Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

www.gs.mgu.ac.in

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Schools offering Majors

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

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

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

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

Schools offering Minors/MDCs/AECs/VACs/SECs

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

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

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
MG1DSCUCY101	Fundamentals of Chemistry 1	4	4		Foundation (100-199)	Major
MG1DSCUCH121	General Chemistry 1	4	4		"	Minor A
MG1DSCUCH141	Applied Chemistry 1	4	4		"	Minor B
MG1MDCUCH101	Science and Society	3	3		"	MDC
	AEC (Eng)	3	3		"	AEC
	AEC (Mal)	3			"	AEC
SEMESTER II						
MG2DSCUCY101	Fundamentals of Chemistry 2	4	3	1	"	Major
MG2DSCUCH121	General Chemistry 2	4	3	1	"	Minor A
MG2DSCUCH141	Applied Chemistry 1	4	4		"	Minor B
MG2MDCUCH101	World of Chemistry	3	3		"	MDC
	AEC (Eng)	3	3		"	AEC
	AEC (Mal)	3	3		"	AEC
SEMESTER III						
MG3DSCUCY201	Physical Chemistry	4	3	1	Intermediate (200-299)	Major
MG3DSCUCY202	Organic Chemistry I	4	4		"	Major
MG3DSCUCY203	Inorganic Chemistry	4	4		"	Major
MG3DSCUCH221	Advanced Chemistry 1	4	4		"	Minor A
MG3MDCUCH201	The Fascinating world of Gels	3	3		"	MDC

MG3VACUCH201	Chemistry for Sustainable Society	3	3		"	VAC
SEMESTER IV						
MG4DSCUCY201	Inorganic and Physical Chemistry	4	4		"	Major
MG4DSCUCY202	Organic Chemistry II	4	4		"	Major
MG4DSCUCY203	Spectroscopic methods in Chemistry	4	4		"	Major
MG4DSCUCH241	Analytical Chemistry	4	4		"	Minor B
MG4SECUCH201	Basic Computation Skills for Science	3	3		"	SEC
MG4VACUCH201	Sustainable Chemical approaches	3	3		"	VAC
MG4INTUCY201	Internship/Fieldwork	2	2			
SEMESTER V						
MG5DSCUCY301	Inorganic Chemistry	4	4		Higher (300-399)	Major
MG5DSCUCY302	Organic Chemistry III	4	4		"	Major
MG5DSCUCY303	Physical Chemistry	4	4		"	Major
MG5DSCUCY304	Practical Chemistry	4		4	"	Major
MG5SECUCH301	Research skills and scientific data analysis	3	3		"	SEC
MG5VACUCH301	Chemistry of Aesthetic	3	3		"	VAC
SEMESTER VI						
MG6DSCUCY301	Inorganic and Physical Chemistry	4	4		"	Major
MG6DSCUCY302	Organic Chemistry IV	4	4		"	Major
MG6DSCUCY303	Polymer Chemistry	4	4		"	Major
MG6DSEUCY301	Natural Polymer Chemistry	4	4		"	Major (E)
MG6DSEUCY302	Chemistry of materials					
MG6DSEUCY303	Medicinal Chemistry					

MG6DSEUCY304	Heterocyclic Chemistry	4	4		"	Major (E)
MG6DSEUCY305	Polymer composites: From macro to nano scale					
MG6DSEUCY306	Electrochemical Energy storage and conversion devices					
MG6VACUCH301	Academic and Scientific Presentation	3	3		"	SEC
Total Credits		**133**				

SEMESTER VII						
MG7DSCUCY401	Advanced Topics in Chemistry 1	4	4		Advanced (400-499)	Major
MG7DSEUCY401	Polymer blends	4	4		"	Major (E)
MG7DSEUCY402	Nanomaterials Synthesis & Device					
MG7DSEUCY403	Photochemistry and pericyclic reactions					
MG7DSEUCY404	Biochemistry					
MG7DSEUCY405	Polymer additives and Compounding	4	4		"	Major (E)
MG7DSEUCY406	Advanced Characterization Techniques					
MG7DSEUCY407	Transition metals in chemical synthesis					
MG7DSCUCH421	Advanced Chemistry	4	4		"	Minor A/B
MG7DSEUCH421	Polymer blends	4	4		"	Minor A/B (E)
MG7DSEUCH422	Nanomaterials Synthesis & Device					

MG7DSEUCH423	Photochemistry and pericyclic reactions					
MG7DSEUCH424	Biochemistry					
MG7DSEUCH425	Polymer additives and Compounding	4	4		"	Minor A/B (E)
MG7DSEUCH426	Advanced Characterization Techniques					
MG7DSEUCH427	Transition metals in chemical synthesis					
SEMESTER VIII						
MG8DSCUCY401	Advanced Topics Chemistry in 2	4	4		"	Major
MG8DSEUCY402	Solar Energy-Advanced Materials for Photovoltaics	4	4		"	Major (E)
MG8DSEUCY403	Chemistry of natural products					
MG8DSEUCY404	Supramolecular chemistry					
MG8DSEUCY405	Polymer processing					
MG8DSEUCY406	Polymer testing					
MG8RPHUCY400	Research Project	12			"	
MG8DSCUCY407	Advanced Inorganic Chemistry	4	4		"	Major*
MG8DSCUCY408	Advanced Physical Chemistry	4	4		"	Major*
MG8DSCUCY409	Advanced Organic Chemistry	4	4		"	Major*
Total Credits		**44**				
SEMESTER IX						
MG09DSCUCY501	Advanced Organic Synthesis	4	4		PG Level (500-	Major

					599)	
MG09DSCUCY502	Theoretical and Computational Chemistry	4	4		"	Major
MG09DSCUCY503	Research Methodology and Ethics	4	4		"	Major
MG09DSCUCY504	Analytical Chemistry	4	4		"	Major
MG09DSCUCY505	Advanced Chemistry Practical's	4		4	"	Major
SEMESTER X						
MG10RPHUCY500	Research Project	20			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
Total Credits		**40**				

