonic and endergonic reactions.	2	1
	1.2	Glycolysis (structure of intermediates required) – aerobic and anaerobic and the energy yield. Gluconeogenesis (structure required). Reciprocal regulation of glycolysis and gluconeogenesis.	3	2
	1.3	Pentose phosphate pathway (structure not required). Krebs cycle (structure of intermediates required) and energetics.	3	2
	1.4	Substrate level phosphorylation. Electron transport chain, oxidative phosphorylation, Chemiosmotic hypothesis. Inhibitors and uncouplers of electron transport chain.	3	2
	1.5	Glycogen metabolism—glycogenesis and glycogenolysis and its regulation	3	2
	1.6	Glycogen storage diseases — Type I, Type II, Type III, Type IV and Type V	1	5
2. Lipid Metabolism	2.1	Beta oxidation of saturated and unsaturated fatty acids (structure of intermediates required)- activation of fatty acids and transport to the mitochondrion via carnitine shuttle. Energetics of beta oxidation	4	3
	2.2	Alpha and omega oxidation of fatty acids (brief study only).	2	3
	2.3	Biosynthesis of saturated fatty acids (palmitic acid). Fatty acid synthase complex. Desaturases and elongases.	4	3
	2.4	Ketogenesis—over production during uncontrolled diabetes and starvation	1	3
	2.5	Biosynthesis and fates of cholesterol.	3	3
	2.6	Lipid storage diseases – Tay-Sachs disease, Gaucher's disease, Niemann-Pick disease and Krabbe's disease.	1	5

3. Amino acid Metabolism	3.1	Overview of biosynthesis of amino acids (without structure)	2	4
	3.2	Metabolic fates of amino groups. Transamination (detailed study required), Decarboxylation, Deamination (oxidative and nonoxidative).	5	4
	3.3	Glucose – alanine cycle.	1	4
	3.4	Nitrogen excretion and Urea cycle (structure of intermediates required), significance and its regulation. Krebs bicycle	3	6
	3.5	Glucogenic and ketogenic amino acids.	2	4
	3.6	Inborn errors of amino acid metabolism-Albinism, Alkaptonuria, Homocystinuria,and Phenylketonuria.	2	5
4. Practical	4.1	Estimation of glucose (any two methods).	6	7
	4.2	Estimation of fructose.	3	7
	4.3	Estimation of maltose.	3	7
	4.4	Estimation of cholesterol.	3	7
	4.5	Separation of amino acids by paper chromatography/ thin layer chromatography	3	7
	4.6	Estimation of amino acids.	3	7
	4.7	Estimation of urea	6	7
	4.8	Estimation of uric acid.	3	7
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos Indirect session: Group discussion, seminar presentation Practical: Hands on learning, real world application, problem solving
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)*

	*This mark to be converted to 17.5 marks

References

1. Botham, K., Mc Guinness, O., Weil, P. A., Kennelly, P., & Rodwell, V. (2022).Harper's Illustrated Biochemistry. McGraw-Hill Education. Grisham, C., & Garrett, R. (2016). Biochemistry. Brooks/Cole.
2. Jain, J. L., Jain S., & Jain, N. (2016). Fundamentals of Biochemistry. S Chand.
3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., & Bretscher, A. (2021). MolecularCell Biology. W H Freeman & Co
4. Nelson, L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry 7th edition.W H Freeman & Co.
5. Rao, B. S., & Deshpande, V. (2013). Experimental Biochemistry: A Student Companion. I K International Publishing House Pvt. Ltd.
6. Sawhney, S. K., & Singh, R. (2005). Introductory Practical Biochemistry. AlphaScience International Ltd.
7. Thimmaiah, S. K. (2016). Standard Methods of Biochemical Analysis. Kalyani Publishers.
8. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Voet's Principles of Biochemistry.Wiley.

Suggested Readings

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

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Life Style Diseases**					
Type of Course	**DSE**					
Course Code	**MG4DSEBCH200**					
Course Level	**200-299**					
Course Summary	This course provides insights into lifestyle diseases, the associated riskfactors, and strategies for their prevention and management. Additionally, it underscores the significance of adopting healthypractices to reduce the risk of developing lifestyle-related conditions.					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Doma,ins *	PO No
1	Elaborate on the classification, epidemiology and global trend of life style diseases	K,U	1,2,3,10
2	Examine the impact of life style on health	K, U, A	2,3,4, 6
3	Discuss different classes, symptoms, causes and diagnosis of diabetes	U, An, A	2,3,6,8
4	Describe the characteristics, causes, diagnosis and treatment of cancer	U, E, I	2,3,6,7,10
5	Illustrate the fundamental knowledge about coronary heart diseases	U, E, A	1,2, 3,4,8,10
6	Explain the strategies for prevention and management of life style diseases	E, A, S, Ap	2,3,4,6,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Concept of Life Diseases	1.1	Lifestyle diseases- definition, classification, epidemiology and global trend	3	1
	1.2	Importance of lifestyle factors in preventing disease developments – diet, exercise, smoking, alcohol.	4	2
	1.3	Genetic predisposition and family history	4	2
	1.4	Socioeconomic factors contributing to lifestyle diseases	4	2
2. DiabetesMellitus	2.1	Classification of diabetes mellitus-type 1 and type 2	5	3
	2.2	Symptoms, causes, diagnosis.	5	3
	2.3	Prevention and Management of diabetes	5	6
3. Cancer	3.1	Characteristics, causes and diagnosis of cancer.	5	4
	3.2	Prevention and management of cancer.	5	6
	3.3	Methods for treatment of cancer	5	4
4. Atherosclerosis and Cardiovascular diseases	4.1	Atherosclerosis and cardiovascular diseases- definition and distinction	3	5
	4.2	Myocardial infarction, congestive heart failure –causes, diagnosis	4	5
	4.3	Progression of atherosclerosis: Factors influencing plaque stability and rupture	4	5
	4.3	Prevention and management of ischemic diseases and hyper tension.	4	6
5. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course content will be transacted through seminars, power point presentations, group activity, and Interactive sessions.
Assessment Types	**MODE OF ASSESSMENT** **A.Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test of one hour (15 marks) 2. Assignment (5 marks) 3. Seminar presentation (5 marks) 4. Involvement in group discussion (5 marks)
	B. End Semester Examination (ESE) Written examination of two hours (70 marks)

References

1. Kumar, M. N., & Kumar, R. (2004). Guide to Prevention of Lifestyle Diseases.Deep and Deep Publication.
2. Satyanarayana, U., & Chakrapani, U. (2021). Essentials of Biochemistry (3rded.).
3. Vasudevan, D. M., & Sreekumari, S. (2019). Textbook of Medical Biochemistryfor Medical Students (5th ed.). Jaypee Brothers, Medical Publishers.
4. Karp, G. (2019). Cell and Molecular Biology (9th edition). John Wiley & Sons.
5. Guyton, A., & Hall, J. E. (1996). Textbook of Medical Physiology (9th edition).Prism Saunders.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Endocrinology**					
Type of Course	**DSE**					
Course Code	**MG4DSEBCH201**					
Course Level	**200-299**					
Course Summary	This course is designed to provide a structured and comprehensive understanding of endocrinology. It covers both theoretical concepts and their practical applications in clinical research.					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	NIL					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Acquire a comprehensive understanding of the physiology and biochemistry of hormones in maintaining homeostasis.	K, U, An	1,2,3, 4
2	Analyse the interactions between hormones and their target tissues.	U, An,E	1,2,3, 4
3	Appraise the chemical and functional aspects of GI Tract hormones	U, An, E, Ap	1,2,3, 4
4	Apply knowledge of hormonal physiology to identify the pathophysiology of endocrine disorders.	U, An, A, S	1,2,3, 4,6,8
5	Develop effective communication skills to educate the community about the hormonal regulation of metabolism	A, S, I, Ap	1,2,3, 4, 5, 6,10
6	Inculcate the habit of lifelong learning by updating advances in endocrinology research.	A, I, Ap	1,2,3, 4, 8,10

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. General endocrinology	1.1	Chemical and physical aspects of hormones-Hormones as a chemical messenger, Hormone discovery. Hormone receptors	3	1
	1.2	Hormonal interactions, synthesis, storage and transport.	5	2
	1.3	Classification and mode of action of Group I & II hormones	5	2
	1.4	Recent advancements in endocrine research (inbrief),	2	6
2. Master regulatory hormones	2.1	Tropins & Statins- Hormones of the Pituitary & Hypothalamus, general regulatory mechanism overother glands	3	2
	2.2	Adenohypophyseal hormones and their pathophysiology	6	4
	2.3	Neurohypophyseal hormones and their patho physiology.	6	4
3. Pancreatic and GI tract hormones	3.1	Introduction to hormones of the gastrointestinal (GI) tract and pancreas.	2	3
	3.2	Classification and functions of GI tract hormones	6	3
	3.3	Classification and functions of pancreatic hormones	7	3
4. Hormonal Regulation of Metabolism- An overview	4.1	Hormonal regulation of glycogen Metabolism	5	5
	4.2	Hormonal regulation of Fatty acid Metabolism	5	5
	4.3	Hormonal regulation of lipid Metabolism.	5	5
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorials, e resources, animated videos Indirect session: Group discussion, seminar presentation

Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** 30 marks 1. Internal Test for half an hour (10 marks) 2. Assignment (5 marks) 3. Seminar presentation (5 marks) 4. Quiz (5 marks) 5. involvement in group discussion 5 marks
	A. End Semester Examination Written examination for two hours (70 marks)

References

1. Chattergie, M. N., & Shinde, R. (2020). Human Physiology. 13th edition. CBSPublisher.
2. Guyton, A. C., & Hall, J. E. (2006). Textbook of Medical Physiology. ElsevierSaunders
3. Larsen, P. R., Melmed, S., Polonsky, K. S., & Kronenberg, H. M. (Eds.). (2016).Williams Textbook of Endocrinology. Elsevier.
4. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., & Rodwell, V. W.(2018).Harpers Biochemistry. McGraw Hill.
5. Nelson, D. L., & Cox, M. M. (2017). Lehninger Principles of Biochemistry. W. H.Freeman.
6. Voet, D. J., & Voet, J. G. (2016). Principles of Biochemistry. John Wiley & SonsInc.
7. Widmaier, E. P., Raff, H., & Strang, K. T. (2018). Vander's Human Physiology:The Mechanism of Body Function. McGraw Hill.

Suggested Reading:

1. Hadley, M. E., & Levine, J. E. (2009). Endocrinology. Pearson.

Mahatma Gandhi University
Kottayam

Programme						
Course Name	**Metabolism of Carbohydrates, Proteins and Lipids**					
Type of Course	**DSC C**					
Course Code	**MG4DSCBCH202**					
Course Level	**200-299**					
Course Summary	This course offers a thorough examination of the biochemical processes that regulate the metabolism and corresponding energetics of carbohydrates, proteins, and lipids in living organisms.					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the mechanisms involved in the digestion and absorption of carbohydrates, proteins, and lipids	K, U, E	1,2,3,4
2	Explain the enzymatic reactions and energetics of breakdown and synthesis of carbohydrates	U, E	1,2,3,4,6
3	Discuss the processes and pathways involved in protein Metabolism	U, An,E	1,2,3,4
4	Compare the catabolic and anabolic pathways of lipids	U, An,	1,2,3,4
5	Analyze and calculate energy yield in oxidation of Palmitic acid	An, A, S	1,2,3,4,6
6	Develop practical skills to determine the amount of carbohydrates, lipids and amino acids in a biological source	An, S, Ap	1,2,3,6,9, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Metabolism of Carbohydrates	1.1	Introduction to carbohydrate metabolism, Digestion and Absorption	1	1
	1.2	Glycolysis (with structure), Energetics and its Regulation (Over view)	2	2
	1.3	Fates of Pyruvate and TCA Cycle and energetics	3	2
	1.4	Electron Transport Chain and Oxidative Phosphorylation	2	2
	1.5	Gluconeogenesis (With Structure)	2	2
	1.6	HMP Shunt Pathway (structure not necessary)	2	2
	1.7	Glycogen Metabolism -Glycogenolysis and Glycogenesis	3	2
2. Metabolism of Proteins	2.1	Introduction to protein metabolism, Digestion and Absorption	3	1
	2.2	Oxidation of amino acids- transamination, deamination, (oxidative and Nonoxidative), Decarboxylation	4	3
	2.3	Glucogenic and ketogenic amino acids	2	3
	2.4	Nitrogen excretion, Urea cycle (structure Not necessary)	3	3
	2.5	Inborn errors of Protein metabolism – albinism, Alkaptonuria, Phenylketonuria (defensive enzyme, Symptoms and effects)	3	3
3. Lipid Metabolism	3.1	Lipids- Introduction to Lipid metabolism, Digestion, Absorption	3	1
	3.2	Fatty acid Oxidation-Alpha, Beta, Omega (Overview)	2	4
	3.2	Beta Oxidation (Activation, Transport with structure), Energy yield in oxidation of Palmitic acid,Ketone bodies	5	5
	3.4	Fatty acid synthesis (in detail), Desaturases and elongases (outline only)	5	4
4.	4.1	Beer Lamberts law verification (Mandatory)	6	6
	4.2	Estimation of carbohydrates (Anthrone Method, Di Nitro Salicylic acid, Folin Wu Method, Nelsons –Any 2)	6	6

Practical	4.3	Protein Estimation (Lowry and Biuret method)	6	6
	4.4	Amino acid estimation (ninhydrin Method)	3	6
	4.5	Estimation of Cholesterol	3	6
	4.6	Enzymatic breakdown of starch	6	6

5.Teacher specific content/ Teacher facilitated activities

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

References

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

Suggested Readings

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

Mahatma Gandhi University Kottayam

Programme						
Course Name	**Biochemical Tests in Disease Diagnosis**					
Type of Course	**SEC**					
Course Code	**MG4SECBCH200**					
Course Level	**200-299**					
Course Summary	This course provides a focused exploration of the clinical significance of biochemical tests in the field of disease diagnosis. Its aim is to equip students with the essential knowledge and abilities to identify and applybiochemical tests, facilitating accurate and efficient monitoring and treatment of various diseases.					
Semester	4	Credits			3	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	0	0	45
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamentals of biochemical tests used in disease diagnosis and the ethical practices	U, E, A	1,2,3,4, 6,8
2	Discuss the various methods for collecting blood, urine and CSF, ensuring accuracy and patient comfort.	K, U, E	1,2,3,4, 6
3	Interpret blood analysis results accurately and communicatethese findings effectively.	A, An, E, Ap	1,2,3, 4, 6, 10
4	Develop a comprehensive understanding of various testsused in diagnosing and monitoring diabetes	U, An, E	1,2,6,8
5	Explore the identification and applications of biomarkers inliver function Tests	U, A, An	1,2,3,4
6	Attain proficiency in accurately interpreting results of thyroid function tests results	An, E, S	1,2,3, 9, 10
7	Evaluate how results of renal function test aid in diagnosingand monitoring kidney diseases	An, E, I	1,2,3,9
8	Enhance the ability to present and communicate observations obtained from experiments, laboratory visits, as well as share insights on emerging techniques.	E, An, S	1,2,4, 9, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Biochemical tests	1.1	Overview of biochemical tests and its importance in disease diagnosis, Ethical practices in laboratory medicine	3	1
	1.2	Sample collection and handling of blood, urine and cerebrospinal fluid.	3	2
	1.3	Blood routine analysis- Erythrocyte Sedimentation Rate (ESR), Hemoglobin (Hb), Red Blood Cell (RBC)Count , White Blood (WBC) Count , Platelets, Differential Count (DC), Packed Cell Volume (PCV)	5	3
	1.4	Lipid profiling - Total cholesterol, High Density Lipoprotein (HDL) Cholesterol, Low Density Lipoprotein (LDL) Cholesterol, Triglyceride (TG)	4	3
2. Common biochemical tests in diagnosis andtheir clinical interpretation	2.1	Tests related to Diabetes Mellitus -Fasting BloodSugar FBS, Post Prandial Blood Sugar (PPBS), Random Blood Sugar (RBS), Glycosylated	3	4
	2.2	Hemoglobin (HbA1C),Glucose Challenge Test (GCT), Glucose Tolerance Test (GTT)	3	4
	2.3	Liver Function Test– Total protein, Albumin,Globulin A/G ratio, Total bilirubin, Serum Glutamate Oxaloacetate Transaminase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT), Alkaline Phosphatase (ALP), Alpha Feto Protein (AFP).	3	5
	2.4	Thyroid Function Tests-Thyroid Stimulating Hormone (TSH), T3,T4, Thyroxine Binding Globulin antibody (antithyroglobulin), Thyroid peroxidase antibody (TPO)	3	6
	2.5	Renal Function Tests-Urea, Creatinine, Uric acid	2	7
	2.6	Emerging technologies in biochemical testing	1	8
3. Laboratory visit and Case study	3.1	Laboratory Visit and Report Submission	8	8
	3.2	Case Study-Interpretation of a clinical Laboratoryreport	7	8
4.Teacher specific content/ Teacher facilitated activities				

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

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

References

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

Suggested Readings

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

Mahatma Gandhi University
Kottayam

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate how narcotics and psychotropic drugs interact with the human body	K, U, E	1,2,4, 8
2	Describe the different classes of NDPSs, their mechanism of action	K, U, An	1, 2,3,4
3	Analyse the potential risks associated with the use of narcotics and psychotropic drugs	U, An, I	1,2,3, 6
4	Evaluate the mechanism for drug addiction and formulate management strategies	U, E, A	1,2,3, 4,8
5	Assess the legal and ethical implications of using narcotics and psychotropic substances.	U, E, I, Ap	1,2,3, 4,6,8
6	Communicate and educate effectively about the risks, benefits,and responsible use of narcotics and psychotropic substances, orally/writing, to diverse communities	U, E, C,S, Ap	2,4,5, 6,8,9, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Overview of NDPSs	1.1	Introduction to NDPSs, understanding the basic principles of how drugs interact with the body, including pharmacokinetics (how the body affects the drug) and pharmacodynamics (how the drug affects the body).	5	1
	1.2	Study of narcotic drugs, their classification, mechanisms of action (in brief), therapeutic uses, and potential for abuse or addiction. Examples include opioids like morphine, heroin, oxycodone	5	2
	1.3	Exploring drugs that affect mental processes, including antipsychotics, antidepressants, anxiolytics, and mood stabilizers. Study of their mechanism of action, indications, and potential side effects. Examples include MDMA, LSD, Barbiturates	5	3
2. Addiction and Dependence	2.1	Investigation of the physiological and psychological mechanisms behind drug addiction and dependence.Thisinclude studying tolerance, withdrawal symptoms	6	4
	2.2	Strategies for managing addiction.	3	4
	2.3	Narcotic Drugs and Psychotropic substances Act1985 - use, prescription, and distribution of narcotics and psychotropic drugs.	6	5
3. Deaddiction centre visit and awareness programmes	3.1	Conduct of awareness programmes	10	6
	3.2	Deaddiction centre visit and submission of report	5	6
4.Teacher specific content/ Teacher facilitatedactivities				

