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PREFACE

Chemistry is a wide-ranging science concerned with matter at the atomic and molecular scale. Important facets are synthesis, structure, microscopic mechanisms, properties, analysis and transformations of all types of materials. Chemists are a constant source of innovation: it is hard to imagine any product introduced in recent times that did not require the creative efforts of a chemist. Chemistry underpins the conceptual framework and methodology of biochemistry and molecular medicine and is at the heart of many major industries.

In Accordance with the implementation of NEP 2020, Government of Kerala and parent University decided to introduce FYUGP in all colleges from the academic year 2024-25 onwards. Taking into account of the recent developments and trends in the educational scenario, the Department of Chemistry, M A College prepared a curriculum based on the objectives of NEP and sustainable development.

Mar Athanasius College, Kothamangalam, in its pursuit of academic excellence was accorded Autonomous status in March 2016. In order to cope with the internationally followed curricula and mode of evaluation, the department was directed to revise the curriculum and syllabi of postgraduate course. The guidelines are provided by the college.

This curriculum is prepared to give sound knowledge and understanding of chemistry to undergraduate students. Salient features of the present syllabus are

1) It provides logical sequencing of the units of the subject matter with proper placement of concepts with their linkages for better understanding.

2) Emphasis has been on promoting processing skills, problem solving abilities, training in laboratory skills and instrumentation, nurturing curiosity and applications of concepts of chemistry useful in real life situations, making learning of chemistry more relevant and interesting.

3) Inculcate the value of honesty, integrity, co-operation, concern for life and preservation of the environment.

4) Equip the students to face challenges related to health, nutrition, environment, population, weather, industries and agriculture.

This syllabi is prepared in a participatory manner, after discussions with a number of teachers in the subject and experts from industries and also comparing with the syllabi of other

Universities and autonomous colleges. The draft syllabus prepared by the members of the faculty was discussed in detail in meeting of Board of the Studies held on 07-05-2024. Appreciable updating has done in keeping with current developments and trends in Chemistry.

I would like to express my sincere gratitude to all the members of the Board of Studies, especially, Dr. S.Sugunan, Emeritus Professor (Retired),Dr. G Anilkumar, Professor, School of Chemical Sciences, MG University Dr. Mereena B A, Sr. Vice President, Product Development, Arjuna Natural Pvt. Dr, Abraham Joseph, Professor, University of Calicut, Thenjipalam, Dr. Ignatious Abraham, SH College, Thevara (Special Invitee) or their whole hearted time bound help, cooperation and encouragement. I also thank Dr. Jyothi P R, Assistant professor in Chemistry, M.A College Kothamangalam for coordinating and editing the Under Graduate syllabus in Chemistry.

Chairperson and Members
Board of Studies of Chemistry (UG)
Mar Athanasius College (Autonomous),
Kothamangalam

MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM
Members of the Board of Studies – B Sc (Honours) Programme
Subject : CHEMISTRY

Chairperson	Dr. Annu Anna Varghese, Associate Professor & Head, Department of Chemistry, Mar Athanasius College, Kothamangalam
Experts (2) (Outside University)	Dr. S Sugunan, Emeritus Professor (Retd.), Cochin University of Science and Technology, Kochi 22 E mail: ssg@cusat.ac.in
	Dr. Abraham Joseph, Professor, University of Calicut, Thenhipalam P O E mail: drabrahamj@gmail.com
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Member from Industry	Dr. Merina B.A Sr. Vice-President Product Development Arjuna Natural Pvt. Ltd, Aluva Kerala India 683101 Email: merina@arjunanatural.com
Meritorious Alumnus	Dr. M.M Joseph, Retd. Principal, Mar Baselios College, Adimali Email: joseph.m.markose@gmail.com
Other Members of the Department	Dr. Manju Kurian, Professor and Principal, Department of Chemistry, Mar Athanasius College, Kothamangalam

	Dr. Binu Varghese, Associate Professor, Department of Chemistry, Mar Athanasius College, Kothamangalam
	Dr. Marymol Moothedan, Assistant Professor, Department of Chemistry, Mar Athanasius College, Kothamangalam
	Dr. Meegle. S Mathew Assistant Professor, Department of Chemistry, Mar Athanasius College, Kothamangalam
Special Invitees	Dr. Jyothi. P.R. Assistant Professor, Department of Chemistry, Mar Athanasius College, Kothamangalam
	Dr. Sherin Philip Assistant Professor, Department of Chemistry, Mar Athanasius College, Kothamangalam

Programme Outcomes (PO)

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 and Entrepreneurship 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. After inculcating all the necessary graduate qualities, a graduate can become an entrepreneur.

PO 6: Social Consciousness and Responsibility

Ability to contemplate 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 behaviour.

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.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO No.	Upon completion of BSc Chemistry programme, the students will be able to:	PO No.
PSO-1	Acquire a comprehensive knowledge, understanding of the major areas of inorganic, organic, theoretical, and physical chemistry including a wide range of other disciplinary subjects such as analytical, bio- and industrial chemistry with specialisation in materials science and natural products chemistry.	1,2,7,10
PSO-2	Interpret chemical information verbally, mathematically and graphically.	2,7
PSO-3	Develop a sense of inquiry and problem-solving ability to pursue higher studies and research and succeed in competitive examinations.	1,2,10
PSO-4	Achieve laboratory skills needed to design safe, eco-friendly and novel chemical experiments to succeed in graduate and professional school, chemical industry and research, chemical simulations and data analysis.	1,2,5,7,10
PSO-5	Illustrate environmental issues and human rights for generating a novel society.	6,7,8,10
PSO-6	Demonstrate writing, speaking, reading and listening competence in different languages.	4