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

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

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

Type	Major	Minor	MDC	SEC	VAC	AEC

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Fundamentals of Chemistry 1**		
Course Type	**Major (Discipline-specific foundation course)**		
Course Level	100-199		
Course Code	MG1DSCUCY101		
Course Overview	Fundamentals of Chemistry is a foundation-level course and it equips the students with the knowledge of basic chemistry concepts for entry to learn various advanced topics in all branches of chemistry. The course covers the evolution of chemistry and its significance, fundamental themes of the atomic structure, properties, states of matter and carbon compounds. Students explore the chemical bonding and chemical & physical properties of elements based on the periodic table. Students learn about how the properties of different states of matter evolved, from a molecular level. Students will also learn to name any organic compounds and predict their properties based on the type of carbon bond.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Should know fundamental particles (electron, proton, neutron), charge, Bohr atomic model, the periodic table, catenation in carbon and difference between solid, liquid and gas		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand modern chemistry's basic facts, principles, theories, and methods.	R, U	
2	Apply atomic models to forecast and explain electronic configurations, atomic behaviour, and characteristics.	R, U, A	
3	Analyse periodic trends, the relationship between electronic configuration and the chemical reactivity of elements, including the formation of chemical bonds.	A, An	
4	Describe the relevance of organic chemistry, able to remember and name organic compounds and can predict their physical as well as chemical properties	R, A	
5	Describe the fundamental principles governing the behaviour of different states of matter.	U	
6	Compare the properties of solids, liquids, and gases and evaluate them based on real-life conditions.	E	

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

COURSE CONTENT

Module 1: Chemistry a Colourful Sciences	**Hours**	**CO No**
Definition of Science. Scientific methods - hypothesis-experiment – theory – law. Evolution of Chemistry- Early form of chemistry -alchemy, the origin of modern chemistry. Chemistry as a central science - Branches of chemistry. Interdisciplinary areas involving chemistry- Nanotechnology and biotechnology. Basic concepts in medicinal and pharmaceutical chemistry as well as methods of pharmaceutical and biomedical analysis: Drug discovery and development process, Review of organic functional groups found in drug molecules.	**12**	**1**
Module 2: Introduction to Atomic Structure and Bonding	**Hours**	
Atomic structure: The Atomic theory of matter, Discovery of atomic structure, Electromagnetic radiation – wave and particle nature, Planck's Quantum Theory, Black body radiation, Photoelectric	**16**	**2,3**

effect, Dual behaviour, Bohr's model for Hydrogen atom and its limitations – Stark and Zeeman effect. **Chemical bonding**: Lewis's symbol, Octet rule, Ionic bond – Lattice enthalpy, Born-Lande equation, Born-Haber cycle, Covalent bond- Strengths and Length, Resonance, Dipole moment, Fajan's rule, Co-ordinate bond, Hydrogen bonding. The Valence Shell Electron Pair Repulsion Theory (VSEPR), Molecular geometry, Orbital Overlap, Hybridization, Valence Bond Theory (VBT), and Molecular Orbital Theory (MOT). **Periodic table- classification of elements and properties**: Development of Periodic table, Block elements- s, p, d and f block, Periodicity, Structure and properties Alkali and alkaline earth metals, p-block elements- B, C, N, P and O family oxoacids of Sulphur and Halogens, Noble gases, Chemical properties, Diagonal relationship, biological importance of Na, K, Ca and Mg. Transition elements –Lanthanides and Actinides,		
Module 3: Organic Chemistry for Beginners	**Hours**	
IUPAC nomenclature: Alkanes, cyclo-alkanes, alkenes, alkynes, halogen compounds, Functional groups and structural diversity, Conformational analysis: alcohols, ethers, aldehydes, ketones, carboxylic acids, nitro compounds. Hybridization and Geometry of Molecules: methane, ethane, ethylene, acetylene. Electronic Effects: Inductive, resonance, hyperconjugation, and steric effect. Concepts of acidity: Acids and bases. Nucleophiles and electrophiles. Cleavage of bonds: homolytic and heterolytic C-C bond fission. Reaction Intermediates and their stability: carbocations, carbanions, and free radicals. Polymers and Macromolecules	**16**	**4**
Module 4: Understanding States of Matter	**Hours**	
Gases: The gas laws; the ideal gas equation; Gas mixtures and partial pressures; Gas mixtures and partial pressures; kinetic-molecular theory of gases; molecular effusion and diffusion; real gases. **Liquid:** A molecular comparison of gases, liquids, and solids; intermolecular forces, select properties of liquids; phase changes; vapour pressure, Phase diagrams; liquid crystals. **Solids:** Bonding in solids; structures of solids, unit cells; classification of solids; metallic bonding; ionic solids; molecular Solids: covalent-network solids	**16**	**5,6**

Mode of Transaction	**Classroom activities: Recitation, Seminar, Quiz** **Field activities:** **Lab-based activities:**
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

Learning Resources

1. P. Atkins, T. Overton, J. Rourke, F. Armstrong, and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, 5ed, W. H. Freeman and Company New York, 2009.
2. G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3rd ed., Pearson, 2008.
3. J. E. House, Inorganic Chemistry, 3rd ed., Academic Press, 2019.
4. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4th ed., Pearson Education, 2006.
5. J. M. McIintosh, Organic Chemistry Fundamentals and Concepts, 2nd Edn., De Gruyter, 2022
6. T. W. G. Solomons, C. B. Fryhle and S. A. Snyder, Solomons' Organic Chemistry, Global Edn., 12th Edn., Wiley International, 2024

Relevance of Learning the Course/ Employability of the Course
It is very relevant in terms of discipline-specific foundation courses. Students will be empowered with the basic knowledge of chemistry and its significance in the modern world.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**General Chemistry 1**		
Course Type	**Minor**		
Course Level	100-199		
Course Code	MG1DSCUCH121		
Course Overview	General Chemistry 1 is a foundation-level course and it equips the students with the knowledge of basic chemistry concepts for entry to learn various advanced topics in all branches of chemistry. The course covers the evolution of chemistry and its significance, fundamental themes of the atomic structure, properties, states of matter and carbon compounds. Students explore the chemical bonding and chemical & physical properties of elements based on the periodic table. Students learn about how the properties of different states of matter evolved, from a molecular level. Students will also learn to name any organic compounds and predict their properties based on the type of carbon bond.		
Semester	1	**Credit**	4

Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**
	60	
Pre-requisite	Should know fundamental particles (electron, proton, neutron), charge, Bohr atomic model, the periodic table, catenation in carbon and difference between solid, liquid and gas	