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

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

References

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

Suggested Readings

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

SEMESTER 5

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Molecular Biology**					
Type of Course	**DSC A**					
Course Code	**MG5DSCBCH300**					
Course Level	**300-399**					
Course Summary	This course examines the key molecular processes involved in DNA Replication, Transcription, and Translation within both prokaryotic and eukaryotic organisms. It aims to equip students with the knowledge necessary for advanced studies, research, and practical applications in diverse scientific and industrial settings.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the fundamental principles governing the structure of nucleic acids.	U, An	1,2,3,4
2	Identify the molecular mechanisms involved in the duplication of genetic information within living cells.	A, An, E	1,2,3,4
3	Examine DNA repair pathways	U, An	1,2,3,4
4	Explain the transcription of DNA to RNA	U, E, An,	1,2,3,4
5	Illustrate the molecular basis of protein synthesis	E, An, Ap	1,2,3,4,10
6	Acquire an understanding of the intricate mechanism governing gene expression in bacteria and delve into cutting-edge advancements in the field of molecular biology	C, S, I, Ap	1,2,3,4,5,6,10
7	Perform and interpret key molecular biology techniques, to solve biological research problems and diagnose genetic conditions	A, An	1,2,3,4,5,6,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. An overview on the flow of information in cell and DNA Replication	1.1	Central Dogma of Life, Molecular nature of DNA, Nucleosome assembly, Chromosomes and genome, denaturation and renaturation of DNA, Types of DNA.	3	1
	1.2	RNA as genetic material, Chloroplast DNA and Mitochondrial DNA	2	1
	1.3	Prokaryotic DNA replication –– mechanism of replication, semiconservative nature of DNA replication,enzymes and necessary proteins in DNA replication, Replication inhibitors	4	2
	1.4	Eukaryotic DNA replication- enzymes and necessary proteins in DNA replication, telomeres, telomerase and end replication.	3	2
	1.5	DNA Repair - mismatch, base-excision, nucleotide excision and direct repair.	3	3
2. Gene Expression Processes – Transcription	2.1	Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, Rho dependent and Rho independent termination.	5	4
	2.2	Transcription in Eukaryotes: Polymerases and Promoters, Initiation, elongation and termination of RNA chains	5	4
	2.3	Post-transcriptional modifications- 5' capping, polyadenylation, splicing	5	4
3. Decoding Proteins – The Translation Process	3.1	Genetic code, properties of genetic code, Wobble hypothesis. Components of Protein synthesismachinery: Messenger RNA, tRNA structure and function,	5	5
	3.2	Mechanism of protein synthesis in prokaryotes and eukaryotes: initiation, elongation and termination. Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly	5	5
	3.3	Regulation of gene expression in bacteria: lac operon concept. Applications and advanced topics in molecular biology.	5	6
4. Practical	4.1	Introduction to Molecular Biology Techniques DNA Extraction- Plant DNA Extraction and Quantification of concentration and purity	10	7
	4.2	Polymerase Chain Reaction (PCR) PCR Setup -Primer Design, sample preparation PCR Analysis -Gel Electrophoresis to analyse PCR products. Visualization- Staining gels with ethidium bromide or alternative safe dyes and imaging results using a UV transilluminator	10	7

	4.3	Cloning and Transformation Cloning - Restriction Digestion. Ligation-Ligating DNA fragments into plasmid vectors. Transformation -Bacterial Transformation-Transforming competent E. coli cells with recombinant plasmids. Plating and Selection-Spreading transformed cells on antibiotic selection plates.	10	7

5. Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction:, Seminar, Group Assignments, Library work andGroup discussion, Presentation by individual student, Laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. MCQ test (10 marks) 2. Seminar Presentation (5 marks) 3. Assignments (5 marks) 4. Involvement in group discussion (5 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination of one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Rastogi, S. C. (2006). Cell and molecular biology. New Age International.
2. Karp, G. (2007). Cell and Molecular Biology. John Wiley & Sons Incorporated.
3. Watson, J. (2008). Molecular Biology of the Gene 6th edn, Cold Spring Harbor Laboratory Press
4. Cooper, G. M., & Adams, K. W. (2023). The cell: a molecular approach. Oxford University Press.
5. Robert, F. W. (2012). Molecular biology. McGraw-Hill Education

Suggested Readings

1. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2011). *Lewin's genes X*.Jones & Bartlett Learning.
2. Griffiths, A. J. F., Gelbart, W. M., Miller, J. H., & Lewontin, R. C. (1999).Chromosome mutations. *Modern genetic analysis. WH Freeman & Co., New York, NY*
3. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., &Amon, 2021). *Molecular cell biology*. New York: WH Freeman.
4. Wayne, M. B., Kleinsmith, L. J., Hardin, J., & Greory, P. B. (2009). The world of the cell. Pearson Education

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Clinical Biochemistry**					
Type of Course	**DSC A**					
Course Code	**MG5DSCBCH301**					
Course Level	**300-399**					
Course Summary	The course imparts fundamental knowledge and comprehension of clinical disorders, illustrating the application of biochemical parameters and laboratory methods in exploring, diagnosing, and managing diseases.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify the basics of quality control in clinical laboratory	K,U	1,2,3,4
2	Develop proficiency in the proper techniques for curation of biological specimens.	U, E	1,2,3, 6
3	Attain a thorough comprehension of performing renal and liver function tests and associated experiments	E, An, S	1,2,3, 6,8
4	Explain the methodologies employed in conducting gastric and thyroid function tests.	U,E	1,2,3, 6
5	Demonstrate an understanding of disorders related to the metabolism of carbohydrates, lipids, nucleic acids, proteins, and amino acids.	A, An, I	1,2,3, 4,9
6	Acquire proficiency in the methodologies employed in clinical biochemistry laboratories.	S, C, Ap	1,2,3, 4,10

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Basic concepts of Clinical Biochemistry	1.1	Definition and scope of Clinical Biochemistry in diagnosis. Accuracy, Precision and reliability. Quality Control	2	1
	1.2	Types of blood samples - whole blood, Serum, Plasma. Specimen collection, storage, preservation and processing.	3	2
2. Organ Function Tests	2.1	Renal Function Test – Urea, Creatinine Test based on Glomerular Filtration - Clearance Tests - Urea and Creatinine.	4	3
	2.2	Liver Function test –Test based on abnormalities of bile pigment metabolism- Serum Bilirubin, Total Bilirubin –Direct & Indirect, VD Bergh reaction	4	3
	2.3	Test based on Carbohydrate metabolism- Galactose Tolerance Test, Fructose Tolerance Test	3	3
	2.4	Test based on changes in plasma proteins- TotalProtein,Albumin, Globulin, Albumin/globulin ratio	2	3
	2.5	Test for serum enzymes derived from liver- Alanine Transaminase(ALT), Aspartate Transaminase(AST), Alkaline Phosphatase (ALP),Gamma-glutamyl transpeptidase (GGT)	4	3
	2.6	Gastric Function Test- Estimation of Resting contents in resting juice (Gastric residuum),Fractional Gastric analysis using a test 'meal' (FTM)	4	4
	2.7	Thyroid Function Test- TSH, T3,T4, FT3,FT4	4	4
3. Disorders of Metabolism	3.1	Carbohydrate metabolism-galactosemia, Lactose intolerance.	4	5
	3.2	Lipid Metabolism –Atherosclerosis, fatty liver, Taysach'sand Niemann Pick diseases, Hyper and hypo lipoproteinemia.	4	5
	3.3	Nucleic acid Metabolism-Hypo and hyper uricemia, gout.	3	5
	3.4	Protein and amino acid Metabolism- Phenylketonuria (PKU), Alkaptonuria, Tyrosinemia, Maple Syrup Urine Disease (MSUD)	4	5
4. Practical	4.1	Preparation of blood serum and plasma	4	6
	4.2	Estimation of urea in blood serum	4	6
	4.3	Estimation of creatinine in blood serum	4	6
	4.4	Estimation of total Protein- Biuret Method	4	6
	4.5	Estimation of Blood sugar-Nelson-Somogyi	4	6
	4.6	Estimation of Total Cholesterol – Zak's Method	4	6
	4.7	Assay for SGPT/SGOT/ALP in Blood serum	4	6

	4.8	Interpretation of laboratory analysis report	2	6

5.Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group assignments, Library work and Group discussion, Presentation by individual student. Laboratory sessions including demonstrations, hands on training
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. MCQ test (10 marks) 2. Seminar Presentation (5 marks) 3. Assignments (5 marks) 4. Involvement in group discussion (5 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination of one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Chawla, R. (2014). Practical clinical biochemistry: methods and interpretations. JP Medical Ltd.
2. Chatterjea, M. N., & Shinde, R. (2011). Textbook of medical biochemistry. Wife Goes On.
3. Gaw, A., Murphy, M., Srivastava, R., Cowan, R. A., & O'Reilly, D. S. J. (2013). Clinical Biochemistry E-Book: An Illustrated Colour Text. Elsevier Health Sciences.
4. Godkar, P. B. (1994). Clinical Biochemistry-Principles and Practice. Bhalani Publications
5. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2013). Textbook of biochemistry for medical students. JP Medical Ltd.

Suggested Readings

1. Candlish, J. K., & Crook, M. (1993). Notes on clinical biochemistry. WorldScientific Publishing Company.
2. Kumar, V., & Gill, K. D. (2018). Basic concepts in clinical biochemistry: a practicalguide. Springer Singapore.
3. Marshall, W. J., & Bangert, S. K. (Eds.). (2008). Clinical biochemistry: metabolicand clinical aspects. Elsevier Health Sciences.
4. Marks, D. B., Marks, A. D., & Smith, C. M. (1996). Basic medical biochemistry: aclinicalapproach.

5. Smith, C. (1987). Mark's Basic Medical Biochemistry.
6. Tietz, N. W., Burtis, C. A., & Ashwood, E. R. (1994). Tietz textbook of clinical chemistry. W. B. Saunders Co., Philadelphia

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Bioinformatics**					
Type of Course	**DSE**					
Course Code	**MG5DSEBCH300**					
Course Level	**300-399**					
Course Summary	The course focus on computational gene hunting, sequencing, DNA arrays, sequence comparison, genome rearrangements, molecular evolution, phylogenetic analysis, computational proteomics and its applications in various fields of science.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PO No
1	Discuss the foundations of bioinformatics and databases	K, U	1,2,3,4
2	Examine bioinformatic tools and softwares.	U, An	1,2,3,4,
3	Describe the concept of sequences, alignment and dynamic programming	U, An	1,2,3,4
4	Evaluate different sequence alignment tools	E, A	1,2,3,9
5	Interpret the applications of bioinformatics in genomics and proteomics	E, C, Ap	1,2,3,9
6	Acquire proficiency in data analysis using bioinformatics tools	S,C, Ap	1,2,3,6, 8,10

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1.1 **1. Introduction to Bioinformatics Databases**	1.1	Definition, History and Development, Scope, and Areas of research.	2	1
	1.2	Biological Database and its Types: Introduction to Biological Databases and Source.	2	1
	1.3	Sequence and structure databases: EMBL, DDBJ, GENBANK, Pubmed, PIR, SwissProt, CSD, PDB, NCBI, EXPASY.	2	1
	1.4	Nucleic acid databases (NCBI, DDBJ, NDB, and EMBL).Protein databases (Primary, Composite, and Secondary)	2	1
	1.5	Specialized Genome databases: (SGD, ACeDB and TIGR). Structure databases (CATH, SCOP, and PDBsum)	2	1
2. Bioinformatic Tools	2.1	FASTA, BLAST, BLAT	5	2
	2.2	Softwares (RASMOL, JMOL, Ligand Explorer), Human Genome Project (HGP)	5	2
	2.3	Data storage and retrieval: Flat files, relational, object oriented databases and controlled file Format (DDBJ, FASTA, PDB).	5	2
3. Sequence Alignments and Visualization	3.1	Introduction to Sequences, alignments and Dynamic Programming.	5	3
	3.2	Local alignment and Global alignment (algorithm and example),	5	4
	3.3	Pairwise alignment (BLAST, FASTA Algorithm and TCoffee) and Multiple sequence alignment (ClustalW algorithm).	5	4
4. Applications of Bioinformatics	4.1	Applications of bioinformatics in Pharmaceutical, Industry, Agriculture , Forensic, Immunology , Environment, Biotechnology, Molecular biology and Neurobiology	5	5
	4.1	Phylogenetic Analysis : Construction of phylogenetic tree, dendrogram- MEGA software,Evolutionary tree	5	6
	4.2	Protein modelling and protein docking. Drug designing- computer aided drug design (structure based and ligand based approaches)	5	6
	4.3	Introduction to nucleotides to aminoacid translation softwares	5	6
5. Teacher specific content/ Teacher facilitatedactivities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** (30 marks) 1. MCQ of one hour (15 marks) 2. Assignment- (2 marks) 3. Seminar presentation (5 marks) 4. Involvement in group discussion (3 marks) 5. Viva (5 marks)
	B. End Semester Examination Written examination of two hours (70 marks)

References

1. Lesk, A. (2019). Introduction to bioinformatics. Oxford university press.
2. Orengo, C., Jones, D., & Thornton, J. (Eds.). (2003). Bioinformatics: genes, proteins and computers. Taylor & Francis.
3. Ramsden, J. (2023). Bioinformatics: an introduction. Springer Nature.
4. Shaik, N. A., Hakeem, K. R., Banaganapalli, B., & Elango, R. (2019). Essentialsof Bioinformatics, Volume I. Springer International Publishing, Cham.
5. Tsai, C. S. (2003). An introduction to computational biochemistry. John Wiley &Sons.
6. Xiong, J. (2006). Essential bioinformatics. Cambridge University Press

Suggested Readings

1. Abdurakhmonov, I. Y. (2016). Bioinformatics: basics, development, and future.Rijeka: InTech.
2. Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (Eds.). (2020). Bioinformatics.John Wiley & Sons.
3. Gu, J., & Bourne, P. E. (Eds.). (2009). Structural bioinformatics (Vol. 44). JohnWiley & Sons.
4. Jones, N. C., & Pevzner, P. A. (2004). An introduction to bioinformaticsalgorithms. MIT press.
5. Polanski, A., & Kimmel, M. (2007). Bioinformatics. Springer Science & BusinessMedia

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Pharmacological Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG5DSEBCH301**					
Course Level	**300-399**					
Course Summary	The course provides a comprehensive overview of the principles of pharmacology and the scope of pharmaceutical biochemistry, encompassing key concepts, techniques, and ethical considerations in drug development and therapy.					
Semester	5	Credits			4	Total Hours
CourseDetails	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Prerequisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the principles of pharmacology and scope of pharmaceutical biochemistry.	K, U	1,2,3,4
2	Examine the biochemical approach to pharmacokinetics.	U, A, E	2,3,4,10
3	Interpret the a conceptual knowledge on the mechanism of drug action	U, An	1.2.3, 4,6,9
4	Explain the concepts of drug tolerance, dependence, and bioavailability	U, An	1.2.3, 4,6,9
5	Analyse the role of biotransformation in drug metabolism	A, E, I	1,2,3, 6,10
6	Illustrate the current trends in pharmaceutics concerning the treatment and prevention of diseases.	S, C, Ap	1,2,3,4 ,6,8, 10

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to pharmacology	1.1	Definition and scope of pharmacology. Importance of pharmacology in healthcare and drug discovery	2	1
	1.2	Historical development and milestones. Natural sources of drugs: plants, animals, microorganisms	4	1
	1.3	Classes of drugs based on their pharmacological actions. Mechanisms of action and therapeutic uses for each class.	4	1
2. Drug Absorption, Distribution, Metabolism, and Excretion (ADME)	2.1	Pharmacokinetics – Absorption, Bioavailability and distribution of drugs,. Factors influencing drug pharmacokinetics.	6	2
	2.1	Pharmacodynamics: mode of administration. Mechanisms of drug action through chemicals and enzymes (stimulation and inhibition)	6	3
	2.2	Receptor theory and drug-receptor interactions. drug – dose response curve, Drug-dose response, combined effect of Drugs	3	3
	2.3	Drug tolerance and dependence, Therapeutic drug monitoring, Adverse responses and side effects of drugs, Drug allergy,	3	4
	2.4	Excretion and kinetics of elimination. Factors affecting drug bioavailability	2	4
3. Biotransformation	3.1	Role of biotransformation in drug metabolism Phase 1 Biotransformation reactions- Oxidation reactions: Cytochrome P450 enzymes, Reduction reactions: Non-CYP enzymes,Hydrolysis reactions: Esterases and amidases.	5	5
	3.2	Phase 2 Biotransformation reactions- Glucuronidation, Sulfation, Methylation, Acetylation, Conjugation with amino acids	5	5
	3.3	Factors Influencing Biotransformation. Inductionand Inhibition of drug-metabolizing enzymes with examples	5	5
4. Emerging Trends and Future Directions	4.1	Introduction to metabolomics, Pharmacogenomics and personalized medicine	3	6
	4.2	Introduction to chemotherapy and cancer cure	3	6
	4.3	Miscellaneous drugs & essential drugs – theirtherapeutic uses & biochemical relevance	3	6
	4.4	Drug binding to nucleic acid -- Antimalarial, anti-cancer, antiviral drugs	3	6
	4.5	Role of vaccines and sera in pharmaceutics.	3	6

5.Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** (30 marks) 1. MCQ test for half an hour (15 marks) 2. Seminar presentation (5 marks) 3. Assignments (5 marks) 4. Involvement in group discussion (5 marks)
	B. End Semester Examination Written examination of 2 hours (70 marks)

References

1. Hilal-Dandan, R., & Brunton, L. (2013). *Goodman and Gilman Manual of Pharmacology and Therapeutics, 2* (pp. 852-854). McGraw Hill Professional, Philadelphia.
2. Goodman, L. S. (1996). Goodman and Gilman's the pharmacological basis oftherapeutics (Vol. 1549, pp. 1361-1373). New York: McGraw-Hill.
3. Tripathi, K. D. (2013). *Essentials of medical pharmacology*. JP Medical Ltd.
4. Walsh, G. (2013). Biopharmaceuticals: biochemistry and biotechnology. John Wiley& Sons.
5. Woodbury, C. P. (2012). *Biochemistry for the pharmaceutical sciences*. Jones & Bartlett Publishers.

Suggested Readings

1. Brunton, L. L., Hilal-Dandan, R., & Knollmann, B. C. (2018).Goodman & Gilman's the pharmacological basis of therapeutics. McGraw-Hill Education.
2. Katzung, B. G., Masters, S. B., & Trevor, A. J. (2021).*Basic and clinical pharmacology.* McGraw-Hill Education.
3. Rang, H. P., Dale, M. M., Ritter, J. M., & Flower, R. J. (2019).Rang & Dale's pharmacology. Elsevier.
4. Trevor, A. J., Katzung, B. G., & Kruidering-Hall, M. (2018).*Pharmacology:Examination & board review.* McGraw-Hill Education.

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Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Advanced Cell Biology**					
Type of Course	**DSE**					
Course Code	**MG5DSEBCH302**					
Course Level	**300-399**					
Course Summary	The course is designed to provide fundamental insights into the structureand functionality of cells and their components. It deals with membrane transport, the role of cell receptors, the intricate processes of cell signalling and advances in cell biology.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the basic cell structure	K, U	1,2,3,4
2	Describe the concept of cell cycle and development	U, An	1,2,3,10
3	Illustrate the membrane structure and functions.	A, E	1,2,3,10
4	Examine the membrane transport system `	An, Ap	1,2,3,5
5	Analyse the basics of cellular organization and cell signalling	An, E, I	1,2,3,6
6	Gain knowledge about development of cancer, mechanism of cell death and emerging technologies in cell biology	U, A, Ap	2,3, 6,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Basics of Cell Biology	1.1	Milestones in the development of Cell Biology, Cell theory, Cell as unit of life, basic properties of a cell.	5	1
	1.2	Prokaryotic and Eukaryotic cells, plant cell and Animal cell. Structure and integrity of cells, subcellular organization of activities	5	1
	1.3	Cell cycle- different phases and regulation. Celldivision-mitosis and meiosis, similarities anddifferences. Types of cells, stem cells, quiescent cells, and cellular differentiation.	5	2
2. Membrane Biochemistry	2.1	Plasma membrane: Structure and functions ofplasma membrane. Different models of plasma membrane, characteristics of fluid mosaic model, biochemical composition.	5	3
	2.2	Membrane proteins- Functions and classification-integral, peripheral, lipid-anchored proteins	5	3
	2.3	Transport mechanism, passive and active transport,co-transport, symport, antiport, uniport, ion channels, bulk transport, endocytosis, exocytosis, phagocytosis, pinocytosis. Role of clathrin, Vesicle trafficking, COPI and COPII in transport. Ca2+ and Fe transport.	5	4
3. Cell Organelle	3.1	Cytoskeleton and organization, microtubules, microfilaments and intermediary filaments. Structure and function of centrosomes. Structure and functions of cilia and flagella.	3	5
	3.2	Structure and function of nucleus and nucleolus. Morphology of chromosomes.	3	5
	3.3	Structure and functions of mitochondria, lysosome, endoplasmic reticulum, Golgi complex, and ribosomes. Transport of proteins from endoplasmic reticulum to Golgi complex, protein sorting in trans golgi network, glycosylation in Golgi complex.	3	5
	3.4	Connective tissue: Collagen, elastin, other fibrous proteins, proteoglycans, fibronectin, other proteins of extracellular matrix.	3	5
	3.5	Cell-Cell interaction and Cell-matrix interaction.	3	5

4. Advanced Cell Biology	4.1	Membrane receptors - Types, Structure and functions of receptors; Mechanism of signal transduction – signals, second messengers. Signalling pathways: GPCR, Receptor Tyrosine Kinases and MAP Kinase.	3	5
	4.2	Cell Biology of cancer- Stages in cancerdevelopment, causes, and properties of cancer cells.	3	6
	4.3	Cellular senescence and aging-Cell death, Apoptosis. and Autophagy	3	6
	4.4	Stem cell Biology properties of stem cells, Types ofstem cells, stem cell niches, cell fate decision and differentiation	3	6
	4.5	Emerging technologies in Cell Biology-CRISPR/Cas9 Genome Editing	3	6
5 Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test for half an hour (15 marks) 2. Seminar presentation (5 marks) 3. Assignment (5 marks) 4. Involvement in group discussion (5 marks)
	B. End Semester Examination Written examination of 2 hours (70 marks)

References

1. Cooper, G. M., & Hausman, R. (2000). The Cell-A Molecular Approach,Sunderland(MA): Sinauer Associates, Inc.
2. Lodish, H. (2008). Molecular Cell Biology. Macmillan.
3. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2004). Microbiology. Tata McGraw-HillPublishing Company Ltd., New Delhi.
4. Pollard, T. D., Earnshaw, W. C., & Lippincott-Schwartz, J. (2007). Cell Biology.Elsevier Health Sciences.