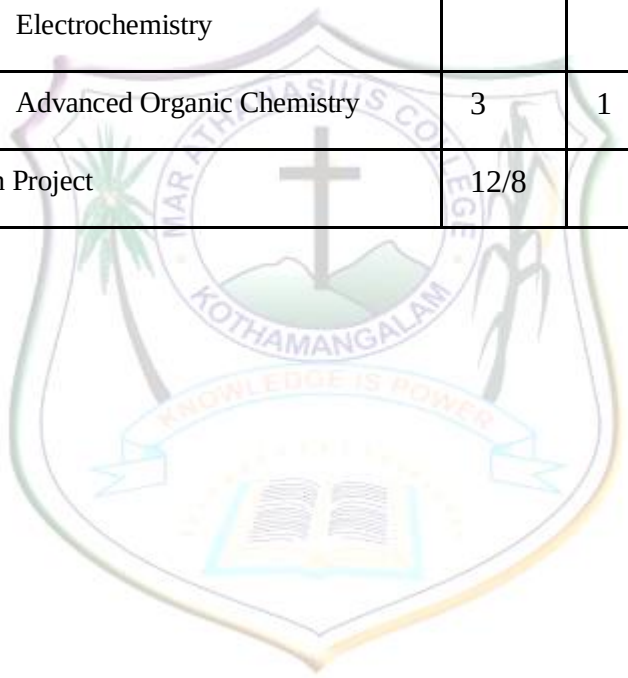
B.SC. (HONOURS) CHEMISTRY

SCHEME OF INSTRUCTIONAL CREDITS AND HOURS

Semester	Type of Course	Course Title		Credits		Hours per week	Total Hours/ Semester
				Theory	Practical		
1	DSC	Fundamentals of Chemistry-1		3	1	5	90
	MDC	Environmental chemistry		2	1	4	72
2	DSC	Fundamentals of Chemistry-2		3	1	5	90
	MDC	Chemistry in Everyday life		2	1	4	60
3	DSC	Inorganic Chemistry -1		3	1	5	90
	DSC	Organic Chemistry -1		4	-	4	72
	DSE	Chemistry of natural products	Any One	3	1	5	90
	DSE	Food Chemistry		3	1	5	90
	MDC	Food Chemistry and Nutrition		2	1	4	72
	VAC	Forensic Chemistry		3	-	3	54
	DSC (B)	Chemistry Minor -1: Inorganic and Organic Chemistry ((For students who have opted Life Sciences, and Family & Community Science as core)		3	1	5	90
4	DSC	Organic Chemistry -2		3	1	5	90
	DSC	Physical Chemistry -1		3	1	5	90
	DSE	Chemistry of materials	Any Two	4	-	4	72
	DSE	Medicinal Chemistry		4	-	4	72
	SEC	Chemistry in daily life		3	-	3	54
	VAC	Environmental Chemistry		3	-	3	54
	DSC (C)	Chemistry Minor -2: Physical Chemistry (For students who have opted Physical Sciences and Geology as Main)		3	1	5	90
Internship				**2**			
	DSC	Physical Chemistry 2		3	1	5	90

	DSC	Organic chemistry 3		4	-	4	72
	DSC	Environmental chemistry and Human rights		4	-	4	72
	DSE	Fats, Oils and Waxes	Any two	4	-	4	72
	DSE	Instrumental methods and spectroscopy		4	-	4	72
	DSE	Polymer chemistry		4	-	4	72
	DSE	Industrial Chemistry		4	-	4	72
	SEC	Analytical Chemistry and Professional skills		3	-	3	54
6	DSC	Inorganic Chemistry -2		3	1	5	90
	DSC	Physical Chemistry -3		3	1	5	90
	DSE	Chemistry of Aromatics and Essential oils		4	-	4	72
	DSE	Nanoscience and Nanotechnology		4	-	4	72
	DSE	Nanotechnology for energy Applications		4	-	4	72
	DSE	Biochemistry		4	-	4	72
	SEC	Diary Chemistry		3	-	3	54
	VAC	Research Methodology for Chemistry		3	-	3	54
7	DCC	Coordination and Organometallic Chemistry 1		4	-	4	72
	DCC	Organic Chemistry -4		4	-	4	72
	DCC	Physical Chemistry-4		4	-	4	72
	DCE	Molecular Spectroscopy in Structural Analysis		4	-	4	72
	DCE	Organic Chemistry-5		4	-	4	72
	DCE	Quantum mechanics and Group		4	-	4	72

		theory				
8	DCC	Coordination and Organometallics Chemistry II	3	1	5	90
	DCC	Instrumental Methods of Chemical Analysis	3	1	5	90
	DCE	Computational chemistry and Molecular Modelling	3	1	5	90
	DCE	Crystallography and Electrochemistry	3	1	5	90
	DCE	Advanced Organic Chemistry	3	1	5	90
	Research Project		12/8			



Syllabus Index: Chemistry Major

Specialization1- Natural Products Chemistry
Specialisation 2- Materials Chemistry

Semester 1

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24CH1DSC100	Fundamentals of Chemistry-1	DSC	4	5	3	0	2	0
M24CH1MDC100	Environmental chemistry	MDC	3	4	2	0	2	0

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

Semester: 2

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24CH2DSC100	Fundamentals of Chemistry-2	DSC	4	5	3	0	2	0
M24CH2MDC100	Chemistry in Everyday life	MDC	3	4	2	0	2	0

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

Semester: 3

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O

M24CH3DSC200	Inorganic Chemistry -1		DSC	4	5	3	0	2	0
M24CH3DSC201	Organic Chemistry -1		DSC	4	4	4	0	0	0
M24CH3DSE200	Chemistry of natural products (S1)	Any One	DSE	4	5	3	0	2	0
M24CH3DSE201	Food Chemistry		DSE						
M24CH3MDC200	Food Chemistry and Nutrition		MDC	3	3	3	0	0	0
M24CH3VAC200	Forensic Chemistry		VAC	3	3	3	0	0	0
M24CH3DSC202	Inorganic and Organic Chemistry		DSC B	4	5	3	0	2	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others, S1- Specialisation 1