COURSE OUTCOMES (CO)

CO No.	**Expected Course Outcome** *Upon completion of this course, students will be able to**;***	**Learning Domains**	**PSO No.**
1	Understand the basic facts, principles, theories, and methods of modern chemistry.	R, U	
2	Apply atomic models to forecast and explain electronic configurations, atomic behaviour, and characteristics.	R, U, A	
3	Analyse periodic trends, the relationship between electronic configuration and the chemical reactivity of elements, including the formation of chemical bonds.	A, An	
4	Describe the relevance of organic chemistry, able to remember and name organic compounds and can predict their physical as well as chemical properties	R, A	
5	Describe the fundamental principles governing the behaviour of different states of matter.	U	
6	Compare the properties of solids, liquids, and gases and evaluate them based on real-life conditions.	E	

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

COURSE CONTENT

Module 1: Chemistry a Colourful Sciences	**Hours**	**CO No**
Definition of Science. Scientific methods - hypothesis-experiment – theory – law. Evolution of Chemistry-Early form of chemistry -alchemy, the origin of modern chemistry. Chemistry as a central science - Branches of chemistry. Interdisciplinary areas involving chemistry- Nanotechnology and biotechnology. Basic concepts in medicinal and pharmaceutical chemistry as well as methods of pharmaceutical and biomedical analysis: Drug discovery and development process, Review of organic functional groups found in drug molecules.	**12**	**1**
Module 2: Introduction to Atomic Structure and Bonding	**Hours**	
Atomic structure: The Atomic theory of matter, Discovery of atomic structure, Electromagnetic radiation – wave and particle nature, Planck's Quantum Theory, Black body radiation, Photoelectric effect, Dual behaviour, Bohr's model for Hydrogen atom and its limitations – Stark and Zeeman effect. **Chemical bonding**: Lewis's symbol, Octet rule, Ionic bond – Lattice enthalpy, Born-Lande equation, Born-Haber cycle, Covalent bond- Strengths and Length, Resonance, Dipole moment, Fajan's rule, Co-ordinate bond, Hydrogen bonding. The Valence Shell Electron Pair Repulsion Theory (VSEPR), Molecular geometry, Orbital Overlap, Hybridization, Valence Bond Theory (VBT), and Molecular Orbital Theory (MOT). **Periodic table- classification of elements and properties**: Development of Periodic table, Block elements- s, p, d and f block, Periodicity, Structure and properties Alkali and alkaline earth metals, p-block elements- B, C, N, P and O family oxoacids of Sulphur and Halogens, Noble gases, Chemical properties, Diagonal relationship, biological importance of Na, K, Ca and Mg. Transition elements –Lanthanides and Actinides	**16**	**2,3**
Module 3: Organic Chemistry for Beginners	**Hours**	
IUPAC nomenclature: Alkanes, cyclo-alkanes, alkenes, alkynes, halogen compounds, Functional groups and structural diversity, Conformational analysis: alcohols, ethers, aldehydes, ketones, carboxylic acids, nitro compounds. Hybridization and Geometry of Molecules: methane, ethane, ethylene, acetylene. Electronic Effects: Inductive, resonance,	**16**	**4**

hyperconjugation, and steric effect. Concepts of acidity: Acids and bases. Nucleophiles and electrophiles. Cleavage of bonds: homolytic and heterolytic C-C bond fission. Reaction Intermediates and their stability: carbocations, carbanions, and free radicals. Polymers and Macromolecules		
Module 4: Understanding States of Matter	**Hours**	
Gases: The gas laws; the ideal gas equation; Gas mixtures and partial pressures; Gas mixtures and partial pressures; kinetic-molecular theory of gases; molecular effusion and diffusion; real gases. **Liquid:** A molecular comparison of gases, liquids, and solids; intermolecular forces, select properties of liquids; phase changes; vapour pressure, Phase diagrams; liquid crystals. **Solids:** Bonding in solids; structures of solids, unit cells; classification of solids; metallic bonding; ionic solids; molecular Solids: covalent-network solids	**16**	**5,6**

Mode of Transaction	Classroom activities: Recitation, Seminar, Quiz Lab-based activities
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

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Relevance of Learning the Course/ Employability of the Course

It is very relevant in terms of foundation courses. Students will be empowered with the basic knowledge of chemistry and its significance in the modern world.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Applied Chemistry 1**		
Course Type	**Minor**		
Course Level	100-199		
Course Code	MG1DSCUCH141		
Course Overview	Applied Chemistry-1 course gives an overview of key areas which influence the day-to-day activities of the society. The students get general information about various industries such as fuel, fertilizer, pesticide, polymer and pharma industries, etc. The students get an idea about the origin of various chemical products they use in daily life. Students will also learn about natural resources, environmental contamination, occupational health and safety, risk management, and environmental toxicology.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Should be familiar with various consumable products (like medicine, fuel, etc)		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand the significance of sustainability and the need to keep the environment free of pollution.	R, U	
2	Remember different chemicals and their uses and how they can be specifically applied to enhance the quality of life.	R, U, A	
3	Will get detailed knowledge regarding the significance of petroleum and petrochemicals in the modern world.	A, An	
4	Will get an overview of various types of polymers used in the modern world and get familiarized with the significance of polymer recycling.	R, A	
5	Realialize how chemistry has helped to develop modern medicines.	U	
6	Will be able to analyze the specific relation between the structure/chemistry of the drug to their pharmacological activity.	E	

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

COURSE CONTENT

Module 1: Industrial Chemistry	Hours	CO No
Sustainable use of- chemical feedstocks, water, energy. Environmental pollution control. Industrial Processes in practice: Basic chemical data, Flow charts; chemical process selection, design, and operation, Plant location, safety, construction of plant, process system engineering. Fuel Industries: Calorific value, the modern concept of fuels, classification, criteria for selection, comparison of gas, liquid, and solid fuels, properties, methods of processing various fuels, solid fuels, and Gaseous fuels. Agrichemical Industries: Fertilizers – Fertilizer type, need for fertilizer, essential requirements, plant nutrients and regulators, soil fertility, pH of the soil, classification of fertilizer, natural fertilizers, nitrogenous fertilizer, Phosphate fertilizers, NPK fertilizers, the effect of fertilizer- pollution. Insecticides classification, DDT, BHC, Gammexane, Endosulfan.	**12**	**1**