Suggested Readings

1. Becker, W. M., Kleinsmith, L. J., Hardin, J., & Bertoni, G. P. (2009). The Worldof theCell. VII Edition. Pearson Benjamin Cummings Publishing.
2. De Robertis, E. D. P., & De Robertis, E. M. F. (2006). Cell and MolecularBiology. VIII Edition. Lippincott Williams and Wilkins.
3. Karp, G. (2007). Cell and Molecular Biology. John Wiley & Sons Incorporated.
4. Nelson, D. L., & Cox, M. M. (2013). Lehninger Principles of Biochemistry 6thEditio

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Programme	**BSc (Hons) Biochemistry**					
Course Name	**Plant Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG5DSEBCH303**					
Course Level	**300-399**					
Course Summary	The Plant Biochemistry course delves into distinctive biochemical pathways that characterize plant metabolism, encompassing processes such as photosynthesis, nitrogen assimilation, and the production of growth regulators and essential secondary metabolites vital for defense and communication. This course consolidates information on plant-specific biochemical mechanisms.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	1	0	60
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Summarise the process of photosynthesis	K, U,A	1,2,3,4, 10
2	Analyse the biochemistry of nitrogen assimilation in plants.	U, An	1,2,3,4
3	Examine the physiological functions of growth regulators	A, E, I	1,2,3,4
4	Attain a comprehensive understanding of the diverse metabolites produced by plants	U,A	1,2,3,4
5	Appraise the significance and analysis of plant secondary metabolites	E, Ap	1,2,3,6
6	Develop expertise in isolation and analysis of plant metabolites	S, C, I	1,2,3,4, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Photosynthesis	1.1	Introduction – Structure and functions of chloroplast, funnelling of energy, Light harvesting complexes, photosynthetic pigments, Photochemical reaction centres.	5	1
	1.2	Light reactions- Z Scheme, ATP synthesis - cyclicand noncyclic photophosphorylation Dark reactions-C3,C4 and CAM pathway, Photorespiration	5	1
	1.3	Regulation of Calvin cycle, Synthesis of sucrose and starch. Photosynthetic responses to light CO2 and temperature	5	1
2. Nitrogen Assimilation	2.1	Nitrogen Cycle- Ammonification, Nitrification, and Denitrification, Assimilation of Nitrate, Ammonium, phosphate and sulphate ions.	4	2
	2.2	Biological Nitrogen fixation- Symbiotic Nitrogen fixation, Specific Associations Between bacteria and Plants, Events in root nodule formation Nonsymbiotic nitrogen fixation- free living Nitrogenfixing organisms	6	2
	2.3	Biochemistry of Nitrogen fixation-Nitrogenase complex and mechanism of action of nitrogenase.	5	2
3. Plant growth regulators	3.1	Hormone concept in plants, Auxins-Physiological and developmental effects of auxins, Structure of IAA, mode of transport of auxins. Gibberellins - Effects of Gibberellins on growth and development. Cytokinins-Regulators of cell division, Properties and biological role of cytokinins.	5	3
	3.2	Ethylene- The gaseous hormone, Structure, developmental and physiological effects of ethylene Abscisic Acid- Seed Maturation and Antistress Signal, Developmental and physiological effects of ABA, Brassinosteroids, jasmonic acid and Salicylicacid.	5	3
4. Plant metabolites	4.1	Plant metabolites-Distinction between primary and secondary metabolites, Occurrence and distribution of secondary metabolites in taxonomically distinct plants, Distribution in various plant parts and at different developmentalstages in plants. Plant derived enzymes.	5	4
	4.2	Major chemical classes of secondary metabolites: A brief account of the following classes: Alkaloids, terpenoids, flavonoids, phenolics and phenolicacids, steroids, coumarins, quinines, acetylenes,cyanogenic glycosides, amines and non-protein amino acids, gums, mucilages, resins etc. (Structures not necessary. Give examples of the	5	5

		compounds and the plants in which present and their importance).		
	4.3	Importance of secondary metabolites: Protection of the producer plant from predators and insects; importance to man as active principles exerting physiological effects to mammalian systems. Uses of secondary metabolites to man: as drugs, precursors of drugs in pharmaceutical industry, as natural pesticides/insecticides; other uses of secondary metabolites.	5	5
	4.4	Techniques for extracting, purifying, and quantifying secondary metabolites.	5	6

5.
Teacher specificcontent/ Teacherfacilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** (30 marks) 1. MCQ test for half an hour (15 marks) 2. Seminar Presentation (5 marks) 3. Assignment and group discussion (5 marks) 4. Quiz (5 marks)
	B. End Semester Examination Written examination of 2 hours (70 marks)

References

1. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant physiology anddevelopment* (No. Ed. 6). Sinauer Associates Incorporated.
2. Hopkins, W. G. (2008). *Introduction to plant physiology*. John Wiley & Sons.
3. Verma, S. K., & Verma, M. (2008). *A textbook of plant physiology, biochemistry and biotechnology*. S. Chand Publishing.
4. Heldt, H. W., & Piechulla, B. (2021). *Plant biochemistry*. Academic Press.
5. Sharma, S., & Tiwari, G. (2022). *A Practical Manual on Fundamentals of PlantPhysiology*. BFC Publications.
6. Sadasivam, S. (1996). *Biochemical methods*. New age international.

Suggested Readings

1. Rhodes, D., & Nadolska-Orczyk, A. (2001). Plant stress physiology. *e LS*.
2. Gupta, D. K., & Corpas, F. J. (Eds.). (2021). *Hormones and Plant Response* (Vol.2).Springer Nature.

3. Jain, V. K. (2018). *Fundamentals of plant physiology*. S. Chand Publishing.
4. Bala, M., Gupta, S., & Gupta, N. K. (2013). *Practicals in plant physiology andbiochemistry*. Scientific Publishers.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Membrane Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG5DSEBCH304**					
Course Level	**300-399**					
Course Summary	This course serves as an in-depth exploration of the fundamental principles of membrane biochemistry, offering students a comprehensive understanding of the structure, composition, dynamics, and transport mechanisms inherent to biological membranes.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe an understanding on the structure and function of biological membranes	K, U, A	1,2,3,4
2	Analyze the influence of polymorphic liquid water systems on the structure and functions of biological membranes	An,E	2,3,4,10
3	Explain the principles governing membrane organization	U, A, E	2,3,4,10
4	Develop a comprehensive understanding of the mechanisms behind membrane fluidity and various techniques used to study membrane fluidity	An, E	2,3,4,10
5	Demonstrate the ways by which processes like diffusion, osmosis and active transport occurs across membrane	U, A, C	1,2,3,4, 6
6	Illustrate the role of channels, carriers, and pumps in maintaining cellular homeostasis.	S, I ,Ap	2,3,4,8, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Membrane Biochemistry	1.1	Historical perspective and various membrane models. Overview of membrane functions.	3	1
	1.2	Detailed study of Fluid Mosaic Model of Membranes. Monolayer, planar bilayer and liposomes as model membrane systems.	8	1
	1.3	Polymorphic lipid-water systems. The various determinants of polymorphic phases: CMG, lipid shape, critical packing parameter.	4	2
2. Composition of Biological Membranes	2.1	Composition of membranes: Lipids- phospholipids, glycolipids, sterols: Proteins- Peripheral proteins, Integral proteins and lipid anchored proteins and carbohydrates.	7	3
	2.2	Comparison of the composition of various biomembranes- prokaryotic, eukaryotic, neuronal and subcellular membranes	5	3
	2.3	Lateral and transverse asymmetry in membranes. Role of Flippase, Floppase and Scramblase.	3	3
3. Membrane dynamics	3.1	Membrane fluidity: Lateral, transverse androtational movements of lipids and proteins. Various factors affecting membrane fluidity	7	4
	3.2	Microdomains in membranes - rafts, calveolae. Fence and Gate model.	3	4
	3.3	Techniques to study membrane dynamics: FRAP, TNBS and STP.	5	4
4. Membrane Transport	4.1	Thermodynamics of transport. Simple diffusion and Facilitated diffusion. Osmosis and its importance. Passive transport- glucose transporter, anion transporter and porins	4	5
	4.2	Primary active transporters - P type ATPases, Vtype ATPases, F type ATPases. Secondary active transporters (Preliminary concept only) - lactose permease, Na^+ - glucose symporter. ABC family of transporters - MDR, CFTR	8	5
	4.3	Ion channels (Na+/ K+ voltage gated channel), ligand gated ion channel (acetyl choline receptor). Ionophores - valinomycin, gramicidin.	3	6
5. Teacher specificcontent/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test for half an hour (15 marks) 2. Seminar presentation – (5 marks) 3. Assignments (5 marks) 4. Involvement in group discussion (5 marks)
	B. End Semester Examination Written examination of two hours (70 marks)

References

1. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2002). Biochemistry (5th ed.) W. H. Freeman Publishing, New York
2. Wardhan, R., Mudgal, P., & Rashmi. (2017). Textbook of Membrane Biology. Springer.
3. Gurr, M. I., Harwood, J. L., & Frayn, K. N. (2002). Lipid Biochemistry (5th ed.). Blackwell Science.
4. Ridgway, N., & McLeod, R. (2015). Biochemistry of Lipids, Lipoproteins and Membranes (6th ed.). Elsevier.
5. Hunte, C., von Jagow, G., & Schagger, H. (2011). Membrane Protein Purificationand Crystallization. Academic Press.
6. Alberts, B., et al. (2012). Molecular Biology of the Cell. Garland Publications.
7. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.
8. Lodish, H., et al. (2012). Molecular Cell Biology (7th ed.). W.H. Freeman and Co.

Suggested Readings

1. Rees, D. (2003). Membrane Proteins. Academic Press.
2. Stillwell, W. (2013). Introduction to Biological Membranes. Elsevier.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	***In-silico* Drug Designing**					
Type of Course	**SEC**					
Course Code	**MG5SECBCH300**					
Course Level	**300-399**					
Course Summary	The course delivers a thorough examination of tools and methodologies for drug design, encompassing both structure- based and ligand-based approaches.					
Semester	5	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Recall the scope of *in silico* drug designing	K, U	1,2,3,4
2	Examine the approaches for drug designing.	U, E	1,2,3,10
3	Gain proficiency in accessing drug databases	U, An	1,2,3,4,6
4	Apply computational tools to identify molecular interactions and structure predictions.	A, An	1,2,3,9
5	Acquire a comprehensive understanding on ligand based drug design	U,An	2,3,4,8
6	Assess ADMET predictor tool	An, S, Ap	1,2,3,6,8

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

COURSE CONTENT
(Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to bioinformatics and drug design	1.1	Scope of *in-silico* drug designing. Role of computational methods in drug discovery	5	1
	1.2	Introduction to databases: chemical, biological, and structural. An Overview of drug databases and repositories.	5	2
	1.3	Overview of the drug design process, Structure -activity relationships (SAR) in drug design, Target Identificationand Validation	5	3
2. Structure Based Drug Designing (SBDD)	2.1	Principles of molecular modeling, Energy minimization techniques, Ligand-receptor interactions, Docking algorithms and scoring functions, ADMET scoring parameters.	5	4
	2.2	Protein structure determination techniques; Homology modeling and structure prediction.	5	4
	2.3	Molecular Modeling Techniques- molecular docking tools with Autodock as example, Molecular dynamics (MD)simulations with GROMACS and LAMMPS as example	5	4
3. Ligand-Based Drug Design (LBDD)	3.1	Steps in LBDD, Categories of LBDD -Quantitative Structure-Activity Relationship (QSAR) methods, Pharmacophore modeling and similarity searching	5	5
	3.2	Virtual screening methods, High-Throughput Screening (HTS), Interaction analysis and binding site prediction.	5	5
	3.3	ADMET predictor tool and Toxicity Prediction	5	6
4.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning, Interactive session: Seminar, Individual Assignment, Library work and Group discussion, Presentation by student, Peer evaluation
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 25 marks 1. Internal test (15 marks) 2. Seminar presentation (2 marks) 3. Assignment (3 marks) 4. Involvement in group discussion (3 marks) 5. Peer evaluation (2 marks)
	B. End Semester Examination Written examination for one and a half hours (50 marks)

References

1. Charifson, P. S. (1997). *Practical Application of Computer-Aided Drug Design.* Marcel Dekker, Inc.
2. Liljefors, T., Krogsgaard-Larsen, P., & Madsen, U. (Eds.). (2002). *Textbook of Drug Design and Discovery.* CRC Press.
3. Mannhold, R., Kubinyi, H., & Timmerman, H. (2008). Molecular Modeling: Basic Principles and Applications. John Wiley & Sons
4. Propst, C. L., & Perun, T. (1989). *Computer-Aided Drug Design: Methods and Applications.* Marcel Dekker, Inc.
5. Reddy, M. R., & Erion, M. D. (Eds.). (2001). *Free Energy Calculations in RationalDrug Design.* Springer.

Suggested Readings

1. Crabbe, J. (1997). Molecular modelling: Principles and applications. *Computersand Chemistry*, *3*(21), 185.
2. English, L. B. (Ed.). (2008). *Combinatorial Library: Methods and Protocols* (Vol.201). Springer Science & Business Media.
3. Folkers, G., Sippl, W., Rognan, D., & Holtje, H. D. (Eds.). (2003). Molecular Modeling: Basic Principles and Applications. Science.
4. Gupta, S. P. (1996). *Quantum Biology.* New Age.
5. Hinchliffe, A. (2003). Molecular modelling for beginners. John Wiley & Sons.

SEMESTER 6

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Immunology**					
Type of Course	**DSC A**					
Course Code	**MG6DSCBCH300**					
Course Level	**300-399**					
Course Summary	The course focus on understanding basic immunology, and also discuss about various immunotechniques and their applications. Itcovers discussions on the various components of the immune system,the activations of those components during immune response and the different types of immune responses.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the fundamental Concept of Immunology	K,U,E	1,2,3,4
2	Discuss the types of Immune responses.	U, An, E	1,2,3
3	Compare basic structure and characteristics of antigen and antibodies	A, An, S	1,2,3
4	Explain the molecular interactions between antigen and antibody and the applications of antibody-based technologies	U, E	1,2,3,4
5	Analyse the immune disorders	A, E	1,2,4
6	Acquire profiency in immunological techniques	E, I, Ap	1,2,6,10

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

COURSE CONTENT

(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Components of Immune System	1.1	An overview of immune system Cells of the immune system - WBC- Granulocytes: Eosinophil, Basophil Neutrophils, Mast cells, Dendritic Cells. Agranulocytes – Lymphocytes: B Cells, T cells, Natural Killer Cells. Mononuclear Phagocytes (Monocytes & Macrophages) and Phagocytosis.	5	1
	1.2	Organs of Immune System – Primary Lymphoid Organs: Thymus & Bone marrow. Secondary Lymphoid Organs -Spleen, Lymph nodes. MALT (mucosa-associated lymphoid tissue)	5	1
2. Types of immunity	2.1	Innate immunity-Components of innate immunity, Physical barriers and cellular components. Innate immune responses-Inflammation and its role ininnate immunity, Complement system: Activation and functions	5	2
	2.2	Acquired (adaptive) immunity- Active & Passive immunityand its types. Cell Mediated Immunity and Humoral Immunity, Immunological memory, Immunisation and vaccination. Interaction between innate and adaptive immunity	5	2
3. Antigens, Antibodies & Immune disorders	3.1	Antigen structure — Epitopes, Haptens. Factors contributing to antigenicity. Adjuvants. Antigen recognition, Major Histocompatibility Complex (MHC) types, structure and functions, B cell receptor, T cellreceptor, Clonal selection, Memory responses, Affinity and avidity	5	3
	3.2	Immunoglobulins – Basic structure, types and functions of each. Antibody diversity and generation.	4	3
	3.3	Mechanism of Antigen — Antibody Reactions, Types of interactions, Effector functions & Applications of Antibody - Opsonization, ADCC. Formation of Monoclonal Antibodies by Hybridoma Technology.	5	4
	3.4	Primary and secondary Immunodeficiency Disorders, Allergic/Hypersensitivity reactions	4	5
	3.4	Autoimmune disorders- Organ specific autoimmune diseases (SLE, Multiple Sclerosis), systemic autoimmune diseases, Specific autoimmunity (Hashimoto's Thyroiditis,IDDM, Grave's Disease, Myasthenia Gravis)	5	5
	3.5	Immunological Techniques -RIA, ELISA and Immunofluorescence	2	6
4. Practical	4.1	Introduction to Immunology Techniques and cell culture Preparation of Buffers and Solutions used in immunology experiments. Basic Cell Culture Techniques including aseptic techniques and maintaining cell lines.	6	6

	4.2	Basic Immunological Assays Enzyme-Linked Immunosorbent Assay (ELISA) - Principle and steps of ELISA. - Perform a sandwich ELISA to detect an antigen.	6	6
	4.3	Western Blotting - Sample preparation, gel electrophoresis, transfer, and detection of proteins	6	6
	4.4	Antigen antibody interactions Ouchterlony Double Immunodiffusion (Ouchterlony Test), Radial immunodiffusion	6	6
	4.5	Demonstration of Cell-Based Assays -Flow Cytometry - Basics of flow cytometry, sample preparation, and data analysis	6	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student, Laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination of one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Owen, J. A., Punt, J., Stranford, S. A., & Jones, P. P. (2013). *Kuby immunology* (Vol. 27, p. 109). New York: WH Freeman.
2. Parija, S. C. (2023). *Textbook of microbiology and immunology*. Springer.
3. Straw, B., Roth, J. A., & Saif, L. J. (1989). *Basics of immunology*. NC AgriculturalExtension Service.
4. Paul, W. E. (2012). *Fundamental immunology*. Lippincott Williams & Wilkins.
5. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Roitt's essential immunology*. JohnWiley & Sons.