Semester: 4

Course Code	Title of the Course		Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
M24CH4DSC200	Organic Chemistry -2		DSC	4	5	3	0	2	0
M24CH4DSC201	Physical Chemistry -1		DSC	4	5	3	0	2	0
M24CH4DSE200	Chemistry of materials (S2)	Any One	DSE	4	4	4	0	0	0
M24CH4DSE201	Medicinal chemistry		DSE						
M24CH4SEC200	Chemistry in daily life		SEC	3	3	3	0	0	0
M24CH4VAC200	Environmental Chemistry		VAC	3	3	3	0	0	0
M24CH4DSC202	Physical Chemistry		DSC C	4	5	3	0	2	0
M24CH4INT200	Internship			2					

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others, S2- Specialisation 2

Semester: 5

Course Code	Title of the Course		Type of the Course	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
M24CH5DSC300	Physical Chemistry 2		DSC	4	5	3	0	2	0
M24CH5DSC301	Organic chemistry 3		DSC	4	5	3	0	2	0
M24CH5DSC302	Environmental Chemistry and Human Rights		DSC	4	4	4	0	0	0
M24CH5DSE300	Fats, Oils and Waxes (S1)	Any Two	DSE	4	4	4	0	0	0
M24CH5DSE301	Instrumental methods and spectroscopy(S2)								
M24CH5DSE302	Polymer chemistry		DSE	4	4	4	0	0	0
M24CH5DSE303	Industrial Inorganic Chemistry and Nuclear Chemistry		DSE						
M24CH5SEC300	Analytical Chemistry and Professional Skills		SEC	3	4	2	0	2	0

L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others, S1- Specialisation 1, S2- Specialisation 2

Semester: 6

Course Code	Title of the Course	Type of the Course .	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O

M24CH6DSC300	Inorganic Chemistry -2		DSC	4	5	3	0	2	0
M24CH6DSC301	Physical Chemistry -3		DSC	4	5	3	0	2	0
M24CH6DSE300	Chemistry of Aromatics and Essential oils (S1)	Any Two	DSE	4	4	4	0	0	0
M24CH6DSE301	Nanoscience and Nanotechnology (S2)								
M24CH6DSE302	Nanotechnology for energy Applications		DSE	4	4	4	0	0	0
M24CH6DSE303	Biochemistry								
M24CH6SEC300	Diary Chemistry		SEC	3	3	3	0	0	0
M24CH6VAC300	Research Methodology for Chemistry		VAC	3	3	3	0	0	0

,
L — Lecture, T — Tutorial, P — Practical/Practicum, O — Others, S1- Specialisation 1, S2- Specialisation 2

Semester: 7

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O

M24CH7DCC400	Coordination and Organometallic Chemistry 1	DCC	4	5	4	0	0	0
M24CH7DCC401	Organic Chemistry-4	DCC	4	4	4	0	0	0
M24CH7DCC402	Physical Chemistry-4	DCC	4	4	4	0	0	0
M24CH7DCE400	Molecular Spectroscopy in Structural Analysis	DCE	4	4	4	0	0	0
M24CH7DCE401	Organic Chemistry-5	DCE	4	4	4	0	0	0
M24CH7DCE402	Quantum mechanics and Group theory	DCE	4	4	4	0	0	0

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

Semester: 8

Course Code	Title of the Course	Type of the Course	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
M24CH8DCC400	Coordination and Organometallics Chemistry II	DCC	4	5	3	0	2	0
M24CH8DCC401	Instrumental Methods of Chemical Analysis	DCC	4	5	3	0	2	0
M24CH8DCE400	Computational chemistry and Molecular Modelling	DCE	4	5	3	0	2	0
M24CH8DCE401	Crystallography and Electrochemistry	DCE	4	5	3	0	2	0
M24CH8DCE402	Advanced Organic Chemistry	DCE	4	5	3	0	2	0
M24PH8PRJ400	Project* (UG Degree-Honours)		8	2DCC+ 1 DSC/DCE + Project OR 2 DCE				
M24PH8PRJ401	Project*(UG Degree - Honours with Research)		12	2 DCC + Project				

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

Courses with Industrial visit/Institutional Visit

Semester	Type	Course Title	Activity

	of Course		
2	MDC	Chemistry in Everyday life	Industry visit
3	DSE	Chemistry of natural products	Industry visit
3	DSE	Food Chemistry	Industry visit
4	DSE	Chemistry of materials	Institutional Visit
4	SEC	Chemistry in daily life	Industry visit
4	VAC	Environmental Chemistry	Institutional Visit
5	DSE	Fats, Oils and Waxes	Industry visit
5	DSE	Instrumental methods and spectroscopy	Institutional Visit
6	DSE	Chemistry of Aromatics and Essential oils	Industry visit
6	DSE	Analytical Chemistry and Professional skills	Institutional Visit
6	DSE	Nanoscience and Nanotechnology	Institutional Visit
6	SEC	Analytical Chemistry and Professional skills	Institutional Visit
7	DCE	Molecular Spectroscopy in Structural Analysis	Institutional Visit
8	DCC	Instrumental Methods of Chemical Analysis	Institutional Visit
8	DCE	Computational chemistry and Molecular Modelling	Institutional Visit

Sl. No.	Semester	Course Type	Course Title

COURSES WITH PRACTICALS AND RECORDS

1	1	DSC	Fundamentals of Chemistry 1
2	1	MDC	Environmental Chemistry
3	2	DSC	Fundamentals of Chemistry 2
4	2	MDC	Chemistry in Everyday Life
5	3	DSC	Inorganic Chemistry -1
6	3	DSE	Chemistry of natural products
7	3	DSC B	Inorganic and Organic Chemistry
8	4	DSC	Organic Chemistry -2
9	4	DSC	Physical Chemistry -1
10	4	DSC C	Physical Chemistry
11	5	DSC	Physical Chemistry 2
12	5	DSC	Organic chemistry 3
13	5	SEC	Analytical Chemistry and Professional skills
14	6	DSC	Inorganic Chemistry -2
15	6	DSC	Physical Chemistry -3
16	8	DCC	Coordination and Organometallics Chemistry II
17	8	DCC	Instrumental Methods of Chemical Analysis
18	8	DCE	Computational chemistry and Molecular Modelling
19	8	DCE	Crystallography and Electrochemistry
20	8	DCE	Advanced Organic Chemistry