Module 2: Petrochemistry	**Hours**	
Origin and formation of petroleum, Composition, Characteristics, Constituents of Petroleum or crude oil. Types of Hydrocarbons and Non- hydrocarbons present in petroleum, their physical and chemical properties. Salty crude oil, sweet and sour crude oil. Classification of crude oil and natural gas: Characterization factor, Correlation index. Primary raw material for petrochemicals: Introduction to paraffinic hydrocarbons, olefinic hydrocarbons, dienes, and aromatic hydrocarbons with their properties. uses as building blocks for various petrochemicals.	**16**	**2,3**
Module 3: Polymer Chemistry	**Hours**	
Rubber, Plastics, and Fibres – Introduction, Viscoelasticity, Tg, Tm, and Crystallinity. Polymer: A wonder material – Specialty polymers – Engineering plastics – Self-curing polymers – Shape memory polymers – Polymer blends-composites – Nanocomposites –Synthetic and natural biopolymers – Polymer waste management and recycling – Applications of polymers (Engineering-Packaging-Biomedical-Electronic-Space-Automotive)	**16**	**4**
Module 4: Pharmaceutical Chemistry	**Hours**	
Development of medicinal chemistry, Basic principles, Basic terminology in drug discovery, MIC, Efficacy, Adsorption, Distribution, Metabolism, Excretion, Drug and disease classification, drug targets, Pharmacology, Pharmacokinetics, Generic and trade names, Lipinski rule, Dose-response curves-Stages in drug discovery, SAR, Natural and synthetic drugs, Introduction to Process Chemistry. Cancer research: Anti-cancer-agents, Antibiotics: Penicillins, Tetracyclines, and Quinolones, Basic knowledge of TB and its treatment, Viral and fungal diseases, Analgesics and Anti-inflammatory drugs-NSAIDS, Proton pump inhibitors: Hyperacidity, Peptic Ulcer disease (PUD), Gastroesophageal reflux disease (GERD), Cardiovascular diseases: Hypertension, Cardiovascular drugs-Statin drugs, ACE inhibitors, Calcium channel inhibitors, Cholesterol absorption inhibitors	**16**	**5,6**

Mode of Transaction	**Classroom activities: Recitation, Seminar, Quiz** **Field activities:** **Lab-based activities:**
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

Learning Resources

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Relevance of Learning the Course/ Employability of the Course
Applied Chemistry course can help students to work in many designated roles such as Chemistry Content Writer, Scientific Data Entry Specialist, Chemical Business Analyst, Quality Assurance, etc.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Science and Society**		
Course Type	**MDC**		
Course Level	100-199		
Course Code	MG1MDCUCH101		
Course Overview	This multidisciplinary course aims to provide a critical understanding for learners of the significance of science in society and vice-versa. The syllabus covers the history of science, developments of sciences, and approaches in science. The syllabus also deals with various processes and approaches adopted in scientific research. Finally, consciousness about scientific ethics is also discussed. This course further offers the prospects for understanding the contemporary trends and growth in diverse fields of scientific research. After completion of this course, students will be able to correlate the mutual relationship and significance between science and society.		
Semester	1	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	54		
Pre-requisite	Should be familiar with various consumable products (like medicine, fuel, etc)		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	To acquire a concrete understanding of the importance of scientific knowledge and its implications in society.	U, An, A	
2	To provide sufficient knowledge about the history of major scientific discoveries and developments.	R, U, E, A	
3	To understand the peculiarities of scientific approaches.	U, A	
4	To Correlate the relationship between scientific and social developments in mankind.	An, E	
5	To outline the basic steps in scientific research.	U, A	
6	To develop critical thinking and reasoning ability and to impart scientific ethics among learners.	A, U, An, E, S	

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

COURSE CONTENT

Module 1: The History of Science	**Hours**	**CO No**
Ancient civilization in India, China, Babylon, Egypt, Greece, Rome, Aristotelian views, Archimedes, The Copernican revolution, Contributions of Galileo, Louis Pasteur, Newton, Einstein, Linus Pauling, Developments and Revolutions in various branches of science, The evolution of modern Science and Technology, Science in the twenty-first century.	**10**	**1**
Module 2: The Scientific Approach	**Hours**	
Process of science and the nature of scientific knowledge. Ideas in science: Research Process, hypotheses, theories, and laws. The process of science beyond methods: Science as a creative human activity and art, creativity in science. Reasoning and Critical thinking, Affective and Cognitive strategies, Science and Knowledge, Beliefs and superstitions, Justification, Scientific temper.	**10**	**2,3**

Module 3: The Practice of Science	**Hours**	
Research methods: Identification of a problem, determination of methodology, literature survey, mode of approach of actual investigation, drawing influences from data, qualitative and quantitative analysis, assessing the status of the problem, results and conclusions, presenting a scientific seminar, abstraction of the research paper, publication of research paper, e-journals, art of writing a thesis. Science Communication: Conventional and Social media role, internet and its applications, Scientific controversies.	**20**	**4**
Module 4: Scientific ethics	**Hours**	
Verifiability and reproducibility, Plagiarism, IPR, Cyber laws, Internet security	**14**	**5,6**

Mode of Transaction	**Classroom activities: Recitation, Seminar, Quiz** **Field activities:** **Lab-based activities:**
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

Learning Resources

1. J. S. Avery, Science and Society, World scientific

Suggested Reading

1. J. D. Bernal, Science in history, 1-4 Volumes, MIT Press, Cambridge, 1971.
2. W. Durant, The Story of Civilization, Simon and Schuster Publishers, United States, 1975
3. B. Russell, The Scientific Outlook, Routledge Classics, United Kingdom, 2009
4. K. Sujatha, S. Kurien, Evolution of the Philosophy of Science-Literary Perspectives, Ane Books Pvt. Ltd, 2011.
5. G. Gammow, One, two, three…infinity, Dover Publications, INC, NewYork,1974
6. T. Crump, A Brief History of Science, Universities Press, 2001.
7. B. N. Ghosh, Lectures on Scientific Method, Sterling, 1986.