6. Murphy, K., & Weaver, C. (2016). *Janeway's immunobiology*. Garland science.

Suggested Readings

1. Bier, O. G., Da Silva, W. D., Götze, D., & Mota, I. (2012). *Fundamentals ofimmunology*. Springer Science & Business Media.
2. Mohanty, S. K., & Leela, K. S. (2013). *Textbook of immunology*. JP Medical Ltd.
3. Playfair, J. H. L., & Chain, B. M. (2012). *Immunology at a Glance*. John Wiley &Sons.
4. Lydyard, P., Whelan, A., & Fanger, M. (2011). *BIOS Instant notes in immunology*.Taylor& Francis.
5. Todd, I., Spickett, G. P., & Fairclough, L. (2015). *Immunology*. John Wiley &Sons.
6. Coico, R. (2021). *Immunology: a short course*. John Wiley & Son

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Molecular Basis of Infectious Human Diseases**					
Type of Course	**DSC A**					
Course Code	**MG6DSCBCH301**					
Course Level	**300-399**					
Course Summary	The "Molecular Basis of Infectious Human Diseases" course imparts understanding of worldwide and regional epidemiology, clinical proficiency, judicious application of antimicrobial agents, transmission modes of infections, formulation of preventive strategies, and familiarity with contemporary investigative methods.					
Semester	6	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Acquire a foundational understanding about infectious diseases	U, An, A	2, 3, 4, 6 6,8,10
2	Explain the concept of drug resistance and its implication on public health	U, An	2,3,6,8
3	Develop a detailed understanding of bacterial diseases	U, E, An	1, 2, 3,4,6
4	Attain an understanding on viral diseases and infections	E, An, A	1, 2, 3, 4,6,8
5	Explain the characteristics of parasitic, fungal and mycotic infections	U, E, A,	1,2,3,6 , 8,10
6	Acquire technical skill in pathogen identification	A, I, Ap	2,4,5,6 ,8,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to infectious diseases	1.1	Classification of infectious agents (brief introduction)-bacteria, viruses, protozoa and fungi.	2	1
	1.2	Source, reservoir and transmission of pathogens	2	1
	1.3	Host parasite relationship, types of Infections associated with parasitic organisms	3	1
	1.4	Overview of viral and bacterial pathogenesis.	3	1
	1.5	Infection and evasion	2	1
	1.6	Inhibitors and vaccines	2	1
	1.7	Drug resistance and implications on public health	1	2
2. Bacterial & Viral infections	2.1	Bacterial diseases: detailed study on Tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, diagnostics, therapeutics	4	3
	2.2	Other bacterial diseases- Typhoid, Diphtheria,Pertussis, Tetanus, leprosy, Pneumonia. Syphilis, Leptospirosis other spirochetes, Nocardia, Actinomycosis Brucellosis, Chlamydial diseases	4	3
	2.3	Viral diseases: AIDS, hepatitis, influenza and polio: causative agents, pathogenesis. Dengue & Chikungunya	3	4
	2.4	Viral fever: Thermoregulation and pathogenesis	2	4
	2.5	Respiratory tract infections: Sinusitis, Common cold, Epiglottitis, Covid -19 – History, epidemiology,virology, treatment.	3	4
	2.7	HIV: history, epidemiology, virology, immunology, disease spectrum including pulmonary, gastroenterological and neurological manifestations of HIV, malignancy, treatment guidelines including antiretroviral, drug toxicity, Drug resistance, prevention, future planning	4	4
3. Parasitic,Fungal and Mycotic infections and Advanced topics in infectious diseases	3.1	Parasitic: Detailed study of malaria, history, causative agents, vectors, life cycle, host parasite interactions, diagnostics, drugs and inhibitors.	3	5
	3.2	Mycoses: Superficial mycoses, Subcutaneous mycoses, Deep mycoses including endemicsystemic mycoses, Fungal: Aspergillosis, Amoebiasis	4	5
	3.3	Travel Medicine, Bioterrorism, National Health Programmes Related to Communicable Diseases, Critical Care Syndromes and Exotic infections.	3	5
4.	4.1	Pathogen Isolation and Identification	7	6

Practical		Bacterial Culture: Culturing bacteria from clinical samples (e.g., throat swab) on agar plates. Gram Staining: Performing and interpreting Gram staining to differentiate bacterial types.		
	4.2	Molecular Techniques for Pathogen Detection DNA Extraction from Pathogens -DNA Extraction: Isolating DNA from cultured bacteria or viral samples. Quantification: Using a spectrophotometer to measure DNA concentration and purity	8	6
	4.3	PCR for pathogen detection- DNA extraction, PCR reaction, analyse the amplified product	8	6
	4.4	Elisa for pathogen detection	7	6
5.Teacher specific content/ Teacher facilitated activities				

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

References

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008). Prescott, Harley,Klein's Microbiology (7th ed.). McGraw Hill International Edition.
2. Mandell, G. L., Douglas, R. G., & Bennett, J. E. (2010). Principles and Practices of Infectious Diseases (7th ed.). Churchill Livingstone Elsevier. McGraw-Hill.
3. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2004). Medical Microbiology.ElsevierHealth Sciences.
4. Devlin, T. M. (2011). Textbook of Biochemistry with Clinical Correlations (6thed.).John Wiley & Sons, Inc.
5. Sherwood, L. (2013). Introduction to Human Physiology (8th ed.). CengageLearning Brooks/Cole.
6. Snustad, D. P., & Simmons, M. J. (2012). Principles of Genetics.

7. Cooper, G. M., & Hausman, R. E. (2009). The Cell: A Molecular Approach (5thed.).ASM Press & Sinauer Associates.
8. Hall, J. E., & Hall, M. E. (2020). Guyton and Hall Textbook of Medical Physiology (14thed.).

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Forensic Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG6DSEBCH300**					
Course Level	**300-399**					
Course Summary	The course deals with the clinical analysis of body fluids to aid the diagnosis, therapy and monitoring of diseases. The course provides knowledge and understanding of clinical disorders and how biochemical parameters and laboratory methods are used for the investigation, diagnosis and management of disease.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Review the basics of blood composition, identification and characterization	K, U, E	1,2,3, 4
2	Describe the semen composition and characterization	U, An, E	1,2,4, 6,8
3	Illustrate the importance of collection and preservation of body fluids in forensic science.	U, An, A	1,2,3, 6
4	Explain the tests for identification of body fluids in crime investigation	U, An	2,3,4, 6,8,
5	Describe the basics of polymorphisms in forensic science	A, E, C	1,2,3, 6,8,10
6	Discuss the importance of forensics in paternity disputes	S, I, Ap	1,2,6, 8,9,10

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No
1. Blood- composition, Identification and Characterisation	1.1	Blood-Composition and functions - Basic concepts- antigen, antibodies, Antigen -antibody binding reactions- primary and secondary. Collection and preservation of blood evidence.	5	1
	1.2	Distinction between human and non-human blood. Human blood groups: General Principles-, theory of their inheritance, Blood group determination from fresh blood, titer, rauleaux formation and Bombay blood group.	5	1
	1.3	Forensic characterization of blood stain, Stain Pattern of Blood. Blood enzymes and proteins. Blood stain Pattern Analysis-Bloodstain characteristics. Impact bloodstain pattern, cast off bloodstain patterns Contact bloodstain patterns,Blood drying times, Documentation of bloodstain pattern evidence, Crime scene reconstruction with the aid of blood stain pattern analysis	5	1
	1.4	Tests for Identification and characterization of blood Presumptive and Confirmatory tests, Physical examination, Phenolphthalein test (Kastle-Meyer Test)-Takayama test, Spectrophotometric estimation, Determination of species of origin, Crossover Electrophoresis, Typing from dried blood stains-Absorption elution technique. Interpretation of results.	5	1
2. Semen - Composition & identification	2.1	Forensic significance of semen Composition - Functions and morphology of spermatozoa, Collection of evidence and preservation, Collection of evidence and preservation	5	2
	2.2	Tests for identification- Presumptive and confirmatory tests-Physical examination-Acid phosphatase test- Florence test- Berberio's test, Microscopic examination for the presence of spermatozoa	5	2
	2.3	Other techniques for identification - P30 test, Identification of seminal vesicles, specific antigen cross-over electrophoresis	5	2
3. Importance of body fluids in Crime investigation	3.1	Introduction-Collection and Preservation of body fluids. Types of Saliva, Sweat,Urine, Milk, Vaginal secretions, faecal matter	5	3
	3.2	Tests for identification Lugol's iodine test- SAP/VAP Electrophoresis —— Uffelmann's test- Urea nitrate crystal test, Creatinine test, Tests for Lactalbumin and casein, Radial diffusion test for Amylase, Edelmann's test for bilirubin	5	4

4. Importance of polymorphism in forensic science	4.1	Protein and Enzymes, Isoenzymes Polymorphism	3	5
	4.2	Polymorphic Enzymes: Phosphoglucomutase-Esterase D and Erythrocyte Acid Phosphatase and its forensic significance Polymorphic Proteins: Haemoglobin,Transferrin and Albumin, HLA typing and its forensic significance	7	5
	4.3	Paternity Disputes: Causes,Paternity Index and Probability for Paternity and Maternity	5	6

5. Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction:, Seminar, Group Assignments, Library work andGroup discussion, Presentation by individual student
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test for half an hour(15 marks) 2. Seminar presentation (3 marks) 3. Involvement in group discussion (4 marks) 4. Assignment (3 marks) 5. Viva (5 marks)
	B. End Semester Examination Written Examination of two hours (70 marks)

References

1. Stryer, L. (1988). Biochemistry (3rd ed.). W.H. Freeman and Company.
2. Eckert, W. G., & James, S. H. (Eds.). (1998). Interpretation of bloodstainevidence at crime scenes. CRC press.
3. Fisher, B. A., Tilstone, W. J., & Woytowicz, C. (2009). Introduction tocriminalistics: the foundation of forensic science. Academic Press.
4. Duncan, G. T., & Tracey, M. L. (1992). Serology and DNA Typing. In “Introductionto Forensic Sciences” Ed. Eckert WG.
5. James, S. H., Kish, P. E., & Sutton, T. P. (2005). Principles of bloodstain patternanalysis: theory and practice. CRC press.

Suggested Readings

1. Ferry, T. S. (1988). Modern accident investigation and analysis. John Wiley &Sons.
2. Lowe, D. (1979). The Tachograph Manual (No. Monograph).
3. Houck, M. M., & Siegel, J. A. (2009). Fundamentals of forensic science.Academic Press.
4. Jamieson, A., & Moenssens, A. (2009). Wiley Encyclopedia of Forensic Science, 5 Volume Set. John Wiley & Sons.
5. Payne-James, J., & Byard, R. (2015). Encyclopedia of forensic and legalmedicine. Academic Press.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Nanotechnology and its Biomedical Applications**					
Type of Course	**DSE**					
Course Code	**MG6DSEBCH301**					
Course Level	**300-399**					
Course Summary	This course provides a comprehensive exploration of nanotechnology and its applications in the Biomedical field. It will also open up a wide range of career opportunities in academia, research institutions, pharmaceutical companies and Biotechnology firms.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Prerequisites,if any	Background knowledge in basic sciences.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe the fundamental concepts of nanotechnology	K,U	2,3,4
2	Describe the properties of nanoparticles and its significance	K,U,E	1,2,3
3	Discuss the methods of preparation of nanomaterials.	U, E, An	1,2,3
4	Explain the modes of characterization of nanoparticles	A, An,C	1,2,3
5	Appraise the role of nanotechnology in medicine	E, I, Ap	1,2,3,4
6	Describe the biomedical applications of nanoparticles.	S, I,Ap	1,2,3,4, 9

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Nanotechnology- An Overview	1.1	Overview of nanotechnology-Fundamental concepts, Size effect of Nanomaterials: Size, shape, density, melting point, wettability and specific surface area. Regulatory and ethical issues	5	1
	1.2	Nanomaterials as molecular building blocks for nanostructure systems- carbon nanomaterials, Buckyball, Graphene (2D), Carbon nanotubes, Inorganic nanomaterials.	5	1
	1.3	Importance and potential impact of nanotechnology	2	
	1.4	Ethical, regulatory and safety aspects of nanotechnology	3	
2. Nanomaterials- Properties and Preparation	2.1	Properties of nanomaterials- catalytic properties, electrical properties, (conductivity and resistivity), magnetic properties (Magnetic hysteresis-Superparamagnetic), Mechanical properties, (adhesion and friction) and optical properties (Photoconductivity, Electroluminescence, Photoluminescence).	5	2
	2.2	Preparation of Nanomaterials Physical methods: Vapor deposition. Chemical methods: Sol-gelprecipitation. Biological methods: Green synthesis	5	3
	2.3	Nanofabrication Bottom-up approach- Wet-chemical synthesis nanomaterials, Self-assembly as an approach nanofabrication. Top-down approach- electron beam lithography and 3D nanofabrication methodology Advantages and disadvantages of bottom-up and top-down method	5	3
3. Characterizationof Nanoparticles	3.1	UV-Visible Spectroscopy, Electron microscopy(TEM & SEM) and X-Ray diffraction (XRD)	5	4
	3.2	Chemical characterisation techniques - optical spectroscopy, electron spectroscopy, Ionic spectroscopy Structural characterization using surface analysis techniques -Scanning tunneling microscopy (STM) and Atomic force microscopy(AFM).	5	4
4. Nanotechnology in medicine and its Biomedical Applications	4.1	Drug delivery sysytems-Nanoscale drug carriers (liposomes, dendrimers, polymeric nanoparticles) Targeted delivery and controlled release Diagnostics and Imaging Quantum dots for bioimaging Magnetic nanoparticles in MRI	7	5

		Nanobiosensors		
	4.2	Nanomaterials in Biomedical Applications Therapeutic Nanomaterials Gold nanoparticles in cancer therapy Carbon nanotubes and graphene in medicine Nanoparticles in photothermal and photodynamic therapy Tissue Engineering and Regenerative Medicine Nanofibers and scaffolds Nanoparticles for bone regeneration Nanomaterials in stem cell therapy Antimicrobial Nanomaterials Silver nanoparticles Nanomaterials for wound healing Mechanisms of antimicrobial action	8	6
	4.3	Group project on any one biomedical application of nanomaterials	5	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminars, Group assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** (30 marks) 1. MCQ for half an hour (15 marks) 2. Assignment- (5 marks) 3. Seminar presentation and (2 marks) 4. Involvement in group discussion (3 marks) 5. Viva (5 marks)
	B. End Semester Examination Written examination of two hours (70 marks)

References

1. Klabunde, K. J., & Richards, R. M. (Eds.). (2009). *Nanoscale materials in chemistry*.John Wiley & Sons.
2. Schwarz, J. A., Contescu, C. I., & Putyera, K. (Eds.). (2004). *Dekker encyclopediaof nanoscience and nanotechnology* (Vol. 5). CRC press.
3. Sergeev, G. B. (2006). *Nanochemistry*.
4. Chan, W. C. (Ed.). (2009). *Bio-applications of Nanoparticles* (Vol. 620). SpringerScience & Business Media.
5. Barhoum, A., & Makhlouf, A. S. H. (2018). *Fundamentals of Nanoparticles* (pp. 605-639). Amsterdam, The Netherlands: Elsevier Inc.

Suggested Readings

1. Nalwa, H. S. (2004). *Encyclopedia of nanoscience and nanotechnology (v. 8. Ne-P)*.

American scientific publishers.
2. Goodsell, D. S. (2004). *Bionanotechnology: lessons from nature*. John Wiley & Sons.
3. Papazoglou, E. S., & Parthasarathy, A. (2007). *Bionanotechnology*. Morgan & Claypool Publishers.
4. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. (2004). *Biomaterials science: an introduction to materials in medicine*. Elsevier.
5. Wagner, W. R., Sakiyama-Elbert, S. E., Zhang, G., & Yaszemski, M. J. (Eds.). (2020). *Biomaterials science: an introduction to materials in medicine*. Academic Press.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Biochemical Toxicology**					
Type of Course	**DSE**					
Course Code	**MG6DSEBCH302**					
Course Level	**300-399**					
Course Summary	This course encompasses key topics to equip students with a profound understanding of biochemical responses to toxins and their implications for human health. It prepares them for careers in environmental health, pharmaceuticals, regulatory agencies, and research institutions.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the fundamental concepts of toxicology, including the definition and scope of the field.	U, An	1,2,3,6
2	Evaluate genetic toxicity testing methods	U, E, An	1,2,3,4,5, 6,7
3	Analyse the environmental consequences of pesticide and chemical toxicology.	An, E, S	2, 4,5,6,7
4	Discuss industrial effluent toxicology and its impact on environment and health	E,An	2,4,6,7,8
5	Explore the processes of xenobiotic metabolism, including absorption and distribution.	An, E, Ap	2, 6,7,8
6	Provide an overview of regulatory systems and organisations involved in the field of toxicology.	U, I, Ap	1,3,8,9, 10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Fundamentals of Toxicology	1.1	Definition and scope- overview of toxicology,scope and boundaries of the field	5	1
	1.2	Classification and Nature of Toxic effects : Basisfor general classification, nature of toxic effects	5	1
	1.3	Dose Response Relationship and Exposure factors:- Dose response relationship; synergism and antagonism; factors influencing acute and chronic exposure.	5	1
2. Assessmentof Toxicity and Mechanisms	2.1	Toxicity testing protocols- overview of toxicity testing, test protocols for assessing toxicity.	5	2
	2.2	In vitro test systems: Bacterial Mutation tests- Reversion test, Ames test, fluctuation tests; Eukaryotic mutation test	5	2
	2.3	Mammalian mutation test- Host mediated assay, dominant lethal test; Biochemical basis of toxicology- mechanisms of toxicity, disturbance of excitable membrane function, altered calcium homeostasis, covalent binding to cellular macromolecules, genotoxicity	5	2
3. Environmental Impact and Toxic Substances	3.1	Pesticide toxicology- environmental consequences of pesticide use	5	3
	3.2	Chemicals in everyday life: toxicology of food additives, toxicology of metals, toxicology ofcommon drugs like paracetamol	5	3
	3.3	Air and Industrial Pollution- common air pollutantsand their sources; air pollution and its effect on theozone layer; industrial effluent toxicology and its impact on the environment and health; toxic effects on mammalian tissues	5	4
4. Xenobiotic metabolism and Detoxification	4.1	Absorption and Distribution: Mechanism of Xenobioticabsorption, distribution of xenobiotics in the body	4	5
	4.2	Phase I reactions- oxidation-reduction processes; hydrolysis and hydration	4	5
	4.3	Phase II reactions and detoxification- Conjugation-methylation; glutathione conjugation; amino acid conjugation	4	5
	4.4	Overview of regulatory agencies for management of toxicological risks, regulatory approaches. Regulatory system and organization	3	6
5. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student, Report on regulatory approaches for toxicological risks.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test for half an hour (15 marks) 2. Seminar presentation – (5 marks) 3. Assignments and group discussion (5 marks) 4. Report of strategies employed in regulating risks associated with toxicology(5 marks)
	B. End Semester Examination Written examination for two hours (70 marks)

References

1. Stine, K. E., & Brown, T. M. (2006). Principles of Toxicology. CRC Press.
2. Timbrell, J. A. (Ed.). (2009). Principles of Biochemical Toxicology. InformaHealthcare.
3. Zakrzewski, S. F. (2002). Environmental Toxicology. Oxford University Press,USA.

Suggested Readings

1. Hodgson, E., & Smart, R. C. (2008). Introduction to Biochemical Toxicology (4thed.). Wiley and Sons.
2. Klaassen, C. D. (Ed.). (2007). Casarett and Doull's Toxicology: The BasicScience of Poisons (7th ed.). McGraw-Hill.