SEMESTER 1

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme /Discipline	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Fundamentals of Chemistry-1**					
Type of Course	**Foundation Course (DSC)**					
Course Code	M24CH1DSC100					
Course Level	**100-199**					
Course Summary	The fundamentals of chemistry-1 course covers the basic principles and concepts of atoms, elements, compounds, and fundamental concepts of analytical chemistry. Students explore atomic structure and the periodic table to understand the foundation of chemical interactions. Fundamental concepts of Analytical Chemistry introduces techniques and principles essential for chemical analysis, including titration techniques.					
Semester	1	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Atomic models (J.J. Thomson model and Rutherford model)					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply atomic models to forecast and explain electronic configurations, atomic behaviour, and characteristics.	A	1,2
2	Describe the fundamental concepts in analytical chemistry.	U	1,2,3
3	Apply principles of analytical chemistry to solve quantitative titrimetric problems.	A	1,2,4
4	Analyse periodic trends, the relationship between electronic configuration and the chemical reactivity of elements, including the formation of chemical bonds.	An	1,2,4
5	Detect metals in flame and spot tests, chloride in water, and lead in food samples; quantify oxidants and reductants through titration.	A, S	1,2,4

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. **Atomic Structure**				
	1.1	Introduction to Bohr atom model, Atomic spectrum of hydrogen and hydrogen like atoms, Explanation using Bohr atom model, limitations of Bohr atom model	4	1
	1.2	Dual nature of matter, de Broglie equation, Heisenberg's Uncertainty Principle and its significance.	2	1
	1.3	Concept of orbit and orbital. Shapes of s, p and d orbitals.	2	1
	1.4	Quantum numbers and their significance	2	1
	1.5	Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle.	2	1
	1.6	Electronic configuration of atoms (Up to atomic number 30). Stability of half-filled and fully filled electronic configurations.	3	1
2. **Fundamental Concepts of Analytical Chemistry**				
	2.1	Methods of expressing concentration- normality, molality, molarity, mole fraction, weight percentage, ppm and ppb	2	2
	2.2	Theory of volumetric analysis- Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point, quantitative dilution - problems	3	2,3

	2.3	Precision and accuracy, ways of expressing precision- types of errors, methods to reduce systematic errors, mean and standard deviation, distribution of random errors, Linear least square method	4	2
	2.4	Acid-base titrations- Strong acid - Strong base, Strong acid - Weak base, Weak acid - Strong base, Weak acid - Weak base -titration curves- Ostwald's theory of acid- base indicators- Double burette method of titration, Introduction of microscale experiments and its advantages	6	2,3
3 **Periodic Table and Periodic Properties**				
	3.1	Modern periodic law – Long form of periodic table. Classification of elements as s,p,d & f block, Classification- Metal, Non-metals & metalloids.	3	4
	3.2	Diagonal relationship and anomalous behaviour of first element in a group	1	4
	3.3	Periodicity in properties: Atomic and ionic radii - ionization enthalpy - electron affinity (electron gain enthalpy) –electronegativity. Electronegativity scales: Pauling and Mullikan scales	6	4
	3.4	Effective nuclear charge – Slater rule and its applications	2	4
	3.5	Valency and oxidation state with examples	1	4
	3.6	Introduction to chemical bonding- Types of bonds, Ionic bond, covalent bond, coordinate bond	2	4
	Foundation Course 1 Practical			

	1. Demonstration of atomic models using softwares (Non-evaluative) 2. Flame tests of Sodium, Potassium, Calcium, Barium and Strontium ions. 3. Spot test of Nickel, Zinc and Copper. 4. Chloride ion detection in well water and tap water. 5. Detection of Lead in food samples. 6. Calibration of apparatus- Standard flask and prepare standard molar solutions of any two primary standards. 7. Acid- base titration- Acidimetry and Alkalimetry: Titration of Strong acid Vs. Strong base, Strong acid Vs. Weak base, Weak acid Vs. Strong base,
5.	**Teacher specific Contents** (To be evaluated internally)
Teaching and Learning Approach	Lecture Sessions, Interactive Sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).

MODE OF ASSESSMENT

A. Continuous Comprehensive Assessment (CCA)	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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6. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
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8. Vogels Textbook of Quantitative Chemical Analysis, 6th Edn. Pearson Education Ltd.
9. F. P. Miller, A. F. Vandome, McB. John, Flame Test, VDM Publishing, 2010.

SUGGESTED READINGS

1. J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry–Principles of Structur and Reactivity, 4th Edition, Pearson Education, New Delhi, 2013.
2. Satya Prakash, Advanced Inorganic Chemistry, Volume 1, 5th Edition, S. Chand and Sons, New Delhi, 2012.

Discipline						
Course Name	**Environmental Chemistry**					
Type of Course	**Multidisciplinary Course (MDC)**					
Course Code	**M24CH1MDC100**					
Course Level	**100-199**					
Course Summary	Environmental Chemistry examines the sources, behaviour, and effects of pollutants in air and water. The course emphasises strategies for monitoring, mitigating, and preventing environmental degradation and emission of greenhouse gases. The practical focus on the different tests for qualitative analysis of water. Overall, the course aims to foster an understanding of the interplay between chemistry and the environment, enabling the development of sustainable solutions for a cleaner world.					
Semester	1	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		1		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand different types air pollutants and effect of air pollutants and methods to monitor and control air pollution	U, K	5
2	Describe sources of water pollution and methods to control it	U, K	1,3
3	Discuss various water quality parameters.	An, S	1, 5
4	Understand and apply Solid waste Management and Significance of 3R - Reduce, Reuse and Recycling	U, K	1,5
5	Skill to test for water quality monitoring	A, U, S	4,5

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.