Relevance of Learning the Course/ Employability of the Course

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Fundamentals of Chemistry 2**		
Course Type	**Major (Discipline-specific foundation course)**		
Course Level	100-199		
Course Code	MG2DSCUCY101		
Course Overview	Fundamentals of Chemistry 2 is a foundation-level course and it equips the students with the knowledge of basic Quantum mechanics and its application in chemical bonding. The course also covers the concepts of acid-base theory. Stereochemistry gives an overview of the structure of organic molecules, and how to distinguish between different types of isomers, including enantiomers and diastereomers. Students will be introduced to chemical thermodynamics and will get familiarized with physical concepts such as work, heat, enthalpy, entropy etc. Students will be introduced to the chemistry lab where they learn about various safety aspects and hazards associated with chemicals, MSDS etc. Students will learn to carry out fundamental experiments such as finding boiling points, melting points, calibrating instruments etc.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Should know fundamental particles (electron, proton, neutron), charge, Bohr atomic model, the periodic table, and basic organic chemistry including naming organic compounds. Students should be aware of basic physical		

	concepts like work, energy etc. Should know about various laboratory glasswares.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand the fundamentals of quantum mechanics and explain chemical bonding based on the theories of quantum mechanics.	R, U	
2	Compare the relative strengths of acids and bases, and the different factors affecting acidity and basicity	R, U, A	
3	Identify stereogenic centres in organic molecules, and distinguish between different types of isomers, including enantiomers and diastereomers	A, An	
4	Understand principles of classical thermodynamics and apply them to analyze systems and thermodynamic cycles	R, A	
5	Understand the various hazards associated with chemicals. Applying this knowledge for handling and disposing of chemicals	R U A	
6	Develop the necessary skills to work in a chemistry lab.	S	

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

COURSE CONTENT

Module 1: Basic Inorganic Chemistry	Hours	CO No
Quantum mechanical model of atom and bonding: Dual behaviour of matter, Heisenberg's Uncertainty Principle, double slit experiments, Classical wave equation, Schrödinger equation, Operators, Postulates of quantum mechanics, Particle-in-a-box, Schrödinger equation for the hydrogen atom, Qualitative description of many-electron systems, concepts of orbitals and quantum numbers. Shapes of orbitals, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Valence bond and molecular orbital descriptions of bonding, Linear combination of atomic orbitals (LCAO) approach,	**16**	**1**

Hybridization and Bonding. Bonding in homonuclear and heteronuclear diatomic molecules, Bond orders. **Chemistry of Solid:** Classification of solids, Classification of crystalline solids, Crystal lattices and unit cell, seven crystal systems, Bravais's lattices, Number of atoms in a unit cell, packing in solids, Packing efficiency, Density of unit cell, Imperfection in solids, Crystal directions and planes, Crystal diffraction – Bragg's law, Electrical and Magnetic properties **Oxidation and reduction:** Reduction potential; electrochemical series, Redox reactions Balancing of redox equations, Factors affecting redox stability, Frost diagrams for redox reactions, Ellingham diagram and extraction of elements. **Acids and bases:** Arrhenius concept, solvent systems, Brønsted concept, Lux-Flood concept and Lewis's concept; HSAB principle, Superacid, Relative strengths of acids, Acid-base neutralization curves and indicators.		
Module 2: Basics of Stereochemistry	**Hours**	
Introduction, Concept of Isomerism, Classification of Stereoisomers, Optical Isomerism, Chirality & Elements of Symmetry, Wedge formula, Fischer projection, Newmann projection. Relative and absolute configurations, sequence rules, D & L, R & S systems of nomenclature. Understanding with examples for Enantiomers, mesoform, erythro/threo forms, diastereoisomers, inversion, retention, and racemization. Conformational understanding with an example of ethane, n-butane, Cyclohexane and Decalin.	**16**	**2,3**
Module 3: Concepts of Physical Chemistry	**Hours**	
Thermodynamics: Thermodynamic terms, State and path functions. Concept of heat and work. First Law of thermodynamics, Second law of thermodynamics, Third law of thermodynamics, Fundamental concepts of Statistical Thermodynamics - Probability - Partition function - ensembles - Boltzmann distribution. Chemical Equilibria: Law of mass action, thermodynamic derivation of law of chemical equilibrium. derivation of relations between the	**12**	**4**

various equilibrium constants Kp, Kc and Kx (using chemical potential). Ionic Equilibria: pKa, pKb and pH – Buffer solutions. Mechanism of buffer action – Buffer index – Henderson equation – Applications of buffers - Hydrolysis of salts of all types – Degree of hydrolysis – Hydrolysis constant and its relation with Kw - Solubility product and common ion effect.		
Module 4: Basic Chemistry Laboratory Practices	**Hours**	
Laboratory orientation and safety protocols Safe lab practices-PPE, Fire and electrical safety. Chemicals and solvents-Storage and handling, Material Safety Data Sheet (MSDS), Special precautions for hazardous chemicals usage. Segregation and disposal of chemicals-sodium and broken mercury thermometer. Introduction to glassware and equipment in the lab and their working. Emergency response and evacuation- chemical spills, gas leakage and fire. Simple first aids: Electric shocks, fire, cut by glass and inhalation of poisonous gases - Accidents due to acids and alkalis - Burns due to phenol and bromine. Scientific ethics in lab-working individually and in a team. Maintaining lab record, Cleanliness and punctuality. 2. Basic principles & experiments related to sample/reagent preparation: practical concept of Molarity, Molality, Normality, equivalence, weight %, vol.%, Preparation of standard solutions, Dilution 0.1 M to 0.001 M solutions. 3. Calibration and use of Electronic Balances, thermometer (using 80-82 °C; Naphthalene, 113.5-114 °C; Acetanilide, 132.5-133°C; Urea, 100 °C; Distilled Water), melting point apparatus (Naphthalene 80-82 °C, Benzoic Acid 121.5-122 °C, Urea 132.5-133 °C, Succinic Acid 184.5-185 ° C, Cinnamic Acid 132.5-133 °C, Salicylic Acid 157.5-158 °C Acetanilide 113.5-114 °C, m-Dinitrobenzene 90 °C p-Dichlorobenzene 52 °C, Aspirin 135 °C) Determination of Boiling Point- Ethanol 78 °C, Cyclohexane 81.4 °C, Toluene 110.6 °C. Working principle of separating funnel, distillation setup, centrifuge, hot air oven, magnetic stirrer, rotary evaporator. 4. Separating homo and heterogeneous mixtures- Filtration, Concentration, Evaporation, recrystallisation, sublimation, separating funnel, distillation, chromatography.	**16**	**5,6**