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Biochemistry of cell signaling**					
Type of Course	**DSE**					
Course Code	**MG6DSEBCH303**					
Course Level	**300-399**					
Course Summary	This course equips students with the knowledge, skills, and insights needed to understand the concept of cell signaling, fostering a deeper understanding of cellular communication and its implications in health and disease.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Attain a comprehensive understanding of the principles of signal transduction and developmental cell signaling	K, U, A	1,2,3,4,
2	Acquire comprehensive knowledge of second messengers and protein phosphorylation and their roles in cellular regulation and signal transduction pathways.	U,E,A	1,2,3,4
3	Examine the intricate processes involved in neurotransmission	U, E, I	2,3,4,6,10
4	Analyze the complex network of interactions between different signaling cascades and the cellular responses to signaling	A, An, C	2,3,4,10
5	Investigate the role of cell signalling in cancer development	An, S, I	2,3,4,6
6	Acquire proficiency in techniques for studying signaling pathways	S, I, Ap	2,3,4,5,10
7	Recognize the recent advancements in the area of cell signaling	U, Ap	2,3,4,10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Signal Transduction	1.1	Principle of Signal transduction: Introduction, basic model of signal transduction pathways, Extracellular signals acting locally or at a distance.	4	1
	1.2	Major types of signaling mechanisms (autocrine, paracrine, endocrine, intracrine, juxtacrine), cell-cell contact, cell surface receptors: G protein-coupled receptors (GPCRs), Receptor tyrosine kinases (RTKs), Ion channel receptors. Mechanisms of signal transduction.	6	1
	1.3	Cell Signalling in Development: Signalling in embryonic development. Tissue patterning and organogenesis.	5	1
2. Intracellular Messengers	2.1	Second messengers (cyclic AMP, inositol phospholipid messengers, diacylglycerol, Ca^{2+}, NO) Brief account of their importance and role in signaling and signal transduction.	5	2
	2.2	Protein kinases and phosphatases. Protein Phosphorylation: Role of phosphorylation in signlaling.	5	2
	2.3	Neurotransmission: Signaling in the nervous system. Neurotransmitters and receptors.	5	3
3. Signal Transduction Networks	3.1	Crosstalk and integration of signaling pathways. Feedback mechanisms in signalling.	5	4
	3.2	Cellular Responses to Signalling: Gene expression regulation. Cell growth, differentiation, and death	5	4
	3.3	Cancer and Aberrant Signalling: Role of signaling in cancer. Therapeutic targeting of signalling pathways.	5	5
4. Experimental Techniques and Emerging Topics in Cell Signalling	4.1	Techniques for studying signaling pathways. Gene knockdown, knockout, and overexpression.	8	6
	4.2	Recent advancements and research areas in cell signaling. Signaling in immune response and inflammation.	7	7
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** The course content will be transacted through seminars, power point presentations, group activity, discussions

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test of one hour (15 marks) 2. Assignment (5 marks) 3. Seminar presentation (5 marks) 4. Involvement in group discussion (5 marks)
	B. Semester End examination Written examination of two hours (70 marks)

References

1. Krauss, G. (2014). Biochemistry of Signal Transduction and Regulation (5th ed.).Wiley-VCH Verlag GmbH & Co.
2. Helmreich, E. J. M. (2001). The Biochemistry of Cell Signaling. OUP.
3. Krauss, G. (2003). Biochemistry of Signal Transduction and Regulation. Wiley-VCH.
4. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.
5. Lim, W., Mayer, B., & Pawson, T. (2014). Cell Signaling. Garland Science.
6. Weinberg, R. A. (2013). The Biology of Cancer. Garland Science

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Marine Biochemistry**					
Type of Course	**DSE**					
Course Code	**MG6DSEBCH304**					
Course Level	**300-399**					
Course Summary	The course provides an introduction of biochemical adaptations and the significant components in seafood. The course also deals with laboratory analysis of various parameters in the marine ecosystem					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Prerequisites, if any	Background in basic science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Develop a comprehensive understanding of marine ecosystems.	U, An	1,2,3,4
2	Summarize the importance and roles of various components found in seafood	U, E	1,2,34
3	Analyze the diverse biochemical adaptations employed by marine organisms to thrive in their unique environments.	An, A	1,2,3,10
4	Examine the biochemistry of fish proteins, elucidating their structural features and exploring their significance in marine organisms and human consumption.	A, E, I	1,2,3,6
5	Explore the roles and significance of biologically important fish lipids	U, E, Ap	1,2,3,6
6	Explain the mechanisms underlying postmortem changes in fish, including biochemical processesleading to spoilage, anddiscuss strategies for preservation.	An, C,	1,2,6,7
7	Investigate the physiological and nutritive aspects of the marine environment.	S, I, Ap	1,2,3,4, 10

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Marine ecosystem	1.1	Biodiversity and biogeochemical cycles in marine ecosystems. Sea as a source of Protein, Lipid and Minerals, vitamins and secondary metabolites	4	1
	1.2	Biochemical adaptations in marine organisms- Acid-base regulation, osmoregulation, thermoregulation and hypoxiaadaptations in fishes.	4	3
	1.3	Ecological roles of marine secondary metabolites, Pharmaceutical potential of marine natural products	2	2
2. Proteins from marine organisms	2.1	Nutritionally important food proteins-Sarcoplasmic myofibrillar & Stroma (connective tissue) proteins, Heme proteins, Myoglobin,Haemocyanin, Parvalbumin and anti-freeze proteins.	5	4
	2.2	Assessment of Protein quality of seafoods -Biological value (BV), Protein efficiency ratio (PER) and Net protein Utilization (NPU)	5	4
	2.3	Factors affecting protein bioavailability,anti-nutritional factors. Functional properties of seafood proteins: Solubility, emulsification, viscosity, water holding capacity, gelation and texture profile analysis.	5	4
3. Lipids from marine organisms	3.1	Lipid types and variations, triglycerides, phospholipids	5	5
	3.2	Hydrolytic and oxidative changes, Mechanism of auto- oxidation. Factors affecting autoxidation, Antioxidant synergists and pro-oxidants.	5	5
	3.3	Fatty acid composition of fish liver oils and body oils. Physiological activities of PUFA- Beneficial effects on human health Omega 3 fatty acids.	5	5
4. Challenges in preservation of sea food	4.1	Spoilage mechanisms in fish. Impact of oxidation on flavor and nutritional quality. Flavor changes in fish, Auto-oxidation of fatty acids and Rancidity	5	6
	4.2	Post mortem changes in Fish,Rigor mortis,significance in fish quality.	5	6
	4.3	Sustainable seafood practices.	5	6
	4.4	Assessment of nutritive value of fish protein	5	7
5. Teacher specific content/Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group assignments, Library work and Group discussion, Presentation by individual student.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ of one hour (15 marks) 2. Assignment- (5 marks) 3. Seminar presentation and involvement in group discussion (5 marks) 4. Viva (5 marks)
	B. End Semester Examination Written examination of two hours (70 marks)

References

1. Castro, P., & Huber, M. E. (2008). Marine biology. McGraw-Hill Education.
2. Hjaltason, B., & Haraldsson, G. G. (2006). Fish oils and lipids from marine sources(pp.56-79). Woodhead Publishing Ltd.
3. Munn, C. B. (2019). *Marine microbiology: ecology & applications*. CRC Press.
4. Pilson, M. E. (2012). An Introduction to the Chemistry of the Sea. Cambridgeuniversity press
5. Shahidi, F., & Botta, J. R. (2012). *Seafoods: chemistry, processing technology andquality*. Springer Science & Business Media.
6. Sikorski, Z. (2012). Seafood proteins. Springer Science & Business Media.

Suggested Readings

1. Hui, Y. H., Nip, W. K., Nollet, L. M., Paliyath, G., & Simpson, B. K. (Eds.). (2006).Food biochemistry and food processing (Vol. 769). Hoboken: Blackwell Publishing.
2. Kaiser, M. J. (2011). Marine ecology: processes, systems, and impacts. OxfordUniversity Press, USA.
3. Kim, S. K. (Ed.). (2013). Marine proteins and peptides: biological activities andapplications. John Wiley & Sons.
4. Libes, S. (2011). *Introduction to marine biogeochemistry*. Academic Press.
5. Shul'man, G. E., & Love, R. M. (1999). *The biochemical ecology of marine fishes*.Academic Press

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Forensic Impression analysis**					
Type of Course	**SEC**					
Course Code	**MG6SECBCH300**					
Course Level	**300-399**					
Course Summary	This course equips students with the knowledge and skills needed to effectively analyse and interpret various types of impressions, providingthem with a solid foundation for a career in forensic science and criminal investigations.					
Semester	3	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the basic requirements for a forensic impression analysis	K, U	1,2,3
2	Discuss the fingerprint development and examination methods	U, E, A	1,2.3. 4.6
3	Demonstrate the recording and examination of finger prints on living and dead body	U, E, A	1,2.3. 4.6
4	Illustrate the development, comparison and casting of foot, lip and tyre impressions	A, E, C	1,2,3, 6,8
5	Attain skill in fingerprint analysis.	An, I,Ap	1,2,3, 6,8
6	Create presentation of reports in courts	C, S, I	1,2,3, 6,8

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Fingerprint Types, development and examination	1.1	History and Development, Legal Definition of Fingerprint Expert	2	1
	1.2	Types of Fingerprint- Latent, Patent and Plastic. Classification of Fingerprint Patterns —— Henry Classification:- Primary, Secondary, Sub-Secondary, Key and Final	3	1
	1.3	Fingerprint Development Methods -Crime Scene Observation Techniques – Development, Liftingand Preservation of Latent prints on different surfaces: - Physical Methods– Black Powder, Fluorescent Powders, Magnetic Powder, etc. Chemical Methods – Iodine Fuming method, Ninhydrin method, Silver Nitrate method and Cyanoacrylate Method	8	2
	1.4	Application of Computer in Fingerprint Examination-AFIS, Digital Imaging, Photography of Impressions on transparent surface and Non- Transparent Surface, Lighting Techniques andFilters.	5	2
	1.5	Recording and Examination of Fingerprints onliving and Dead body.	2	3
2. Foot and Other impressions	2.1	Foot Impressions:- Introduction, Types:- Human,Wild Animals(Pug Marks), Significance, Identification, Development and Comparison. Footwear Impressions: Introduction, Significance, Types- Surface and Sunken, Location and Collection of footwear impression. Gait pattern Analysis, Case Laws.	4	4
	2.2	Other Impressions -Tyre impression-Introduction, parts of tyre, types of impressions; sunken and surface, lifting and development techniques: casting ink method.	4	4
	2.3	Lip Prints; Introduction, Types and classification, development techniques, significance of lip printsand their preservation. Palm prints; Importance, Identification, Preservation and comparison.	2	4
3. Practical	3.1	Fingerprint Collection and Analysis Fingerprint Collection: Techniques for collecting latent fingerprints using powder, fuming (cyanoacrylate), and lifting with tape. - Fingerprint Classification: Basic classification systems (e.g., loops, whorls, arches) and ridge characteristics.	8	5
	3.2	Footwear Impression Analysis Collection and Casting of Footwear Impressions - Lifting Techniques: Electrostatic lifting and gelatin lifters for dust prints. - Casting: Using dental stone or plaster of Paris to cast footwear impressions in soil or snow.	8	5
	3.3	Tire Track Analysis Collection and Casting of Tire Tracks -Documentation: Photographing and sketching tire tracks at a crime scene. - Casting: Using dental stone to cast tire tracks.	8	5

		Analysis and Comparison of Tire Tracks -Class Characteristics: Identifying class characteristics such as tread design and tire size. - Individual Characteristics: Identifying unique features such as wear and defects.		
	3.4	Report of any cases pertaining to impressions evidence; sectionspertaining to impressions under court of law	6	6
4.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning, Interactive session: Seminar, Individual Assignment, Library work andGroup discussion, Presentation by student, Peer evaluation, laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 15 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Assignment (2 marks) 5. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement and report presentation (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one hour (35 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Houck, M. M., & Siegel, J. A. (2009). *Fundamentals of forensic science*.Academic Press.
2. Datta, A. K., Lee, H. C., Ramotowski, R., & Gaensslen, R. E. (2001). *Advancesin fingerprint technology*. CRC press.
3. Ashbaugh, D. R. (1999). *Quantitative-qualitative friction ridge analysis: anintroduction to basic and advanced ridgeology*. CRC press.
4. Champod, C., Lennard, C. J., Margot, P., & Stoilovic, M. (2004). *Fingerprints andother ridge skin impressions*. CRC press.
5. Ferry, T. S. (1988). *Modern accident investigation and analysis*. John Wiley &Sons.

Suggested Readings

1. Siegel, J. A., & Saukko, P. J. (2012). *Encyclopedia of forensic sciences*.Academic Press.
2. Jamieson, A., & Moenssens, A. (2009). *Wiley Encyclopedia of Forensic Science,5 Volume Set*. John Wiley & Sons.
3. Payne-James, J., & Byard, R. (2015). *Encyclopedia of forensic and legalmedicine*. Academic Press.
4. Eckert, W. G. (1996). *Introduction to forensic sciences*. CRC press.

5. De Forest, P. R., & DeForest, P. R. (1983). *Forensic science: an introduction to criminalistics*. New York: McGraw-Hill Humanities/Social Sciences/Languages.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Environmental Biochemistry and Human Rights**					
Type of Course	**VAC**					
Course Code	**MG6VACBCH300**					
Course Level	**300-399**					
Course Summary	This course offers a comprehensive understanding of the intricate relationships within ecosystems and the importance of biodiversity, enabling them to analyse and contribute positively to environmental conservation and sustainability efforts. It also inculcate in students the need of understanding the basics of human rights.					
Semester	6	Credits			3	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	0	0	45
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Review the basic concepts of the ecosystem.	K, U	2,3,6,7
2	Discuss the concept of biodiversity	K,U	2,3,4,6
3	Explain the pollution issues and waste management challenges	U, E, An	3,6,7,8
4	Apply the knowledge of biosensors, bioremediation and biodegradation for environmental sustainability.	A, C	1,2,3
5	Debate the ethical dilemmas and complexities within human rights contexts.	E, I, Ap	6,7,8,10
6	Develop effective communication skills to articulate and convey human rights issues related to environment	E, C,A	2, 4,5,6,8

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

COURSE CONTENT
(Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Basic concepts of Ecosystem	1.1	Ecosystem-Concept of ecosystem, structure and function of ecosystem, producers, consumers, decomposers, abiotic components	1	1
	1.2	Ecological succession, Food chain, Food Web, Energy flow in ecosystem, ecological pyramids Biogeochemical cycles(N, C, P cycles)	2	1
	1.3	Biodiversity- concept of Biodiversity, Importance of Biodiversity, Types of diversity; Genetic diversity,Species diversity and Ecosystem diversity	2	2
2. Pollution and its Management, Detection and Remediation	2.1	Pollution: Definition and types - Air, water, soil,marine, noise pollution	3	3
	2.2	Treatment of wastewater- primary, secondary and tertiary treatment. Biological treatment of wastewater- aerobic methods, floc and film based processes, activated sludge process, trickling filter process, aerobic pond. Anaerobic process- methanogenesis, single and double stage reactors.	4	3
	2.3	Solid waste management- anaerobic treatment and land filling. Composting	3	3
	2.4	Biosensors - types and application in environmental pollution, detection and monitoring	5	4
	2.5	Bioremediation - constraints and priorities of bioremediation, evaluating bioremediation	5	4
	2.6	Biodegradation- factors affecting process of biodegradation, methods in determining biodegradability	5	4
3. Environment and Human Rights	3.1	An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).	5	5
	3.2	Human Rights in India. Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities.	5	5
	3.3	Environment and Human Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety	5	6
4. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, ,E-learning Interactive session: Seminar, Individual Assignment, Library work andGroup discussion, Presentation by student, Peer evaluation
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous comprehensive Assessment (CIA)** 25 marks 1. Internal test (15 marks) 2. Seminar presentation (3 marks) 3. Assignment (2 marks) 4. Involvement in group discussion (2 marks) 5. Peer evaluation (3 marks)
	B. End Semester Examination: Written test for one and a half hours (50 marks)

References

1. Bharucha, E. (2005). *Textbook of environmental studies for undergraduatecourses*. University Press.
2. Mongillo, J. F., & Zierdt-Warshaw, L. (2000). *Encyclopedia of environmentalscience*. University Rochester Press.
3. Chiras, D. D. (2009). *Environmental science*. Jones & Bartlett Publishers.
4. Manahan, S. E. (2022). *Environmental chemistry*. CRC press.
5. Begon, M., Howarth, R. W., & Townsend, C. R. (2014). *Essentials of ecology*.John Wiley & Sons.
6. Alexander, D. E., & Fairbridge, R. W. (Eds.). (1999). *Encyclopedia ofenvironmental science*. Springer Science & Business Media.

Suggested Readings

1. Sodhi, G. S. (2005). *Fundamental concepts of environmental chemistry*. AlphaScience Int'l Ltd..
2. Calow, P. P. (2009). *Encyclopedia of ecology and environmental management*.John Wiley & Sons.
3. Townsend, C. R., Begon, M., & Harper, J. L. (2003). *Essentials of ecology* (No.Ed. 2). Blackwell Science.
4. De Anil, K. (2003). *Environmental chemistry*. New Age International.
5. Miller, G. T. (2006). *Environmental science: Working with the earth*. Thomson Brooks/Cole.

SEMESTER 7

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Research Methodology**					
Type of Course	**DCC**					
Course Code	**MG7DCCBCH400**					
Course Level	**400-499**					
Course Summary	This course provides a comprehensive introduction to researchmethodology, covering the fundamental concepts, objectives, and techniques essential for conducting scientific investigations. It is designed to equip students with the knowledge and skills needed to formulate research problems, develop hypotheses, design experiments, collect and analyse data, and communicate research findings effectively.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain fundamentals of research	K, U	1,2,3,4
2	Discuss the significance and socio economic impact of research	U, An	2, 6,8,10
3	Describe research questions and hypotheses	U, An,E	1,2,3,8
4	Design and appraise experimental protocols	A, An,C	1,2,4,6
5	Demonstrate competence in scientific writing and publication	A, ,C,Ap	1,2,3,10
5	Develop collaborative skills through engagement with research teams	A, I, Ap	2,3,4,5, 7,8,9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Research Methodology	1.1	Definition, objectives, goal of research,characteristics of research	5	1
	1.2	Types of research – applied, basic, descriptive, experimental, exploratory research. Research Methods – Quantitative and Qualitative	5	1
	1.3	Significance of research and its socio economic impact,qualities of a good researcher	5	2
2. Formulation of research	2.1	Research Problems - identifying research questions, articulating research problems,characteristics of a good research problem	5	3
	2.2	Research Hypothesis- The role of hypotheses in research, types of hypotheses, developing testable hypotheses, evaluating hypotheses	5	3
	2.3	Development of experimental protocol- elements of an experimental protocol, designing experiments to test hypotheses, controlling variables, ethical considerations in research	5	4
3. Research Design	3.1	Collection of data- primary and secondary data, quantitative and qualitative data, sampling methods	5	4
	3.2	Organization and representation of data - data cleaning and editing, data entry and coding, data tabulation and frequency distribution; visualization of data - charts and graphs, tables and figures,maps	5	4
	3.3	Data analysis: descriptive statistics, inferential statistics, hypothesis testing, interpretation of data, drawing conclusions from data, identifying patterns and trends, communicating research findings	5	4
4. Scientific Writing	4.1	Preparation of scientific literature - research article, research proposal, thesis, dissertation.	4	5
	4.2	Proofreading and types of publications, Peer review – Single, double-blind, open	3	5
	4.3	Types of references, reference Management tools	3	5
	4.4	Field visit- Visit to a research institute	5	6
5.Teacher specific content/ Teacher facilitated activities				

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

Assessment Types	MODE OF ASSESSMENT **A. Continuous Comprehensive Assessment (CCA)** 30 marks 1. MCQ test for half an hour (15 marks) 2. Present a review of an article (5 marks) 3. Seminar presentation – (5 marks) 4. Report of the visit to a research institution- (5 marks)
	B. End Semester Examination Open book examination for two hours (70 marks)

References

1. Burke, L., Collier, C. J., & Jago, S. R. (2007). Doing Quantitative Research: A PracticalGuide.
2. Cooper, D. R., & Schindler, P. S. (2019). Business Research Methods.
3. Creswell, J. W. (2020). Research Design: Qualitative, Quantitative, and MixedMethods Approaches.
4. Desai, P. B., & Pathan, S. S. (2009). Research Methodology in Social andBehavioral Sciences.
5. Kothari, C. R. (2018). Research Methodology: A New Indian Perspective
6. Paul, M. E., Elder, L., & Machi, S. (2016). Essential Research Methodology forStudents and Researchers.