1. **Air Pollution**	1.1	Primary and secondary pollutants, Effects of atmospheric pollution - acid rain, smog; green-house effect, Greenhouse Gases - global warming - Schemes to reduce greenhouse gases- ozone layer depletion, climate change. Concept of carbon neutrality- Life Cycle Assessment (LCA) and carbon neutrality - Carbon footprint.	8	**1**
	1.2	Air pollutant monitoring methods: Filtration, sedimentation, electrostatic samplers, thermal precipitator. Control measures: Gravitational settling chambers; Fabric filters, cyclone collectors; electrostatic precipitators, zoning; Green Belt.	7	**1**
2. Water Pollution and Solid Waste management	2.1	Sources of water pollution. Pesticide pollution, Thermal pollution, Methods to control water pollution. Drinking water and effluent water quality standards ,water quality parameters: pH, turbidity, TDS,COD, BOD, DO- Basic idea of waste water purification and disinfection	8	**2,3**
	2.2	Solid waste Management; Classification of solid wastes (source and type based), solid waste management (SWM), waste characteristics (physical and chemical), health and environmental effects (public health and environmental) E-waste generation Zero waste concept; Significance of 3R - Reduce, Reuse and Recycling	**7**	**4**
3. Laboratory tests for water quality monitoring	3.1	Determination of pH and conductivity, Test for acidity and alkalinity, Test for total hardness,	15	**5**
	3.2	Test for halides, nitrate, ammonia, heavy metals, trace metals, calcium, iron etc., and total solids. Analysis of Gaseous Compounds	15	**5**

4.		**Teacher Specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in laboratory		

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 15 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 35 marks, Duration 1 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 3 out of 6 x 5 = 15 marks Part C (Long essay) – 1 out of 2 x 10 = 10 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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16. Peter O' Neil, Environmental Chemistry, Blackie Academic and Professional, London.

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SEMESTER 2

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Fundamentals of Chemistry-II**
Type of Course	**Foundation Course(DSC)**
Course Code	M24CH2DSC100
Course Level	100-199
Course Summary	Fundamentals of Chemistry-2 Students explores fundamental concepts in organic chemistry, importance of Organic chemistry in day today life and electron displacements in organic chemistry and the reactive intermediates involved in an organic reaction. It also covers fundamental reactions involving carbon compounds, focusing on key mechanisms and types of reactions like substitution, addition, elimination, and polymerisation. These courses provide a foundational understanding of the physical nature of matter and the concepts involved.

Semester	2	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre requisites, if any	Knowledge about carbon and its compounds					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Describe the relevance of organic chemistry, catenation and hybridization.	A	1
2	Utilize arrow-pushing mechanisms to illustrate and solve simple chemical reactions involving reactive intermediates.	A	1
3	Evaluate electron displacement patterns in organic molecules using arrow notation.	E	1,3
4	Predict and classify various types of organic reactions based on their mechanisms.	U	1,4
5	Describe the fundamental principles governing the behaviour of different states of matter.	U	1,4
6	Compare and contrast the properties of solids, liquids, and gases.	S	1

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Fundamentals of Organic Chemistry (15 Hours)	1.1	Relevance of organic chemistry in day-to-day life (with 2-3 examples). Carbon: catenation and hybridizations (with examples Ethane, ethene, ethyne)	3	1
	1.2	Bond fissions: Homolysis and heterolysis with examples, Arrow notations in organic reaction mechanisms. Polarity of bonds (basic concepts)	2	2
	1.3	Electron displacement effects: Inductive effect: Influence of inductive effect in the acidity of carboxylic acids, Electromeric effect, Resonance effect (delocalization, contributing structures, resonance energy and stability) Hyperconjugation.	6	3
	1.4	Reaction intermediates: Formation, structure and stability of carbocations, carbanions, and free radicals	4	2
2. Introduction to Organic Reactions (15 Hours)	2.1	Representation of organic molecules: Projection formula (Fischer, Sawhorse, Flying wedge, Newman and their interconversions)	4	4
	2.2	Types of reagents: Electrophiles and nucleophiles	3	4
	2.3	Addition reactions: Markovnikov's addition, peroxide effect. Elimination reactions: E1 and E2 mechanism. Substitution reactions (SN1, SN2 reactions of alkyl halides only).	8	4
3.	3.1	Matter and its different states (elementary idea only), Intermolecular Forces: dipole-dipole interaction, Dipole-induced dipole interaction and induced dipole-induced dipole interaction, Ion- dipole interaction, Hydrogen bonding: intra and inter molecular hydrogen bonds- effect on physical properties..	4	3

States of matter (15 Hours)	3.2	Gaseous state: - postulates of Kinetic theory, Ideal and real gas behaviour, compressibility factor deviation from ideal behaviour, van der Waals equation.	4	3
	3.3	Liquid state: Properties of liquids: Vapour pressure, boiling point, Surface tension, Viscosity	3	5,6
	3.4	Solid state: Types of Solids: Crystalline and amorphous solids: Ionic solids: Unit cell, Crystal systems, Bravais lattices.	4	5,6
4. Fundamentals of Chemistry-2 Practical (30 Hrs)	4.1	1. Find the pH of different water sources and any two common acids and bases using pH meter. 2. Estimation of Phosphoric acid in soft drinks. 3. Estimation of citric acid in citrus fruits. 4. Determination of viscosity of liquids using Oswald viscometer. 5. Test for unsaturation,	30	1,4,5
5.	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. J. Mendham, R.C. Denney, J. D. Barnes and M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition, Pearson Education, Noida, 2013.
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9. K. L. Kapoor, "A Textbook of Physical chemistry", Volume 1, Macmillan India Ltd
10. J.B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
11. K.K. Sharma : 'An Introduction of Practical Chemistry': Vikas Publishing House, New Delhi