Mode of Transaction	**Classroom activities: Recitation, Seminar, Quiz** **Field activities:** **Lab-based activities:**
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination 4. Viva

Learning Resources

1. D. A. McQuarrie, Quantum Chemistry, Viva Student ed., Viva, 2011.
2. P. Atkins, J. de Paula and J. Keeler, Atkins' Physical Chemistry, 11th ed., OUP, 2018.
3. J. Barrett, Structure and Bonding, Wiley-Royal Society of Chemistry, 2002.
4. T. Engel and P. Reid, Physical Chemistry, 3rd ed., Pearson, 2013.
5. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry, 4th ed., Wiley Student ed., 2006.
6. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4th ed., Pearson Education, 2006.
7. T. W. G. Solomons, C. B. Fryhle and S. A. Snyder, Solomons' Organic Chemistry, Global Edn., 12th Edn., Wiley International, 2024
8. D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edn., New age international, 2018
9. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, 11th Edn., New Age International, 2022
10. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal
11. Vogel's Textbook of Practical Organic Chemistry (5th Edition)
12. Vogel's Inorganic Practical Chemistry

Relevance of Learning the Course/ Employability of the Course
It is very relevant in terms of discipline-specific foundation courses. Students will be empowered with the basic knowledge of chemistry and its significance in the modern world.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**General Chemistry 2**		
Course Type	**Minor**		
Course Level	100-199		
Course Code	MG2DSCUCH121		
Course Overview	General Chemistry 2 is a foundation-level course and it equips the students with the knowledge of basic Quantum mechanics and its application in chemical bonding. The course also covers the concepts of acid-base theory. Stereochemistry gives an overview of the structure of organic molecules, and how to distinguish between different types of isomers, including enantiomers and diastereomers. Students will be introduced to chemical thermodynamics and will get familiarized with physical concepts such as work, heat, enthalpy, entropy etc. Students will be introduced to the chemistry lab where they learn about various safety aspects and hazards associated with chemicals, MSDS etc. Students will learn to carry out fundamental experiments such as finding boiling points, melting points, calibrating instruments etc.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		

Pre-requisite	Should know fundamental particles (electron, proton, neutron), charge, Bohr atomic model, the periodic table, and basic organic chemistry including naming organic compounds. Students should be aware of basic physical concepts like work, energy etc. Should know about various laboratory glasswares.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand the fundamentals of quantum mechanics and explain chemical bonding based on the theories of quantum mechanics.	R, U	
2	Compare the relative strengths of acids and bases, and the different factors affecting acidity and basicity	R, U, A	
3	Identify stereogenic centres in organic molecules, and distinguish between different types of isomers, including enantiomers and diastereomers	A, An	
4	Understand principles of classical thermodynamics and apply them to analyze systems and thermodynamic cycles	R, A	
5	Understand the various hazards associated with chemicals. Applying this knowledge for handling and disposing of chemicals	R U A	
6	Develop the necessary skills to work in a chemistry lab.	S	

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

COURSE CONTENT

Module 1: Basic Inorganic Chemistry	Hours	CO No
Quantum mechanical model of atom and bonding: Dual behaviour of matter, Heisenberg's Uncertainty Principle, double slit experiments, Classical wave equation, Schrödinger equation, Operators, Postulates of quantum mechanics, Particle-in-a-box, Schrödinger equation for the hydrogen atom,	**16**	**1**

Qualitative description of many-electron systems, concepts of orbitals and quantum numbers. Shapes of orbitals, Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Valence bond and molecular orbital descriptions of bonding, Linear combination of atomic orbitals (LCAO) approach, Hybridization and Bonding. Bonding in homonuclear and heteronuclear diatomic molecules, Bond orders. **Chemistry of Solid:** Classification of solids, Classification of crystalline solids, Crystal lattices and unit cell, seven crystal systems, Bravais's lattices, Number of atoms in a unit cell, packing in solids, Packing efficiency, Density of unit cell, Imperfection in solids, Crystal directions and planes, Crystal diffraction – Bragg's law, Electrical and Magnetic properties **Oxidation and reduction:** Reduction potential; electrochemical series, Redox reactions Balancing of redox equations, Factors affecting redox stability, Frost diagrams for redox reactions, Ellingham diagram and extraction of elements. **Acids and bases:** Arrhenius concept, solvent systems, Brønsted concept, Lux-Flood concept and Lewis's concept; HSAB principle, Superacid, Relative strengths of acids, Acid-base neutralization curves and indicators.		
Module 2: Basics of Stereochemistry	**Hours**	
Introduction, Concept of Isomerism, Classification of Stereoisomers, Optical Isomerism, Chirality & Elements of Symmetry, Wedge formula, Fischer projection, Newmann projection. Relative and absolute configurations, sequence rules, D & L, R & S systems of nomenclature. Understanding with examples for Enantiomers, mesoform, erythro/threo forms, diastereoisomers, inversion, retention, and racemization. Conformational understanding with an example of ethane, n-butane, Cyclohexane and Decalin.	**16**	**2,3**
Module 3: Concepts of Physical Chemistry	**Hours**	
Thermodynamics: Thermodynamic terms, State and path functions. Concept of heat and work. First Law of thermodynamics, Second law of thermodynamics, Third law of thermodynamics, Fundamental concepts	**12**	**4**