Suggested Readings

1. Abeles, R. H. (1982). A Practical Guide to Experimental Design in Biochemistry.
2. Cooper, D. R., & Schindler, P. S. (2014). Business Research Methods (12th ed.). McGraw-Hill/Irwin.
3. Moore, D. S. (2001). Designing Experiments for Biochemical Research.
4. Turner, J. R., Gardner, R. D., & Mussell, J. A. (2009). A Primer on Biochemical Methods.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Biostatistics**					
Type of Course	**DCC**					
Course Code	**MG7DCCBCH401**					
Course Level	**400-499**					
Course Summary	The Biostatistics course is designed to equip students with the statistical tools and methodologies essential for analysing biological and health- related data. Through the course, students will gain proficiency in statistical techniques relevant to the design, conduct, and interpretation of experiments in the fields of science.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites,if any	Basic knowledge in Mathematics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the basic statistical concepts	U, A	1,2,3 ,4
2	Describe the application of statistical tests in biomedical research	A, An, E, I	1,2,3,4, 6,8,10
3	Design and plan experiments using appropriate statistical methodologies	An, E, C, S	1,2,3,4, 9,10
4	Evaluate and critically assess the appropriateness of statistical methods for different research questions.	E, S,I, Ap	1,2,3,5, 6
5	Employ statistical software tools for the interpretation of acquired data	A, An,E, S	1,2,3,6, 9,10
6	Achieve expertise in the analysis of experimental data	S,I, Ap	2,6,8,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to Basic Statistical Concepts	1.1	Explore methods of descriptive Statistics: concept of primary and secondary data, methods of collection and editing of primary data, designing a questionnaire and aschedule, sources and editing of secondary data, classification and tabulation of data, measures of central tendency	6	1
	1.2	Understanding principles of probability theory, random sampling, sampling distribution and standard error, standard errors of moments and functions of moments.	5	1
	1.3	Correlation coefficients and simple linear regression.	4	1
2. Statistical Tests in Biomedical Research: Applications and Interpretations	2.1	Introduction to biostatistics: Overview of biostatistics in biomedical research, parametric tests and non-parametric tests	6	2
	2.2	Categorical data analysis: Chi-square test for independence, fisher's exact test, odds ratio and relative risk, log-linear models, application of categorical data analysis in biomedical research	5	2
	2.3	Survival analysis: Kaplan-Meier survivalcurves, log- rank test, cox proportional hazards model, interpretation of survival analysis in biomedical studies	4	2
3. Experimental Design and Statistical Methodologies	3.1	Fundamentals of experimental design: definition of key terms: independent variable, dependent variable, control group, and experimental group Overview of the scientific method and its application in experimental design Ethical considerations in experimental research	5	3
	3.2	Principles of experimental design: randomization and its role in reducing bias, replication and its significance in obtaining reliable results, control groups and their importance in isolating the effects of theindependent variable, Bbinding and double-blinding in experimental design	5	3
	3.3	Factorial design: definition and structure of factorial experiments, main effects and interaction effects, advantages and challenges of factorial design	5	3
4. Identification of research question and Statistical	4.1	Research Questions: importance of well- formulated research questions, Characteristics of good research questions, different types of research questions (descriptive, exploratory, explanatory).	4	4

Software for Experimentation & Data Analysis	4.2	Hypothesis development: definition andimportance of hypotheses, null and alternative hypotheses, one-tailed vs. two-tailed hypothesis; basics of Statistical Inference: overview of statistical inference, confidence intervals and their interpretation, P-values and their role in hypothesis testing, Type I and TypeII errors	3	4
	4.3	Statistical Software Packages: SPSS, R software	3	5
	4.4	Graphical representation of data by Histogram, Frequency polygons, frequency curves	2	6
	4.5	Calculation of measures of location. Calculationof measures of dispersion.	1	6
	4.6	Estimation of sampling size in different sampling techniques	1	6
	4.7	F test, t test, ANOVA	1	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, tutorial, E-learning Interactive Instruction:, Seminar, Group Assignments Library work and Group discussion, data analysis
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) (30 marks)** 1. Written test for half an hour (15 marks) 2. Viva (5 marks) 3. Seminar presentation (5 marks) 4. Submission of work book report on the software's used for data analysis (5 marks)
	B. End Semester Examination Written examination for two hours (70 marks)

References

1. Elhance, D. N. (1972). Fundamentals of Statistics. Kitab Mahal, Allahabad.
2. Gupta, S. P. (1997). Biostatistical Methods. S. Chand & Sons.
3. Sundar Rao, P. S. S., Jesudian, G., & Richard, J. (1987). An Introduction to Biostatistics (2nd edition). Prestographit, Vellore, India.
4. Rama Krishna, P. (1995). Biostatistics. Saras Publication.

Suggested Readings

1. Armitage, P., Berry, G., & Matthews, J. N. S. (2008). Statistical Methods in Medical Research. Wiley.
2. Campbell, D. T., & Stanley, J. C. (1963). Experimental and Quasi-Experimental Designs

for Research. Houghton Mifflin.
3. Fisher, C. B., & Oransky, M. (2008). Informed Consent to Psychotherapy: Protecting the Vulnerable and Promoting Good Practice. American PsychologicalAssociation.
4. Keppel, G., & Wickens, T. D. (2004). Design and Analysis: A Researcher's Handbook (4th ed.). Pearson.
5. Leedy, P. D., & Ormrod, J. E. (2014). Practical Research: Planning and Design (10th ed.). Pearson.
6. Sullivan, L. M. (2011). Essentials of Biostatistics in Public Health (2nd ed.). Jones & Bartlett Learning.
7. Trochim, W. M., & Donnelly, J. P. (2008). The Research Methods Knowledge Base (3rd ed.). Atomic Dog.
8. Zar, J. (Year). Biostatistical Analysis. Prentice Hall of India.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Genomics**					
Type of Course	**DCC**					
Course Code	**MG7DCCBCH402**					
Course Level	**400-499**					
Course Summary	The course provides a comprehensive introduction to the field of genomics, exploring the fundamental principles, techniques, and applications that underpin the study of genomes. As a rapidly evolving field with profound implications for various scientific disciplines, this course aims to equip students with a solid foundation in genomic concepts and methodologies.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites,ifany	Basic knowledge of molecular biology and genetics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the fundamental concepts and ethics in genomics	U, A	1,2,3,4,5,8
2	Discuss the concept of genome variation, SNPs and mutation	U, An,E	1,2,3,4
3	Identify the significance of genome organization in gene expression	An,E	2,3,4,10
4	Explain gene function, disease mechanisms, and potential therapeutic interventions.	An,E,	1,2,3,4, 10
5	Apply methods in genomics to study the functions and structures of biological macromolecules	A, E, I	2,3,5,8
6	Acquire technical skills in latest technologies in genomics	E, S, Ap	2,5,6,8, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Fundamentals of Genomics	1.1	Overview of genomics, the significance of the human genome project, Legal and regulatory frameworks governing genomics research.	5	1
	1.2	Genome Organization-Single sequence DNA, GC content, Intermediate repeat DNA, highly repetitive DNA, CpGislands , Gene Families,Pseudogenes, Duplicated genes, SNPs, STS, Tandemly repeated genes. Non proteinCoding genes, Split genes, Overlapping genes, Spacer regions, ORF's Cryptic genes	5	1
	1.3	Genome Variation Single Nucletide Polymorphism Mutation	5	2
2. Structural, Functional And Comparative Genomics	2.1	Understanding 3D Genome Organization in gene expression, Organization of genomes: Main features of bacterial and eukaryotic genome organization. Comparative genomics —— purpose and methods of comparison. Database for comparative genomics, Applications of comparative Genomics	9	3
	2.2	Crispr-Cas9, RNA Interference, and Functional Genomics Assays.	5	4
	2.3	Structural and Functional Genomics in Understanding of Diseases. Functional annotation: sequence based and structure based annotation	6	4
3. Genomic Sequencing and Functional Annotation	3.1	Genome Sequencing Technologies, History of sequencing, Sanger's sequencing, Next-generation sequencing techniques	5	5
	3.2	Bioinformatics related genomics techniques	5	5
4. Practical	4.1	Next-Generation Sequencing (NGS) NGS Library Preparation -Fragmentation and Adapters-Fragmenting genomic DNA and adding sequencing adapters. Library Quantification and Quality Control: Using Qubit or Bioanalyzer to assess library quality.	10	6
	4.2	Bioinformatics Analysis Quality Control and Preprocessing Quality Control: Using tools like FastQC to assess raw sequencing data quality. Data Trimming and Filtering: Removing low-quality reads and adapter sequences using software like Trimmomatic.	10	6
	4.3	Functional Genomics and Annotation Gene Prediction and Annotation -Gene Prediction: Using software like Augustus or GeneMark for gene prediction. - Functional Annotation: Annotating predicted genes using databases like NCBI, UniProt, and tools like BLAST.	10	6
5. Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning, animated videos Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student, Laboratory sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Boddington, P. (2012). Ethical Challenges in Genomics Research: A Guide toUnderstanding Ethics in Context
2. Eng, C., & Kumar, D. (2015). Genomic Medicine: Principles and Practice.
3. Lesk, A. (2012). Introduction to Genomics. Publisher.
4. Mir,R. A., Shafi, S. M., & Zargar, S. M. (2023). Principles of Genomics andProteomics. Publisher.
5. Primrose, S. B., & Twyman, R. (2013). Principles of Gene Manipulation andGenomics.
6. Saccone, C., & Pesole, G. (2005). Handbook of Comparative Genomics:Principles and Methodology.
7. Sensen, C. W. (2008). Essentials of Genomics and Bioinformatics.
8. Singh, R. (2015). Bioinformatics: Genomics and Proteomics.
9. Soh, J., Gordon, P. M. K., & Sensen, C. W. (2016). Genome annotation.Chapman and Hall/CRC. ISBN: 9781439841181

Suggested Readings

1. Baxevanis, A. D., & Ouellette, B. F. F. (2004). Bioinformatics: A Practical Guideto the Analysis of Genes and Proteins.
2. Ginsburg, G. S., & Willard, H. F. (Year). Genomic and Personalized Medicine. Publisher.
3. Hongladarom, S. (2011). Genomics and Bioethics: Interdisciplinary Perspectives, Technologies, and Advancements.
4. Kumar, D., & Chadwick, R. (2015). Genomics and Society: Ethical, Legal,Cultural, and Socioeconomic Implications.
5. Kumar, D., & Weatherall, D. (2008). Genomics and Clinical Medicine.
6. Mushegian, A. R. (2010). Foundations of Comparative Genomics.
7. Pevsner, J. (2005). Bioinformatics and Functional Genomics

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Cancer Biology**					
Type of Course	**DCE**					
Course Code	**MG7DCEBCH400**					
Course Level	**400-499**					
Course Summary	The Cancer Biology course is designed to provide students with a comprehensive understanding of the molecular and cellular processes underlying cancer development, progression, and treatment. The course integrates principles from genetics, cell biology, biochemistry, and immunology to explore the complex mechanisms that contribute to the initiation and spread of cancer.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Explain the fundamental concepts of cancer biology	K, U	1,2,3,4
2	Analyse the molecular biology of cancer development	U, An, E	2,3,4,6
3	Evaluate the mechanism of genomic instability and repair	An, S, I	1,2,6,8,10
4	Evaluate the basic principles of cancer therapy	U, An, E	1,2,3,4,6
5	Demonstrate the mechanisms and application of immunotherapy	An, E, Ap	1,2,3,4,6,8, 9,10
6	Applying the knowledge and skills for participating in collaborative programmes	A, S, I	2,3,4,5, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Fundamentals of Cancer Biology	1.1	Properties of cancer cells, metamorphogenesis,clonal expansion	5	1
	1.2	Benign tumour and malignant tumour type of cancer	5	1
	1.3	Tumour Microenvironment, Cancer Invasion and Metastasis	5	1
2. Molecular Biology of Cancer Development	2.1	Genetic Basis of Cancer, Oncogenes and Tumor Suppressor genes	6	2
	2.2	Cell Signaling Pathways in Cancer, Activation of growth factor signaling pathways.PI3K-AKT-mTOR and MAPK pathways in cancer.	5	2
	2.3	Mechanism of Genomic Instability and DNA Repair	4	3
3. Principles of Cancer Therapy, Cancer Immunology and Epidemiology	3.1	Imaging Techniques, Biomarkers, Pathological Staging	4	4
	3.2	Chemotherapy - basic principles	3	4
	3.3	Clinical Trials and Translational Research, Palliative and Supportive Care	3	4
	3.4	Descriptive, analytical Epidemiology of Cancer and Emerging Topics in Cancer Epidemiology	5	5
	3.5	Cancer Vaccines and Adoptive Cell Therapies, Combination Therapies	5	5
4. Training on Basics of cell culture techniques	4.1	Interactive Workshops / Seminars/Training	2	6
	4.2	Demonstration / Hands-on training in Cell Culture Techniques	8	6
5. Teacher specific content/ Teacher facilitated activities				

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

Assessment Types	MODE OF ASSESSMENT **A. Continuous Comprehensive Assessment (CCA) (30 marks)** MCQ test for 45 minutes (15 marks) Seminar presentation (5 marks) Report of Workshops / Seminars attended (5 marks) Report of training attended on cell culture techniques (5 marks)
	B. End Semester Examination Written external Examination of 2 hours (70 marks)

References

1. Hayes A W (1988) Principles and methods of toxicology, II nd edition, Raven press NewYork.
2. Lodish, H. F., Berk, A., Kaiser, C., Krieger, M., Bretscher, A., Ploegh, H. L., Martin, K.C.,Yaffe, M.B. & Amon, A. (2021). Molecular cell biology. New York: WH Freeman
3. Klaassen C D, Amdur M O &Doull J (1986) Casarett and Doull's Toxicology, IIIrdedition, Macmillan publishing company, New York. 26
4. Stewart C P&Stolman A (1960) Toxicology, vol I, Academic press, New York.
5. Weinberg, R. A., & Weinberg, R. A. (2006). The biology of cancer. WW Norton & Company
6. Williams P L&Burson J L (1985) Industrial Toxicology, Van- Nostrand Reinhold, NewYork.

Suggested Readings

1. Burch, P. R. (2012). The biology of cancer: A new approach. Springer Science & Business Media.
2. Chabner, B. A., & Longo, D. L. (2011). Cancer chemotherapy and biotherapy: principlesand practice. Lippincott Williams & Wilkins.
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5. Hesketh, R. (2023). Introduction to cancer biology. Cambridge University Press.
6. McIntosh, J. R. (2019). Understanding Cancer: An Introduction to the Biology,Medicine, and Societal Implications of this Disease. Garland Science.
7. Pecorino, L. (2021). Molecular biology of cancer: mechanisms, targets, andtherapeutics. Oxford university press.
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9. Pezzella, F., Tavassoli, M., & Kerr, D. J. (Eds.). (2019). Oxford textbook of cancerbiology. Oxford University Press
10. Tannock, I. F., Hill, R. P., Bristow, R. G., & Harrington, L. (2013). The basic science of oncology. McGraw-Hill

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**
Course Name	**Xenobiotics and Antioxidants**
Type of Course	**DCE**
Course Code	**MG7DCEBCH401**
Course Level	**400-499**
Course Summary	This course offers an understanding on the identification, categorization, sources and mechanism of action of xenobiotics, and antioxidants. It delves into the environmental impact and their role in disease prevention. Students can apply this knowledge for understanding their environmental and health interactions.

Semester	7	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Discuss a detailed understanding on pharmacokinetics and pharmacodynamics	K, U, An	1,2,3,4
2	Demonstrate a comprehensive understanding of antioxidants, including their types, sources, mechanisms of action, and their role in preventing various diseases.	U, An,E	1,2,3,4 ,5,6,8
3	Describe the role of xenobiotics and antioxidants in precision medicine	An, A, C	2,3,6,8 ,910
4	Apply the understanding on how antioxidants and xenobiotics work in preventing diseases associated with oxidative stress.	A, E, S	1,2,3,4 ,8, 10
5	Analyse the environmental impact of xenobiotics and antioxidants.	An, E, I, Ap	1,2,3,6 ,8,9
6	Develop an understanding on ethical and regulatory considerations in the use of xenobiotics and antioxidants	U, A, Ap	2,4,6,8 ,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Pharmacokinetics and pharmacodynamics	1.1	Introduction to pharmacokinetics and pharmodynamics; basics of xenobiotics : classification, structure and properties	2	1
	1.2	Understanding drug absorption, distribution, metabolism, and excretion of xenobiotics. Phases of biotransformation	4	1
	1.3	Receptor Pharmacology - Receptor types and distribution, mechanism of drug binding with receptor	3	1
	1.4	Drug Interactions and Adverse Effects - signal transduction pathways, role of second messenger	3	1
	1.5	Dose response relationship-graphical representation and interpretation of dose response curve	3	1
2. Antioxidants - Types, sources, mechanism, disease prevention	2.1	Types of antioxidants - Enzymatic, non-enzymatic, phytochemical	5	2
	2.2	Sources and mechanism of action	5	2
	2.3	Antioxidants in disease prevention - cancer, diabetes management, immune system, skinhealth	5	2
3. Xenobiotics and Antioxidants in Precision Medicine	3.1	Xenobiotics in precision medicine – Definition and types of xenobiotics Genetic variations in xenobiotic metabolismpathways Case studies on drug responses influenced by xenobiotics	5	3
	3.2	Antioxidants as Molecular Signatures in Precision Medicine - Identification of antioxidant biomarkers, Techniques for assessing oxidative stress in precision medicine, Application of antioxidant profiling in individual health assessments	4	3
	3.3	Precision Dosing and Xenobiotics- Personalized drug dosing strategies Individualized Treatment plans considering xenobiotic metabolism Importance of pharmacogenomics in precisiondosing	3	3
	3.4	Xenobiotics, Antioxidants, and Disease - The role of xenobiotics and oxidative stress in various diseases, Case studies illustrating the connection between drug exposure and oxidative stress, Targeting antioxidant interventions for disease prevention and treatment	3	4
4. Ethical and Regulatory Considerations in the Use of	4.1	Environmental impact of xenobiotics and antioxidants.	3	5
	4.2	Risk assessment and management strategies to mitigate and control identified risks, both in clinical and environmental contexts.	4	5

Xenobiotics and antibiotics				
	4.3	Ethical considerations governing the development and testing of xenobiotics and antioxidants.	4	6
	4.4	Regulatory and ethical processes involved in the approval and patenting of xenobiotics and antioxidants.	4	6
5.Teacher specificcontent/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) (30 marks)** MCQ test for 45 minutes (15 marks) Seminar presentation (5 marks) Quiz/Viva (5 marks) Assignment (5 marks)
	B. End Semester Examination Written examination of 2 hours (70 marks)

References

1. Halliwell, B. (2007). Biochemistry of oxidative stress. Biochemical Society Transactions, 35(5), 1147–1150.
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3. Sharma, P., Jha, A. B., Dubey, R. S., & Pessarakli, M. (2012). Reactive oxygen species, oxidative damage, and antioxidative defense mechanism in plants under stressful conditions. Journal of Botany, 2012, 1-26.
4. Singh, R. P., Gangadharappa, H. V., Mruthunjaya, K., & Sannegowda, L. N. (2014). Occurrence and impact of pesticides in the Kaveri River water, South India. Environmental Monitoring and Assessment, 186(5), 2919-2926.
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Suggested Readings

1. Caskey, T. (2018). Precision medicine: Functional advancements. Annual Review of Medicine, 69, 1-18.
1. Gad, S. C. (2016). Drug Safety Evaluation. John Wiley & Sons.
2. Golan, D. E., Tashjian, A. H., & Armstrong, E. J. (Eds.). (2011). Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy. Lippincott Williams & Wilkins.
3. Lam, Y. W. F., & Scott, S. R. (Eds.). (2018). Pharmacogenomics: Challengesand Opportunities in Therapeutic Implementation.
4. Mishra, K., Ojha, H., & Chaudhury, N. K. (2012). Estimation of antiradicalproperties of antioxidants using DPPH assay: A critical review and results. FoodChemistry, 130(4), 1036-1043.