Course Name	**Chemistry In Everyday Life**					
Type of Course	**MDC**					
Course Code	**M24CH2MDC100**					
Course Level	**100 – 199**					
Course Summary	This course provides a comprehensive understanding of how chemistry permeates various aspects of our daily life.					
Semester	**2**	Credits			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		1		**60**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Explain the uses of fertilizers and pesticides and their impact on environment	A, An	1, 2
2	Differentiate between various types of drugs	U, An	1, 2
3	Differentiate soap types and understand cleansing action	A, An	1, 2
4	Investigate the chemical components in personal care products	U, E	1, 2

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.

1. Chemistry in Agriculture and Medicine **(15 Hours)**	1.1	Fertilizers – Introduction. Types of fertilizers - Natural, Synthetic, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio- fertilizers and Organic Manures. (4) Pesticides - Introduction. Classification (Brief idea only) - Insecticides, Fungicides, Herbicides (Structures not needed). Excessive use of pesticides - Environmental hazards. Bio pesticides. (4)	8	1
	1.2	Classification of drugs - Analgesics, Antipyretics, Antihistamines, Antacids, Antibiotics and Antifertility drugs with examples (Structures not needed). (4) Psychotropic drugs - Tranquilizers, Antidepressants and Stimulants with examples (Structures Not needed). (2) Drug addiction and abuse. Preventionand treatment.(1)	7	2
2. Chemistry in Personal Care Products **(15 Hours)**	2.1	Soaps – Introduction. Types of soaps - Toilet soaps, Washing soaps. Liquid soap. TFM and grades of soaps. Cleansing action. Environmental aspects. (5)	5	3
	2.2	Composition of different types of cosmetics - Tooth paste, Hair dye, Face and skin powders, Lipsticks, Perfumes, Shaving creams (5) Shampoos- Ingredients and functions – Different kinds of shampoos (Antidandruff, anti-lice, herbal and baby shampoos). (3) Harmful effects of cosmetics.(1) Herbal Cosmetics- Definition, Natural Ingredients used- Aloe Vera, Turmeric, Henna, Amla, Neem, Clove (1)	10	4
3. Practicals:		1. Synthesis of Organic manure 2. Preparation of Toilet Soap 3. Evaluate TFM value of Soap	15	1,3
4.	**Teacher specific Content** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions • Visual aids like videos and models to enhance understanding. • Peer discussions.

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 15 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 35 marks, Duration 1 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 3 out of 6 x 5 = 15 marks Part C (Long essay) – 1 out of 2 x 10 = 10 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. T Coultate, Food: The Chemistry of Its Components, 6th Edition, RSC. 2015.
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SEMESTER 3

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Inorganic Chemistry-1**
Type of Course	DSC
Course Code	M24CH3DSC200

Course Level	**200-299**					
Course Summary	This course addresses bonding concepts in molecules, the chemistry of p,d, and f block elements, and discusses the fundamentals of nuclear chemistry and their applications. The practical component includes complex preparation and complexometric titration.					
Semester	3	Credits			5	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply the various bonding concepts to molecules. Learn different theories to explain covalent and ionic bond	A	1.2
2	Understand the structure and properties of important P block elements such as Boron and Si.	An	1.2
3	Compare the physical and chemical properties of transition metals	An	1, 2
4	Compare the physical and chemical properties of lanthanides and actinides	U	1,2
5	Understand the basic concept of Nuclear Chemistry, nuclear reactions, and Applications	An	1,2,5
6	Apply the knowledge for estimation of Zn , Ca,Mg using complexometric titration and complex preparation	A, S	1,2,4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. **Chemical Bonding**	1.1	Brief introduction on types of bonds- Ionic, covalent, coordinate covalent and metallic bonds, intermolecular	2	1

		forces.		
	1.2	Properties of ionic compounds - polarisation of ions – Fajan's rule and its applications. Lattice energy of ionic compounds - solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications	4	1
	1.3	Covalent Bond: Properties of covalent compounds, dipole moment, VSEPR theory: Postulates - applications.Shapes of molecules - BeF_2, BCl_3, CCl_4, NH_3, H_2O, PF_5, SF_4, ClF_3, XeF_2, SF_6, IF_5, XeF_4, IF_7 and XeF_6. Valence Bond Theory and its limitations. Hybridization: Definition, characteristics, and Shape of molecules ($BeCl_2$, BF_3, NH_4^+, H_3O^+, PCl_5, SF_6, XeF_2, XeF_4, and XeF_6).	6	1
	1.5	Molecular Orbital Theory – LCAO - bonding and anti-bonding molecular orbitals – bond order and its significance. MO diagrams of homonuclear and heteronuclear diatomic molecules: N_2, O_2, F_2, CO and NO – comparison of bond length, magnetic behavior and bond energy of O_2, O_2^+, O_2^{2+}, O_2^- and O_2^-.	3	1
2. **Chemistry of p, d and f block elements**	2.1	Anomalous behaviour of Boron Hydrides, Preparation, Structure, preparation and bonding of diborane, Classification of boranes, B_5H_9, B_4H_{10}- Styx numbers. Preparation and uses of borazine - similarities in structure with benzene. Wade's rule (Closo, nido, arachno)	6	2
	2.2	Silicate minerals. Structure of silicates-common silicates, classifications, Framework silicates. Zeolites.	2	2
	2.2	Transition Metals: General characteristics: Metallic character, oxidation states, colour, magnetic properties, catalytic properties, complex formation and alloy formation.	3	3