of Statistical Thermodynamics - Probability - Partition function - ensembles - Boltzmann distribution. Chemical Equilibria: Law of mass action, thermodynamic derivation of law of chemical equilibrium. derivation of relations between the various equilibrium constants Kp, Kc and Kx (using chemical potential). Ionic Equilibria: pKa, pKb and pH – Buffer solutions. Mechanism of buffer action – Buffer index – Henderson equation – Applications of buffers - Hydrolysis of salts of all types – Degree of hydrolysis – Hydrolysis constant and its relation with Kw - Solubility product and common ion effect.		
Module 4: Basic Chemistry Laboratory Practices	**Hours**	
Laboratory orientation and safety protocols Safe lab practices-PPE, Fire and electrical safety. Chemicals and solvents-Storage and handling, Material Safety Data Sheet (MSDS), Special precautions for hazardous chemicals usage. Segregation and disposal of chemicals-sodium and broken mercury thermometer. Introduction to glassware and equipment in the lab and their working. Emergency response and evacuation- chemical spills, gas leakage and fire. Simple first aids: Electric shocks, fire, cut by glass and inhalation of poisonous gases - Accidents due to acids and alkalis - Burns due to phenol and bromine. Scientific ethics in lab-working individually and in a team. Maintaining lab record, Cleanliness and punctuality. 2. Basic principles & experiments related to sample/reagent preparation: practical concept of Molarity, Molality, Normality, equivalence, weight %, vol.%, Preparation of standard solutions, Dilution 0.1 M to 0.001 M solutions. 3. Calibration and use of Electronic Balances, thermometer (using 80-82 °C; Naphthalene, 113.5-114 °C; Acetanilide, 132.5-133°C; Urea, 100 °C; Distilled Water), melting point apparatus (Naphthalene 80-82 °C, Benzoic Acid 121.5-122 °C, Urea 132.5-133 °C, Succinic Acid 184.5-185 ° C, Cinnamic Acid 132.5-133 °C, Salicylic Acid 157.5-158 °C Acetanilide 113.5-114 °C, m-Dinitrobenzene 90 °C p-Dichlorobenzene 52 °C, Aspirin 135 °C) Determination of Boiling Point- Ethanol 78 °C, Cyclohexane 81.4 °C, Toluene 110.6 °C. Working principle of separating funnel, distillation setup,	**16**	**5,6**

centrifuge, hot air oven, magnetic stirrer, rotary evaporator. 4. Separating homo and heterogeneous mixtures- Filtration, Concentration, Evaporation, recrystallisation, sublimation, separating funnel, distillation, chromatography.		

Mode of Transaction	Classroom activities: Recitation, Seminar, Quiz Field activities: Lab-based activities:
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination 4. Viva

Learning Resources

1. D. A. McQuarrie, Quantum Chemistry, Viva Student ed., Viva, 2011.
2. P. Atkins, J. de Paula and J. Keeler, Atkins' Physical Chemistry, 11th ed., OUP, 2018.
3. J. Barrett, Structure and Bonding, Wiley-Royal Society of Chemistry, 2002.
4. T. Engel and P. Reid, Physical Chemistry, 3rd ed., Pearson, 2013.
5. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry, 4th ed., Wiley Student ed., 2006.
6. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4th ed., Pearson Education, 2006.
7. T. W. G. Solomons, C. B. Fryhle and S. A. Snyder, Solomons' Organic Chemistry, Global Edn., 12th Edn., Wiley International, 2024
8. D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edn., New age international, 2018
9. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, 11th Edn., New Age International, 2022
10. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal
11. Vogel's Textbook of Practical Organic Chemistry (5th Edition)
12. Vogel's Inorganic Practical Chemistry

Relevance of Learning the Course/ Employability of the Course
It is very relevant in terms of discipline-specific foundation courses. Students will be empowered with the basic knowledge of chemistry and its significance in the modern world.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**Applied Chemistry 2**		
Course Type	**Minor**		
Course Level	100-199		
Course Code	MG2DSCUCH141		
Course Overview	The Applied Chemistry-2 course gives an overview of the chemistry of various commodities which a person uses daily. of how chemistry influences day to day activity of a person. The students get general information about the chemical nature of the food they consume. The course gives an overview of the chemistry of different biomolecules and how they act as building blocks for life. The course will introduce the students to the field of forensic sciences and how chemistry has contributed to its success.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Should be familiar with various consumable products (like medicine, fuel, etc)		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand the important concepts of the chemical, physical and functional properties of food constituents	R, U	
2	Evaluate and explain how the highly complex nature of food results in biological activities.	R, U, A	
3	Will be able to understand and explain the physical as well as chemical properties of dyes and pigments	A, An	
4	Will get an overview of the development of forensic chemistry.	R, A	
5	Apply fundamental chemistry to solve forensic problems.	U	
6	Will be able to develop an understanding of the chemistry of biomolecules such as proteins and nucleic acids	E	

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

COURSE CONTENT

Module 1: Food Chemistry	**Hours**	**CO No**
Food Lipids: Edible fats and Oil, classification and chemical composition Food Carbohydrates: properties and utilization of common polysaccharides, Food minerals: Main elements and trace elements in common food, Enzymes in Food: Importance enzymes available in common food, the effect of inhibitors, pH and temperature on enzymes, Food Additives: Vitamins, Amino acids and Minerals, Aromo compounds, Flavour enhancers, Sugar substitutes, Food colour, Food contaminants: Impact of adulterant on food (melamine, formaldehyde, rhodamine etc) Beverages: Health benefits and its anti-oxidant properties, Food Preservation: Physical and chemical preservation of food	**16**	**1, 2**
Module 2: Dyes and Pigments	**Hours**	
Definition, colour and constitution of dyes- Armstrong theory (quinonoid theory) and its limitations. Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic	**12**	**3**

effect. Modern theories; Valence Bond theory and Molecular Orbital Theory. Requirements and properties of dyes, Classification based on origin: Natural dyes, Synthetic dyes-history and examples, Classification based on chromophore, examples with structure and synthesis, Chemistry of dying and dye industry, Mordants, Classification based on dying process, Analysis of dyes, health and safety aspects, Introduction to Fluorescence and laser dyes. Pigments: Introduction, Natural pigments - Structures of Porphyrins, Bile pigments. Synthetic pigments – Phthalocyanines; synthesis, properties and applications		
Module 3: Forensic Chemistry	**Hours**	
History of Development of Forensic Science: Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science, Branches of Forensic science. Forensic Chemistry: Tools and techniques in forensic chemistry, Introduction, Colour & Spot test, microcrystal tests, inorganic and organic analysis. Analysis of Beverages, trace evidence and petroleum products. Classification of commonly encountered drugs and it's analysis. Recent trends in Forensic science - Biometrics in Personal Identification- Role in person Identification, Techniques and Technologies.	**16**	**4, 5**
Module 4: Biomolecules	**Hours**	
Structure and Functions of Biomolecules: Carbohydrates; Lipids; Amino acids and proteins; Nucleic acid: DNA and RNA, Coenzymes and cofactors.	**12**	**6**

Mode of Transaction	**Classroom activities: Recitation, Seminar, Quiz** **Field activities:** **Lab-based activities:**
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

Learning Resources

1. Nanda, B.B. and Tewari, R.K. Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi (2001).
2. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
3. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
4. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
5. R. M. Christie, Colour Chemistry, 2nd Edn., Royal Society of Chemistry, 2012
6. Fennema's Food Chemistry, fourth edition, edited by S. Damodaran, K.L. Parkin, and O. R. Fennema, 2007, published by CRC Press

Relevance of Learning the Course/ Employability of the Course
Applied Chemistry course can help students to work in many designated roles such as Chemistry Content Writer, Scientific Data Entry Specialist, Chemical Business Analyst, Quality Assurance, etc.