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Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**IPR and Bioethics**					
Type of Course	**DCE**					
Course Code	**MG7DCEBCH402**					
Course Level	**400-499**					
Course Summary	The Intellectual Property Rights (IPR) and Bioethics course is designed to provide students with a comprehensive understanding of the legal andethical dimensions of intellectual property rights in biological and biomedical innovations. Students will explore the principles and regulations governing the protection of intellectual property, especially in the fields of biotechnology, pharmaceuticals, and healthcare, while also considering the ethical implications of these advancements.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the scope and duration of protection for various typesof intellectual property.	K, U, E	1,2,3, 6,8
2	Analyse the patenting procedures and challenges in biotechnological inventions.	E, An, Ap	1,2,3,4, 6, 8
3	Understand the principles of bioethics and human rights.	U, A, I	4,5,6,6
4	Evaluate responsible conduct of research, including issues of misconduct.	U, E, Ap	2,6, 8, 9, 10
5	Apply biosafety principles in laboratory and field settings.	A, An, Ap	2,3,4,6 , 8, 10
6	Develop a comprehensive understanding of intellectual property rights, as they apply to industrial innovations.	U, S, I	3, 4, 6, 7, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No
1. Introduction to Intellectual Property Rights	1.1	Meaning of property, Origin, Nature, Meaning and characteristics of Intellectual Property Rights; Types of Intellectual Property	4	1
	1.2	Property Rights: Paris Convention, 1883, WIPO Convention, 1967, the Patent Co-operation Treaty,1970, the TRIPS Agreement, 1994	5	1
	1.3	IPR in India: Genesis and development — IPR in abroad - Major International Instruments concerning Intellectual, IPR infringement	6	1
2. Patents in Biotechnology	2.1	Elements of Patentability: novelty, non- obviousness; Understand the patent application process, criteria for patentability inventions. Types of patents; patentableand non - patentable subjectmatter	5	2
	2.2	Registration procedure, rights and duties of patentee, assignment and license, restoration of lapsed patents, surrender and revocation of patents	5	2
	2.3	Infringement, remedies & penalties; patentable protection in biotechnology, challenges in biotech patenting	5	2
3. Bioethics, Biosafety and Translational Research	3.1	Definition, historic evolution, codes and guidelines	4	3
	3.2	Bioethical issues- bio-safety environmental impacts Ethical challenges related to access to medicines and the role of intellectual property rights in drug development.	3	3
	3.3	Ethics related to research on human subjects and animal samples Ecological ethics.	3	3
	3.4	Understanding of biosafety principles and their significance in the context of translational research	4	4
	3.5	Concept of biosafety levels and their application in different laboratory settings.	3	5
	3.6	Biosafety implications of emerging technologies in translational research	3	5
4. Field Visit	4.1	Intellectual Property Offices	5	6
	4.2	Biotechnology and Pharmaceutical Companies	5	6

5. Teacher specific content/ Teacher facilitated activities

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Group Assignments, Library work and Group discussion, Presentation by individual student, field visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) (30 marks)** MCQ test for half an hour (15 marks) Seminar presentation – (5 marks) Viva (2 marks) Report of the field visit - (8 marks)
	B. End Semester Examination Written examination for two hours (70 marks)

References

1. Fleming, D. O., & Hunt, D. L. (2006). Biological Safety: Principles and Practices.(4thEdition). ASM.
2. Parashar, S., & Goel, D. (2013). IPR, Biosafety and Bioethics. Pearson India.
3. Sree Krishna, V. (2007). Bioethics and Biosafety in Biotechnology. New AgeInternational (P) Ltd., Publishers, New Delhi – 110002, India.
4. Sell, S. K. (2000). Private Power, Public Law: The Globalization of IntellectualProperty Rights. Cambridge University Press.

Suggested Readings

1. Poltorak, A. I., & Lerner, P. J. (2011). Essentials of Intellectual Property: Law,Economics, and Strategy. (2nd edition). Wiley

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Food Safety and Quality Control**					
Type of Course	**DCE**					
Course Code	**MG7DCEBCH403**					
Course Level	**400-499**					
Course Summary	This undergraduate course provides a comprehensive exploration of the principles, practices, and regulations related to food safety and quality control. It equip students with both theoretical knowledge and practical skills necessary for ensuring the safety and quality of food products.					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate a comprehensive understanding of local and international food safety and its regulations	U, An, E	2,3,6,8, 10
2	Examine the characteristics of food hazards and contaminants	U, E	2,4,6,8
3	Evaluate the concept of food quality and food safety	An, E, I	1,2,3, 5,6, 8
4	Apply the principles of food safety management systems to identify potential hazards in various food production processes and develop control measures to ensure foodsafety.	A, E, Ap	2, 3, 6,7, 8
5	Develop skills in food testing methods to assess food safetyand quality attributes.	C, I, Ap	1, 2,3,4, 8.9.10
6	Analyse the effectiveness of various quality control measures observed during industry visits.	A, An, S	3,4,6,7, 10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Food Safety, Food Hazards and Contaminants	1.1	Introduction to food safety: Definition and Scope of Food Safety and Quality Control. Significance of Food Safety practices, Principles of Food Quality control measures	4	1
	1.2	Indian and International Regulatory Frameworks	2	1
	1.3	Biological Hazards: Bacteria, Viruses, Fungi, and Parasites; Chemical Hazards: Pesticides, Food Additives, and Residues; Physical Hazards: Foreign Materials and Allergens	4	2
	1.4	Techniques in Food Analysis; Microbiological Testing Methods; Aseptic techniques in microbiological testing, Enumeration of bacteria in food samples	5	5
2. Food Quality and Standards	2.1	Definition of Food Quality; Factors Affecting Food Quality: Freshness, Flavour, Texture, and Appearance; Quality Attributes in Different Food Categories	5	3
	2.2	Relationship Between Safety and Quality; Global Food Safety challenges International Standards (ISO 22000, BRC, SQF)	5	3
	2.3	Food Safety Management Systems: Hazard Analysis and Critical Control Points (HACCP); Good Manufacturing Practices (GMP);Quality Assurance vs. Quality Control	5	4
3. Food Testing and Analysis	3.1	Identification of common foodborne pathogens	10	5
	3.2	Chemical Analysis: Proximate Analysis (moisture, fat,protein, ash), nutrient Composition	7	5
	3.3	Sensory Evaluation Techniques: Designing and conducting sensory evaluation experiments-Demonstration	3	5
4. Industrial visit	3.4	Industry visits to observe quality control measures,Case studies on successful quality control practices.	10	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Lecture, E-learning Interactive Session: Seminar, Assignment, Peer evaluation, Library work, Group discussion, Presentation by individual student, industrial visit, demonstrations
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) (30 marks)** MCQ for half an hour (10 marks) Seminar presentation (5 marks) Report of visit to food industry (5 marks) Viva (5 marks)
	B. End Semester Examination Written examination for one and a half hours (70 marks)

References

1. Aneja, K. R. (2003). Food Microbiology. New Age International (P) Ltd.,Publishers.
2. Dave, B. P., & Mishra, D. D. (2005). Food Processing and Preservation:Principlesand Practices. S. Chand & Company Ltd.
3. Dave, B. P., & Mishra, D. D. (2006). Food Quality Assurance: Principles andPractice. S. Chand & Company Ltd.
4. Ossewaarde, D. W. (2011). Food Safety and Quality Assurance.
5. Rao, G. S., Sharma, D. D., & Joshi, P. R. (2012). Food Safety and Standards: APractical Guide for the Food Industry. Wiley India Pvt. Ltd.
6. Sawhney, S. K., & Aneja, K. R. (2009). Food Analysis: A Manual for theLaboratory.New Age International (P) Ltd., Publishers.

Suggested Readings

1. Bryan, Adams, & Moss. (2016). Food Safety: A Practical Guide for the FoodIndustry.
2. Doyle, M., Beuchat, L., & Montville. (2018). Food Microbiology: FundamentalsandFrontiers.
3. Jay. (2005). Food Microbiology: A Laboratory Manual.
4. Valentine, Nigel, & Setford. (2016). Food Quality and Safety Systems: A PracticalGuidefor the Food Industry.

SEMESTER 8

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Proteomics**					
Type of Course	**DCC**					
Course Code	**MG8DCCBCH400**					
Course Level	**400-499**					
Course Summary	The aim of this course is to encompass diverse facets of proteomics, encompassing quantitative proteomics, protein extraction, purification, characterization and identification. Students will explore the fundamental principles, methodologies, and applications of proteomics, with a focus on practical skills for addressing complex research questions.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Acquire a strong foundation in proteomics and its clinical applications in biomarker discovery and disease research.	K, U	1,2,3,4
2	Apply knowledge to choose appropriate proteomic techniques for specific research questions.	U, A, An, E	1,2,3, 4, 5,8
3	Explain the structural bioinformatics principles for a deeper understanding of the functional implications of proteomics results.	An, E, S	2,3,4, 10
4	Develop advanced knowledge and skills in pharmaceutical and environmental proteomics	A, E, I,Ap	2,3,4,5, 8,10
5	Acquire an understanding of emerging technologies shaping the future of proteomics research.	U, An,I	2,3,6, 8,10
6	Attain practical skills in protein extraction, analysis, and proteomic data interpretation for understanding of cellular processes and protein functions.	E, S, Ap	2,3,4, 6,8,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to proteomics	1.1	Basics of proteomics Protein-primary, secondary, tertiary, and quaternary structure and function	3	1
	1.2	Quantitative proteomics Stable isotope labeling by amino acids in cell culture(SILAC),isotope-coded affinity tag (ICAT), isobaric tagging for relative and absolute quantitation (iTRAQ); Label-free proteomics	4	1
	1.3	Clinical proteomics and biomarker discovery	3	1
2. Protein Sample Preparation and Analysis	2.1	Protein extraction, purification and quantification techniques Sample preparation, el-based proteomics - two-dimensional gel electrophoresis (2-DGE), two-dimensional fluorescence difference in-gel electrophoresis.(DIGE), Staining methods, PF-2D, Tandem FPLC, Mass spectroscopy: basic principle, ionization sources, mass analyzers, different types of mass spectrometers (MALDI-TOF Q-TOF, LC- MS)	5	2
	2.2	Structural analysis techniques Prediction of protein secondary structure: Chou-fasman/GOR method, nearest Neighbour method, Homology modeling, Active site mapping and prediction	5	2
	2.3	High-Throughput Techniques Two-hybrid assay, affinity purification,fluorescence polarization (FP), and fluorescence resonance energy transfer (FRET)	5	2
3. Functional and Quantitate Proteomics - Data Analysis & Applications of Proteomics	3.1	Introduction to proteomics data	3	3
	3.2	Protein identification and database searching Introduction to search algorithm (e.g., SEQUEST, Mascot, and X! Tandem). Parameters and scoring in Database Searching.	4	3
	3.3	Structural bioinformatics in proteomics	3	3
	3.4	Pharmaceutical proteomics: Effect of drugs on proteomes, personalized medicine and proteomics, proteomicapplications in pharmacokinetics and pharmacodynamics	3	4

	3.5	Environmental proteomics: Monitoring environmental pollutions using proteomics techniques, biomarker discovery for environmental stress and toxicity, proteomics analysis of microbial communities in environmental samples; applications in environmental conservation and remediation	4	4
	3.6	Emerging technologies and future perspectives: AI and machine learning in proteomic data analysis; standardization, reproducibility, ethical considerations and challenges in proteomics research	3	5
4. Practical	4.1	Extraction, isolation and purification of proteins from cell/tissue samples.	5	6
	4.2	Quantification of protein concentration using spectrophotometry or a Bradford assay.	5	6
	4.3	Electrophoresis of extracted protein samplesand staining.	5	6
	4.4	Search proteomic data and identify the protein from protein databases.	10	6
	4.5	Visualization of protein-protein interaction networks.	5	6
5.Teacher specific content/ Teacher facilitatedactivities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student, laboratory experiments
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Mishra, N. C. (2011). Introduction to Proteomics: Principles and Applications

2. Liebler, D. C. (2002). Introduction to Proteomics: Tools for the New Biology.
3. Lovric, J. (2011). Introducing Proteomics: From Concepts to Sample Separation,Mass Spectrometry and Data Analysis.
4. Eyers, C. E., & Gaskell, S. J. (2014). Quantitative Proteomics. Mirzaei, H., & Carrasco, M. (2018). Modern Proteomics — Sample Preparation, Analysis and Practical Applications.
5. Von Hagen, J. (2011). Proteomics Sample Preparation.
6. Cecconi, D. (2021). Proteomics Data Analysis
7. Kuruc, M., & Wang, X. (2018). Functional Proteomics: Methods and Protocols
8. Rosenberg, I. M. (2013). Protein Analysis and Purification: Benchtop Techniques

Suggested Readings

1. Saraswathy, N., & Ramalingam, P. (2011). Concepts and Techniques inGenomics and Proteomics (1st ed.)
2. Thangadurai, D., & Sangeetha, J. (Eds.). (2015). Genomics and Proteomics:Principles, Technologies, and Applications.
3. N.C.Mishra, N. C. (2010). Introduction to Proteomics: Principles and Applications. Günter Blobel (Foreword). Publisher. ISBN: 978-0-471-75402-2.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Genetic Engineering**					
Type of Course	**DCC**					
Course Code	**MG8DCCBCH401**					
Course Level	**400-499**					
Course Summary	This course provides students with a comprehensive understanding of recombinant DNA technology, key aspects of genetic engineering, genetically modified organisms (GMOs), and relevant laboratory techniques. This course is suitable for students pursuing advanced studies in molecular biology, genetics, biotechnology, and related fields, as well as professionals seeking to enhance their knowledge and skills in genetic engineering.					
Semester	8	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate the fundamentals of recombinant DNA technology	U, An, E	1,2,3, 4
2	Acquire expertise in a variety of genetic engineering techniques	U, E, S, I	1,2,3, 4,10
3	Attain an understanding of advanced tools in genetic engineering.	E, C, S	2,3,4, 6
4	Describe the principles and applications of synthetic biology	U,An	2,3,6, 8,10
5	Apply critical thinking skills to evaluate the broader impact of GMOs on society and the environment.	U, An, ,C	1,2,3, 4,6,8, 10
6	Demonstrate proficiency in laboratory techniques related to genetic engineering.	S,I,Ap	1,2,3, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Recombinant DNA Technology	1.1	Introduction to Recombinant DNA technology Role of restriction enzymes, ligases, Principles of PCR reaction Role of plasmids Transformation studies	2	1
	1.2	Gene cloning and construction of expression vectors Primer handling, PCR reactions and analysing the products, Restriction digestion, Cloning and expression vectors	4	1
	1.3	Applications of Recombinant Proteins inMedicine Research Biotechnology Agriculture	2	1
	1.4	Recombinant DNA techniques in vaccine production. Strategies involved, Examples of Recombinant DNA vaccine	2	1
2. Techniques and tools in Genetic Engineering .	2.1	DNA cloning and restriction enzyme analysis, Protein expression using different host systems such as bacteria, yeast, insect or mammalian systems	3	2
	2.2	Protein Expression Analysis- Reverse transcription polymerase chain reaction (RT-PCR) , q PCR, Western blot, Microarray analysis	3	2
	2.3	Transfection and Transformation Techniques	2	2
	2.4	Site-Directed Mutagenesis: Principle and Techniques involved	2	2
	2.5	Molecular cloning techniques: Restriction enzyme based cloning and PCR cloning	3	3
	2.6	Gene expression analysis in transcription, translation and post-translational modification of a protein.	3	3
	2.7	Synthetic biology - principles and applications	3	4
	28	Microarrays- Arrays of DNA or RNA probes for parallel analysis of gene expression.	3	3
	2.9	Genome editing with CRISPR-Cas9:principle and technique involved’	3	3
3. Genetically Modified Organisms	3.1	Understanding the real-world applications of GMOs in various sectors	3	5
	3.2	GMOs in Agriculture, medicine, Industry	3	5
	3.3	Analysing the societal and ethical implications of genetic modification.	2	5
	3.4	Health and Safety Assessment of GMOs	2	5

4. Practical	4.1	Perform gene cloning experiments, including vector selection, plasmid preparation, and transformation.	10	6
	4.2	Analyse the results of gene cloning experiments through gel electrophoresis and other relevant methods.	10	6
	4.3	Evaluate the efficiency of protein expression using bacterial or yeast expression systems.	10	6
5. Teacher specific content/Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student Practical: Laboratory experiments, involvement, interpretation of results
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hours (50 marks) Practical examination (35 marks)* *This mark to be converted to 17.5 marks

References

1. Berg, J., Tymoczko, J. S., & Stryer, L. (2008). Genetic Engineering: Principlesand Applications. New York, NY: W. H. Freeman.
2. Brown, T. A. (2016). Gene Cloning and DNA Analysis: An Introduction. Hoboken,NJ:Wiley-Blackwell.
3. Brown, T. A. (2023). Genomes 5. Hoboken, NJ: Wiley-Blackwell.
4. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual(4thed.). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
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6. Joglekar, S. N. (2018). Essentials of Genetic Engineering. Singapore: Springer.
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Researchers. Cold Spring Harbor, NY: Cold Spring Harbor LaboratoryPress.