	2.3	Lanthanides: lanthanide series, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of Ln(III) cations, magnetic properties, colour and electronic spectra of lanthanide compounds,	2	4
	2.5	Chemistry of actinides – actinide series, abundance and natural isotopes, occurrence, preparation of actinides, oxidation states, general properties.	2	4
3. **Nuclear Chemistry**	3.1	Introduction, nuclear size and density, Stability of nucleus: n/p ratio, Nuclear binding energy, packing fraction, Nuclear forces, Composition of nucleus, Isotopes, isobars and isotones with examples.	3	5
	3.2	Radioactivity: Natural and induced. Radioactive decay-α-decay, β-decay, γ-decay; neutron emission, positron emission and electron capture. Units of radioactivity, radiation dose. Group displacement law and radioactive series. Measurement of radioactivity: Geiger counters. Separation of radioactive isotopes.	5	5
	3.3	Nuclear reactions, Bethe's notation, Photonuclear reactions, Nuclear fission-Atom Bomb, Nuclear reactors-Nuclear reactors in India -Nuclear fusion- Stellar energy, Hydrogen Bomb.	4	5
	3.5	Applications of radioisotopes – Carbon dating-Rock dating-Neutron activation analysis, Isotopes as tracers – Radiodiagonosis and radiotherapy. Industrial applications of radioactivity.	3	5
4		**Inorganic Practical-1**		
	4.1	Preparation of simple coordination complexes, such as hexaaquacobalt(II),hexaaquacopper(II), hexaaquanickel(II)	**8**	**6**

		ions and Prussian Blue.		
	4.2	Complexometric Titration Using EDTA Estimation of Ca Estimation of Mg Estimation of Zn Determination of Hardness of water	10	6
	4.3	Permanganometry 1. Standardization of $KMnO_4$ using (i) oxalic acid (ii) Mohr's salt 2. Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard $KMnO_4$.	10	6
5.		**Teacher specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion		

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
2. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
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Reactivity, 4th Edn., Harper Collins College Pub.,1993.
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SUGGESTED READINGS

1. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann,2012. 2. Miessler, G. L. &. Tarr, Donald A. Inorganic Chemistry 3rd Ed.(adapted), Pearson, 2009 3. Catherine E. Housecroft , Alan G. Sharpe C. E. Barnes, Inorganic Chemistry 4th Ed.. Journal of Chemical Education, 2003.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/Disciple	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Organic Chemistry-1**
Type of Course	**DSC**
Course Code	M24CH3DSC201

Course Level	**200-299**					
Course Summary	Organic Chemistry I provide students with an understanding of hydrocarbons, aromaticity, alcohols, and phenols, carbonyl compounds and active methylene compounds. Module 1 discusses the preparation, properties, reactions and industrial uses of Alkanes, Alkenes and Alkynes. In the second module, students delve into the concept of aromaticity through the exploration of resonance, focusing on both benzenoid and non-benzenoid aromatic compounds. The module covers aromatic electrophilic substitution reactions, as well as the orientation and reactivity of aromatic compounds towards electrophilic substitution reactions. Third module explores alcohols (organic compounds containing hydroxyl groups) and phenols (aromatic compounds containing hydroxyl groups). Module 4 focus on the structure, reactivity and synthetic applications of aldehydes, ketones and active methylene compounds					
Semester	3	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		4				60
Pre-requisites, if any	Basic understanding about the classification of organic compounds					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Know the classification, methods of preparation, physical/chemical properties and reactions of alkanes, alkenes, alkynes, alcohols, phenols, carbonyl compounds and active methylene compounds	U, K	1, 2
2	Outline industrial uses of aliphatic compounds	A	1, 3

3	Understand the concept of resonance, aromaticity and reactions/ reaction mechanism of of aromatic compound	U, K	1, 2
4	Gain a deep understanding of the mechanisms underlying key reactions involving carbonyl compounds and active methylene compounds	U, K, S	1, 2,3
4	Predict the important synthetic applications of active methylene compounds	A, C, S, I	1,3
5	Develop proficiency in performing functional group transformations	A, C, S, I	1,3
***Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S),Interest (I) and Appreciation (Ap)**			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Alkane, Alkenes and Alkynes	1.1	Alkanes: Physical properties, industrial use - LPG and petrol, Preparation-Wurtz reaction, Reactions -Free radical substitutions (chlorination) with mechanism, cracking.	5	1,2
	1.2	Alkenes: Physical Properties, industrial uses of ethylene, Preparation and Reactions- hydration, hydrohalogenation, ozonolysis, dihydroxylation using KMnO4, Bromination (with mechanisms)	5	1,2
	1.3	Alkynes: Physical Properties, industrial uses of acetylene, Preparation of acetylenes dehydrohalogenation of vicinal dihalides, Reactions- Acidity of alkynes, formation of metal acetylenes	5	1,2

2. Aromaticity	**2.1**	Resonance: - Concept of resonance, resonance energy and resonance hybrid. Orbital picture and stability of Benzene	2	3
	2.2	Aromaticity:- Concept of aromaticity – Huckel's rule –Definition- Application of Huckel's rule to Benzenoid – (benzene, naphthalene and anthracene) and Non–benzenoid compounds– cyclopropenyl cation, cyclopentadienyl anion, tropylium cation, heterocyclic aromatic compounds (Pyridine, Pyrrole and furan and Indole), annulenes, azulene . Non-aromatic and antiaromatic compounds)	9	3
		Aromatic electrophilic substitution reactions of benzene – General mechanism of electrophilic substitution-halogenation, nitration, sulphonation, Friedel Craft's alkylation and acylation	2	3
		Orientation of aromatic substitution – ortho-para and meta directing groups-Ring activating and deactivating groups with examples	2	3
3. Alcohols and Phenols	3.1	Alcohols-Classification (Monohydric, Dihydric, Polyhydric, primary, secondary, Tertiary), Luca's Test, Preparation, Physical properties–hydrogen bonding- Chemical Properties-Esterification, Reactions with Sodium and $KMnO_4$, Pinacol Pinacolone rearrangement (with mechanism), Ascending and descending in alcohol series.	7	1,5
	3.2	Phenols- Acidity of phenol, Effect of substituent on acidity, Comparison of acidity of phenols with alcohols and carboxylic acid. Hydrogen bonding (inter and intramolecular) in phenols. Effect of H-bonding on boiling point and solubility in water. Chemical	8	1,5