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

School	**School of Chemical Sciences**		
Programme	**4 + 1 Integrated UG and PG Programme**		
Course Title	**World of Chemistry**		
Course Type	**MDC**		
Course Level	100-199		
Course Code	MG2MDCUCH101		
Course Overview	This multidisciplinary course targets multiciliary leaners and hence provides a fundamental understanding on the significance and importance of chemistry as a central science. The strong influence of chemistry in our daily life is emphasized through various modules. The chemistry in and around us is presented followed by a brief introduction to the chemistry of nature involving biomolecules, natural products and atmospheric processes. The applications of chemistry in various sectors such as petroleum, agrochemicals, pharmaceuticals, forensic and polymer etc is also included. The overall objective of this course to inculcate an appreciation among students about the importance of chemistry		
Semester	2	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	54		

Pre-requisite	A basic idea about the significance and diverse applications of chemistry in our life.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Appreciate the significance of chemistry	U, A	
2	Understand the importance of chemistry in daily life	U An	
3	To familiarise the chemistry involved in natural compounds and processes	U, E	
4	To correlate different segments of atmospheric chemistry & their influences	U, An,	
5	To understand the basics of petroleum, agrochemicals, drugs, and forensic chemistry	U, An	
6	To familiarise with various class of polymeric materials and their applications	A, An	

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

COURSE CONTENT

Module 1: Chemistry as central science	**Hours**	**CO No**
Evolution of chemistry-alchemy, ancient concepts to particulate nature of matter, laws of chemical combination, mole concept, molarity and normality; Branches of chemistry, Atomic structure and chemical bonding, periodic table, Contribution of chemistry to mankind and society, Need for Green Chemistry, 12 principles of Green Chemistry. Chemistry in everyday life: Chemistry everyehere: Agriculture, food, textile, Petrochemicals, medicines, Automobiles, building materials (bricks, marbles, granites, cement, paints and coatings etc), household goods: plastics, rubber, ceramics, steel, wood, electrical and electronics etc; soaps and detergents; Stellar energy : fission and fusion reactions, solar cells.	**10**	**1,2**
Module 2: Chemistry of Nature	**Hours**	

Origin of life, Amino acids, water, Basic elements; Chemistry in and around us, Chemical composition of the earth's atmosphere, Composition of the Human Body and chemical processes, Chemistry of vision; Chemistry of flowers. Biomolecules: Structure and Functions of Biomolecules: Carbohydrates; Lipids; Amino acids and proteins; Nucleic acid: DNA and RNA, Enzymes, plant pigments, cellulose, collagen, vitamins Natural Products and processes: NR latex, Photosynthesis, Phosphorescence and fluorescence, Bioluminescence, Bioinorganic chemistry: Hemoglobin and Myoglobin, Chlorophyll and photosynthesis, Nitrogen fixation and vitamin B12 Atmospheric chemistry: Various segments of atmosphere & their significance, sources and toxic effects of air pollutants, Stratospheric Chemistry-Ozone formation, processes for catalytic decomposition of ozone; Tropospheric Chemistry-Smog, Phototransformation,, Acid rains, sources & sinks, The chemistry of global climate, greenhouse gases & global warming	**20**	**3,4**
Module 3: Applied Chemistry	**Hours**	
Fuels and Petroleum:, classifications: gas, liquid and solid fuels, comparison, properties and methods of fuel processing; Calorific value, Origin and formation of petroleum, Constituents of Petroleum or crude oil, Types of Hydrocarbons and Non- hydrocarbons present in petroleum Agrichemicals: classification of fertilizers, natural fertilizers, nitrogenous fertilizer, Phosphate fertilizers, NPK fertilizers, the effect of fertilizer- pollution. Insecticides classification, DDT, BHC, Gammexane, Endosulfan. Pharmaceuticals: An overview of drugs and drug targets; Basic terminology in drug discovery, IC50, LogP, LogD, MIC, classification of drugs and diseases, structure, functions and applications of common drugs (one example each): Antibiotics, antibacterials, Antiviral drugs, Analgesics and anti inflammatory drugs, non-steroid anti-inflammatory drugs(NSAIDS), ATPase inhibitors and cardiovascular drugs. Forensic chemistry: Introduction, Colour & Spot test, microcrystal tests, inorganic and organic analysis. Analysis of Beverages	**24**	**5, 6**

Polymers: Synthesis, Properties and aapplications of various commodity polymers: Thermoplastics, Resins, elastomers, fibres, silicone polymers; Specialty polymers – Engineering plastics, biomedical polymers; Natural and Synthetic rubbers, vulcanization; Synthetic Fibers: preparation, properties, Rayon, Nylons, Orlon, Teflon.		

Mode of Transaction	Direct Instruction: Lecture, Explicit Teaching, E-learning Interactive Instruction: Active co-operative learning, Seminar, Group Assignments, Peer teaching and learning, Technology-enabled learning, Library work
Mode of Assessment	1. Continuous Internal Assessment (CIA) Internal Test Assignment – Every student needs to write an assignment on a given topic based on the available published literature 2. Seminar Presentation – A topic needs to be presented and discussed with the class 3. Semester End Examination

Learning Resources

1. Lehninger's Principles of Biochemistry, Cox and Nelson, Fifth Edition (Reference).
2. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
3. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. An Introduction to Medicinal Chemistry, Graham L. Patrick; Second Edition.
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Relevance of Learning the Course/ Employability of the Course
Job prospects in Several industrial sector discussed above.