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2. Church, G. M., & Regis, E. (2012). Regenesis: How Synthetic Biology CanReinventNature and Ourselves. New York, NY: Basic Books.
3. Doudna, J. A., & Sternberg, S. H. (2014). "CRISPR/Cas9: A Revolutionary Toolfor Gene Editing." Nature Reviews Molecular Cell Biology, 15(7), 427–431.
4. Doudna, J., & Sternberg, S. (2017). CRISPR: Revolution in Gene Editing. NewYork,NY: Houghton Mifflin Harcourt.
5. Fauconnier, C., et al. (2008). "Zinc Finger Nucleases: A New Frontier in GenomeEngineering." Journal of Experimental Botany, 59(10), 2653–2663.
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7. Mullis, K. B. (1985). "The Polymerase Chain Reaction: A New Method forAmplifying Nucleic Acids." Cold Spring Harbor Symposia on Quantitative Biology, 51(1), 263–273.
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Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) Biochemistry**					
Course Name	**Computer Aided Drug Design**					
Type of Course	**DCE**					
Course Code	**MG8DCEBCH400**					
Course Level	**400-499**					
Course Summary	This course is designed to provide students with a comprehensive understanding of the intersection between pharmacology and bioinformatics, focusing on the modern techniques used in drug discovery and design. The course integrates theoretical concepts with practical applications, emphasizing the role of computational tools in identifying, designing, and optimizing potential drug candidates.					
Semester	8	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	1	0	75
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the fundamental pharmacological concepts and drug-receptor interactions.	K, U, An	1,2,3, 4,6,8
2	Describe the fundamental concepts in computer aided drug design	K, U, An, E	1,2,3, 4,6,8
3	Discuss molecular dynamic simulations	U, E, I	1,2,3,4
4	Apply computational tools to predict molecular interactions, analyse binding affinities, and understand drug discovery.	An, A, C,S	1,2,3, 4,6,9,10
5	Analyze the drug-likeness of molecules using computational approaches and assess ADMET properties.	An, S, I, Ap	1,2,3, 4,6,9, 10
6.	Design and execute virtual screening experiments, demonstrating the ability to create a systematic approach for identifying potential drug candidates.	A, An, E, C,S	1,2,3, 4,6,8, 9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to pharmacological bioinformatics	1.1	Introduction to bioinformatics, biological databases, sequence analysis, structural bioinformatics Basic pharmacological concepts, definition and its branches, overview of drug sources and classifications, Introduction to receptors and their types, mechanisms of drug-receptor interactions	5	1
	1.2	Pharmacokinetics: Absorption and factors affecting drug absorption, drug distribution in the body, principles of drug metabolism, routesof drug elimination	5	1
	1.3	Drug Design and Discovery: Overview of the drug design process, structure -activity relationships (SAR) in drug design, target Identification and Validation	5	1
2. Introductio nto Drug Discovery and CADD	2.1	Biochemical principles relevant to drug design, role of computational methods in drug design	5	2
	2.2	Introduction to CADD tools and software, principles of molecular modelling	5	2
	2.3	Energy minimization techniques, docking algorithms and scoring functions, Molecular dynamics simulations	5	3
3. Structure-Based Drug Design and Ligand-BasedDrug Design	3.1	Protein structure determination techniques; Homology modelling and structure prediction	5	4
	3.2	Virtual screening methods, interaction analysis and binding site prediction	5	4
	3.3	Quantitative structure-activity relationship (QSAR) methods; pharmacophore modeling; ADMET and toxicity Prediction	5	5
4. Practical	4.1	Bioinformatics Tools: Hands-on use of bioinformatics tools for sequence analysis, database searches for drug targets and pharmacological information	10	6
	4.2	Molecular Docking: Performing molecular docking simulations using software tools, analysis of protein-ligand interactions	10	6
	4.3	Ligand-Based Design: Pharmacophore modelling and virtual screening, Application of molecular similarity methods	10	6
5.Teacher specific content/Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Instruction: Seminar, Individual Assignment, Library work and Group discussion, Presentation by student, Peer evaluation Practical: laboratory experiments, Laboratory involvement
Assessment Types	**MODE OF ASSESSMENT** **A.Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination for one and a half hour (50 marks) Practical examination (35 marks) *This mark to be converted to 17.5 marks

References

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3. Contini, A. (Year). Chemoinformatics Approaches to Virtual Screening: RSC.
4. Leach, A. R. (Year). Molecular Modelling: Principles and Applications. PearsonHigher Education.
5. Liljefors, T., Krogsgaard-Larsen, P., & Madsen, U. (Eds.). (2002). Textbook ofDrugDesign and Discovery. CRC Press.
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7. Propst, C. L., & Perun, T. (1989). Computer-Aided Drug Design: Methods andApplications. Marcel Dekker, Inc.
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Suggested Readings

1. Folkers, G., Sippl, W., Rognan, D., & Holtje, H. D. (Eds.). (2003). MolecularModeling: Basic Principles and Applications. Science.
2. Gupta, S. P. (1996). Quantum Biology. New Age.
3. Kothekar, V. (2005). Essentials of Drug Designing. Dhruv Publications.

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Programme	**BSc (Hons) Biochemistry**					
Course Name	**Bioanalytical techniques**					
Type of Course	**DCE**					
Course Code	**MG8DCEBCH401**					
Course Level	**400-499**					
Course Summary	This course aims to explore the fundamental principles and techniques of molecular biophysics, delving into the intricate world of molecular interactions and the tools used for their study. Covering topics from atomic forces to advanced spectroscopic methods, it provides a comprehensive understanding of biological molecules.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Demonstrate a comprehensive understanding of atomic structure and interactions, elucidating the molecularbehaviour in biological systems.	K, U, E	1, 2, 3, 4
2	Explain the unique properties of water and their crucial roles in biological processes at the molecular level.	U, An, Ap	1,2,3, 4, 10
3	Apply the knowledge in biophysical techniques to study molecularprocesses in living systems.	U, A, E	1,2,3, 4,10
4	Analyse molecular structures, demonstrating a holistic understanding of spectroscopy	U, An, I	1,2,3, 4, 10
5	Apply techniques for the separation and analysis of proteins	A, An, S	1,2,3, 9,10
6	Develop skills in analyzing complex biological and medical data.	U, A, An, C, S, Ap	1,2,3, 4, 6, 10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Molecular Biophysics	1.1	Atoms, forces governing molecular interactions, including hydrogen bonding, van der Waals forces, and electrostatic interactions.	2	1
	1.2	Water: Physical and Chemical Properties of water.	2	2
	1.3	Diffusion, Filtration, Centrifugation: Principle, method and applications	3	3
	1.4	Principle, method and applications of Chromatography	2	3
	1.5	Electrophoresis- method, types and applications	3	3
	1.6	Basic principle, working and applications of Microscopy, Fluorescence and Cryoelectron microscopy	3	3
2. Spectroscopic techniques	2.1	Principle, instrumentation and applications of UV-Vis spectroscopy, FluorescenceSpectroscopy	5	4
	2.2	Principle, process and applications of Infrared spectroscopy, Raman spectroscopy	5	4
	2.3	Instrumentation and applications of NMR and ESR spectroscopy	5	4
3. Protein Separation and identification Techniques	3.1	Protein Separation and Characterization Comparison of techniques- gel electrophoresis, chromatography (ion exchange, size exclusion, affinity), and capillary electrophoresis, based on principles, resolution, and application.Introduction to mass spectrometry for protein identification and characterization.	5	5
	3.2	Mass spectrometry Introduction to the basic principles, including ionization, mass analysis, and detection. Typesof ionization methods -electron impact, electrospray ionization (ESI), matrix-assisted laser desorption/ionization (MALDI), and chemical ionization.	5	5
	3.3	X-ray crystallography Fundamentals of X-ray diffraction and its application to crystallography. Types of detectors used in X-ray crystallography and the applications of X-ray crystallography	5	5
4. Practical	4.1	Prediction of primary and secondary structure of protein structure and its function	15	6
	4.2	Data interpretation of FTIR, NMR, LCMS.	5	6

	4.3	Visit to Medical Imaging centres and demonstration of CT Scan, MRI, Ultrasonography, and Angiography.	10	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brain storming lecture, E-learning, Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by individual student/ Group representative Practical: Hands on learning, problem solving
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination Written examination of one and a half hours (50 marks) Practical examination (35 marks) *This mark to be converted to 17.5 marks

References

1. Boyer, R. F. (2012). Biochemistry Laboratory: Modern Theory and Techniques (2nd ed.). Pearson Prentice Hall.
2. Katoch, R. (2011). Analytical Techniques in Biochemistry and Molecular Biology.Springer.
3. Spector, D. L., & Goldman, R. D. (2006). Basic Methods in Microscopy: Protocolsand Concepts from Cells: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
4. Voet, D., & Voet, J. (2010). Biochemistry (4th ed.). John Wiley and Sons.
5. Wilson, K., & Walker, J. (2009). Principles and Techniques of Biochemistry and Molecular Biology (7th ed.). Cambridge University Press.

Suggested Readings

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014).Molecular Biology of the Cell (6th ed.). Garland Science.
2. Banwell, C. N., & McCash, E. M. (1994). Fundamentals of MolecularSpectroscopy (4th ed.). McGraw-Hill.
3. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2015). Stryer's Biochemistry (8thed.).W.H. Freeman and Company.
4. Creighton, T. E. (1993). Proteins: Structures and Molecular Properties (2nd ed.).W.H. Freeman and Company.
5. Engel, T., & Reid, P. (2006). Physical Chemistry (Pearson International Edition). Pearson Education.
6. Hofmann, A. F. (2010). Chromatography: A Science of Discovery (1st ed.). Wiley.

7. Maniatis, T., Fritsch, E. F., & Sambrook, J. (1982). Molecular Cloning: ALaboratoryManual. Cold Spring Harbor Laboratory Press.
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Programme	**BSc (Hons) Biochemistry**
Course Name	**Pharmacognosy and Phytochemistry**
Type of Course	**DCE**
Course Code	**MG8DCEBCH402**
Course Level	**400-499**
Course Summary	This course provides a comprehensive exploration of plant-based substances, emphasizing the study of phytochemicals, crude drugs, analytical techniques, functions, and applications in various fields. This interdisciplinary course combines principles from pharmacology, chemistry, and biology to foster an understanding of the medicinal and therapeutic properties of natural products derived from plants.

Semester	8	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3	0	1	0	75

Pre-requisites,if any	Nil

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Discuss the historical context, fundamental concepts of phytochemicals, fostering a solid foundation for further exploration in the field.	K, U, I	1,2,3,4, 10
2	Explain the methods of isolation, collection and extraction techniques of phytochemicals	A, An, E	1,2,34,5 ,7,8,9
3	Demonstrate a comprehensive understanding of traditional herbal medicine and the processing of plant drugs as well as integration of phytochemicals into modern medicine and pharmaceuticals	An, A, Ap	2,3,6,8, 10
4	Demonstrate the principles and applications of UV-Visible spectroscopy, chromatography, and electrophoresis, enabling them to contribute to research and development in various scientific fields.	An, E, C	2,3,4,6,7, 9,10
5	Describe the multifaceted roles of phytochemicals in thedevelopment of functional foods, nutraceuticals, and sustainable agricultural practices.	An, E, Ap	2,3,4,6, 8
6	Acquire skills to recognize the practical implications of phytochemicals across various industries	C,S,I,Ap	2,3,4,6, 8,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Introduction to phytochemicals	1.1	History of phytochemicals, understanding the basics of phytochemicals, tracing the historical roots of the study of phytochemicals.	4	1
	1.2	Significance of phytochemicals Introduction to the definition and classification of phytochemicals. Exploration of the chemical structure and properties of key phytochemical groups	4	1
	1.3	Bioactive secondary metabolites Examination of the role of phytochemicals in nutrition and their contribution to health.	2	1
2. Phytochemicals and crude drugs, Analytical techniques for the identification and quantification of phytocompounds	2.1	Introduction to phytochemical isolation, plant selection, collection and extraction techniques Overview of the methods and techniques used in the discovery and isolation of phytochemicals. Historical milestones in the identification and extraction of key phytochemical compounds.	5	2
	2.2	Traditional herbal medicine and processing of plant drugs Identification and classification of medicinal plants used in traditional herbal medicine. Understanding the principles of herbal formulation for specific health conditions. Techniques for quality control and standardization of herbal products.	3	3
	2.3	Phytochemicals in Modern Medicine: Overview of the integration of phytochemicals into modern medicine and pharmaceuticals.	2	3
	2.4	UV-Visible Spectroscopy Understanding the relationship between absorbance, concentration, and path length as described by the Beer-Lambert law. Application of UV-Visible spectroscopy for quantitative analysis of analytes.	4	4
	2.5	Chromatography Principle and types of chromatography. Applications of chromatography as an analytical method	5	4
	2.6	Electrophoresis Principle, process, types and applications of electrophoresis in various areas of analytical methods.	6	4
3. Functions and applications of phytocompounds	3.1	Bioactive compounds and health, functional foods and nutraceuticals Exploration of ongoing research and developments in the use of phytochemicals for therapeutic purposes and their contribution to a balanced diet. Evaluation of dietary guidelines incorporating phytochemical-rich foods.	4	5

	3.2	Applications in agriculture and crop protection Phytochemicals in enhancing crop resilience, tolerance to abiotic stress, and overall growth. Use of phytochemicals aligns with principles of sustainable agriculture.	4	5
	3.3	Future Trends and Applications Challenges in the research and application of phytochemicals. Exploration of emerging trends and future directions in phytochemical research.	2	5
4. **Practical**	4.1	Field trip to collect plant specimens.	5	6
	4.2	Extraction of plant parts using different methods.	15	6
	4.3	Interpretation of spectra obtained by spectroscopic techniques	5	6
	4.4	Report on the practical applications of phytochemicals in various industries.	5	6
5.Teacher specific content/ Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive Session: Seminar, Group Assignments, Library work and Group discussion, Presentation by student Practical: Collection of specimens, laboratory experiments, interpretation of results, industry visit, field trip

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

References

1. Evans, W. C. (2009). Trease and Evans Pharmacognosy (16th ed.). W.B.Saunders &Co.

2. Lawrence, D. R., & Bachrach, W. H. E. (1959). Evaluation of Drug Activities.Wiley.
3. Swarbrick, J. (1977). Methods in Pharmacology. Academic Press.
4. Turner, R. A. (1965). Screening Methods in Pharmacology. Academic Press.
5. Tyler, V. E., Brady, L. R., & Robbers, J. E. (1988). Pharmacognosy (9th ed.). LeaandFebiger.
6. Vogel, H. G. (2002). Drug Evaluation. Springer.

Suggested Readings:

1. Ansari, Dr. S. H. (2007). Essentials of Pharmacognosy (2nd ed.). BirlaPublications.
2. Choudhary, R. D. (1996). Herbal Drug Industry (1st ed.). Eastern Publisher.
3. Mohammad Ali. (2020). Pharmacognosy and Phytochemistry. CBS Publishers &Distribution.
4. Kokate, C. K., Purohit, Gokhlae. (2007). Textbook of Pharmacognosy (37th ed.).Nirali Prakashan.
5. Kokate, C. K., Purohit, Gokhlae. (2009). Practical Pharmacognosy (13th ed.).Nirali.
6. Wallis, T. E. (2005). Textbook of Pharmacognosy. CBS.

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Programme	**BSc (Hons) Biochemistry**					
Course Name	**Biochemistry of Specialized Tissues**					
Type of Course	**DCE**					
Course Code	**MG8DCEBCH403**					
Course Level	**400-499**					
Course Summary	This specialized course explores the intricate biochemistry underlying the unique functions of various tissues in the human body. Delving into the molecular and cellular aspects of specialized tissues, students gaininsights into the biochemical processes that define tissue function and contribute to overall physiological homeostasis.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites,if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the significance of tissue-specific biochemistry in physiological processes and its implications for health and disease.	U, An, I	1,2,3, 4,6,8
2	Apply knowledge of muscle biochemistry to explain energy metabolism during muscle contraction.	U, A, An, E	1,2,3, 4, 6
3	Analyse how disruptions in neurobiochemical pathways contribute to neurological disorders.	A, An, Ap	2,3,5, 6,7
4	Apply knowledge of bone biochemistry to understand the etiology and pathophysiology of bone-related disorders such as osteoporosis and osteoarthritis	U, A, E, An,	2,3,4. 6,8
5	Evaluate the impact of tissue dysfunction on overall physiological homeostasis	U, E, A, C, Ap	1,2,3, 5,6, 9,10
6	Attain skill to identify biomarkers of muscle, nerve and bone health	An, E, S	2,3,6, 8,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Module	Units	Course description	Hrs	CO No.
1. Tissue physiology	1.1	Overview of tissue types: muscle, nervous, connective, epithelial; importance of specialized tissues in physiology; techniques in tissue-specific biochemical analysis	3	1
	1.2	Epithelial tissue - types and classification;cellular junctions and epithelial barrier function; specialized functions of different epithelial tissues	3	1
	1.3	Connective tissue - adipose, cartilage, bone, blood, and reticular tissues; extracellular matrix composition and function; proteoglycans and glycoproteins in connective tissues	4	1
2. Molecular Foundations of Muscle Biochemistry	2.1	Types of muscles, molecular Basis of muscle contraction, sliding filament theory: actin and myosin interactions, cross-bridge cycling, role of calcium ions in muscle contraction, troponin-tropomyosin complex and regulatory proteins	5	2
	2.2	Role of enzymes and proteins in muscle function, energy metabolism in muscle tissues, mitochondrial respiration, creatine phosphate system, synaptic junctions	5	2
	2.3	Muscle fatigue and recovery: causes of muscle fatigue, role of lactic acid and pH changes, nutritional strategies for muscle recovery Muscle-specific disorders- myopathy and muscular mystrophy	5	2
3. Molecular Landscape of Neural Function and Dysfunction	3.1	Neuronal structure, function and neurotransmittersystem, central nervous system and peripheralnervous system	4	3
	3.2	Resting membrane potential, action potential,ion channels, electrical signaling, synaptic transmission, neurotransmitters and types	3	3
	3.3	Neural plasticity: mechanisms underlying learning and memory; synaptic pruning,and neurodegeneration	3	3
& Bone Biochemistry	3.4	Bone composition, osteoblasts and osteoclasts, structure and bone formation	3	4
	3.5	Bone resorption, mineralization and calcium homeostasis	3	4

	3.6	Hormonal regulation: parathyroid hormone(PTH),calcitonin - mechanism of action; molecular basisof bone disorders: osteoporosis, osteomalacia	4	5
4. Practical	4.1	Visit to histopathology lab and examine slides with tissue materials	10	6
	4.2	Discussion and analysis of case studies involving muscle, nervous, or bone tissues.	5	6
	4.3	Identify biomarkers of muscle, nerve andbone health with interpretation of results	6	6
	4.4	Measurement of creatine kinase, serum calcium, phosphate, and alkaline phosphatase levels.	9	6
5.Teacher specific content/Teacher facilitated activities				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Direct Instruction: Brainstorming lecture, E-learning Interactive session: Seminar, Group Assignments Library work and Group discussion, Presentation by individual student Practical: Laboratory visits, case studies, interpretation of results, laboratory experiments
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory 25 marks 1. Poster making/model building (2 marks) 2. Seminar presentation/Quiz (5 marks) 3. Involvement in group discussion (3 marks) 4. Multiple Choice questions (10 marks) 5. Assignment (2 marks) 6. Open book test (3 marks) Practical 15 marks* 1. Viva (5 marks) 2. Record (5 marks) 3. Laboratory involvement (5 marks) *This mark to be converted to 7.5 marks
	B. End Semester Examination: Written examination for one and a half hours (50 marks) Practical examination (35 marks) *This mark to be converted to 17.5 marks

References

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter,P. (2002). Molecular Biology of the Cell.4th Edition, New York: Garland Science.
2. Berg, J. M., Tymoczko, J. L., Gatto Jr., G. J., & Stryer, L. (2002). Biochemistry.W. H. Freeman Publishing, New York
3. Guyton, A. C., & Hall, J. E. (2020) Textbook of Medical Physiology. Elsevier.

4. Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2021). Principles of NeuralScience. McGraw-Hill, New York
5. Khurana, I. (2015). Textbook of Medical Physiology.Elseivier
6. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2017). Principles ofBiochemistry.4th Edition, WH Freeman
7. Raja, S. M., & Madak, B. (2010). Illustrated Medical Biochemistry. JaypeeBrothers Medical Publishers Pvt Ltd. New Delhi.

Suggested Readings

1. Cammack, R., Attwood, T., Campbell, P., Parish, H., Smith, A., Vella, F., & Stirling, J. (Eds.). (2006). Oxford Dictionary of Biochemistry and MolecularBiology (3rd ed.). OxfordUniversity Press, Oxford.
2. Chatterjea, M. N., & Rana, S. (2012). Textbook of Medical Biochemistry (8th ed.).Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
3. Jeremy, M. B., John L. T., & Lubert, S. (2002). Biochemistry (5th ed.). W. H. Freeman &Co., New York.
4. Meisenberg, G., & Simmons, W. H. (2012). Principles of Medical Biochemistry (3rd ed.). Saunders, Elsevier, Philadelphia.
5. Robert, K. M., Daryl K. G., Mayes, P. A., & Rodwell, V. W. (2009). Harper's Illustrated Biochemistry (29th ed.). Lange Medical Books, New York.

Internship Evaluation

Course Code: MG4INTBCH200

Internship evaluation has two components internal and external with a total marks of 50. Internal evaluation has 15 marks whereas external evaluation has 35 marks. Assessment detals of internship are given below

Types of assessment	**Internship 2 credits)**	**Components**
Internal	15 marks	1. Laboratory/technical Skill 2. Execution of experiments 3. Data analysis and interpretation 4. Presentation skills 5. Viva
External	35 marks	
Total	**50 marks**	

Project Evaluation

Course Code: MG8PRJBCH400

The project component are of two types: Honours with Research (12 credits with 200 marks) and Honours (8 credits with 100 marks)

Types of assessment	**Honours with Research (Project with12 credits)**	**Honours (Project with 8 credits)**	**Components**
Internal	60 marks	30 marks	1. Basic Knowledge of the topic 2. Relevance of the topic 3. Methodology and Analysis used 4. Presentation skills 5. Viva
External	140 marks	70 marks	
Total	**200 marks**	**100 marks**	