		Reactions of Phenol including Reimer – Tiemann reaction, Lederer- Mannase reaction, Fries Rearrangement. Liebermann's nitroso reaction. Structure and uses of Catechol, Resorcinol, Quinol and Picric acid		
4. **Aldehydes , Ketones and active methylene compounds**	4.1	Structure and reactivity of the carbonyl compound - acidity of alpha hydrogen. Nucleophilic addition reactions of aldehydes and ketones	2	3,5
	4.2	Reaction with HCN, alcohol, water, ammonia and ammonia derivatives (primary amine, secondary amines, hydrazine, phenyl hydrazine, Borsche's reagent, hydroxylamine, semicarbazide), Grignard reagent	5	3,5
		Reaction with Tollen's and Fehling's solution. Chemistry of enolates and enamines- Stork enamine reactions-Wittig, Favorski reaction	3	3
		Compounds containing active methylene groups: - Keto-enol tautomerism, Synthesis and applications of malonic ester and acetoacetic ester, cyano acetic ester	5	3,4
5.		**Teacher Specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in laboratory		

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India. (Chapter-18)
2. I. L. Finar, Organic Chemistry 6 th Edition, Vol.- I, Pearson. ((Chapters-8,27) 25
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4. K.S Tewari and NK Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House (Chapter-19)
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Chemistry of Natural Products**					
Type of Course	**DSE**					
Course Code	M24CH3DSE200					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the properties of various natural products, phytochemicals, and nutraceuticals.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Give an idea about the fundamentals of terpenoids, steroids, vitamins, lipids, andalkaloids.	U	1
2	Illustrate Nutraceuticals' classification, scope, future prospects, sources and properties.	A	1
3	Discuss the role of Nutraceuticals in managing health and diseases and quality control and assurance.	E	1
4	Investigate Nutraceuticals as bridging the gap between food and drug.	Ap	1,4
5	Acquire skills for extracting and isolating plant pigments and terpenoids from plant products.	S, An	1,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1 Natural products (15 hours)	1.1	Terpenoids: Essential oils - isoprene rule. Elementary study of citral, geraniol and natural rubber. Alkaloids- Isolation, general properties. Structure of coniine Lipids: Simple lipids and compound lipids- isolation-properties.	8	1
	1.2	Vitamins - Structure and biological activity ofvitamins A, B and C. Steroids- general introduction, HDL and LDL, cholesterol and bile acids.	7	1
2. Nutraceuticals and Functional foods (15 hours)	2.1	Nutraceuticals: Classification, scope & future prospects. Sources of Nutraceuticals. Properties, structure and functions of Glucosamine, Lycopene, Carnitine, Melatonin and Ornithin. Use of proanthocyanidins, grape products, and flaxseed oil as Nutraceuticals.	7	2
	2.2	Food as remedies: Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. A brief idea about some Nutraceutical supplements like Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Spirulina, etc.	8	4
3. Nutraceuticals and the Future of Medical Science: Quality Control & Assurance (15 hours)	3.1	The increasing role of Nutraceuticals in managing health and diseases, the development of designer foods for specific chronic diseases like diabetes, cardiovascular diseases, AIDS, and degenerative diseases like Parkinson's, functional foods for specific sports, oligosaccharides, and dietary fibres of microbial and plant origin as Nutraceuticals of the future.	8	3
	3.2	Quality Control and Assurance: QC concepts in Nutraceuticals and food products, Label claims and their support. Requirements for implementing quality assurance in Nutraceuticals and food products.	7	3

4. Practicals **(30 hours)**	4.1	1. TLC separation of Plant pigments - Curcumin and carotene. 2. Isolation of lycopene from tomato. 3. Isolation of citral from lemongrass oil. 4. Isolation of eugenol from clove oil.	15	5
	4.2	1. Isolation of total catechins and caffeine from black tea and green tea. 2. Isolation of polyphenols from moringa leaves and tamarind seed. 3. Assessment of purity and quality using appropriate standard tests for milk and butter.	15	5
5	**Teacher Specific contents** This content will be evaluated internally.			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture Discussion Presentation			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. Handbook of Nutraceuticals and Functional Foods Edited by Robert E.C. Wildman, Routledge Publishers.
2. Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press.
3. Methods of Analysis for Functional Foods and Nutraceuticals Edited by W. Jeffrey, Hursts, Routledge Publishers.
4. Food is Medicine by P.J Cousion; Duncan Baired Publishers, London.
5. Dietary Supplements of Plant Origin, M. Maffei (Ed.), Taylor & Francis, 2003.
6. Nutraceutical beverages Chemistry, Nutrition and Health Effects, Shahidi and Weerasinghe (Ed.), American Chemical Society, 2004.
7. T.P. Coultate, Food- The Chemistry of its components. Royal Society of Chemistry, London.
8. I.L. Finar, *Organic Chemistry* Vol. 1 & 2, 6th edn., Pearson, 2002.
9. Puri and Sharma. Advanced Organic Chemistry.
10. R. T. Morrison, R. N. Boyd, Organic Chemistry, 7th Edn., Pearson Education, New Delhi, 2013.
11. I.L. Finar, Organic Chemistry, Vol. I, 5th Edn., Pearson Education, New Delhi, 2013.
12. M. K.Jain, S. C. Sharma, Modern Organic Chemistry, 3rd Edn., Vishal Publishing Company Co., 2010.
13. Swaminathan M., Food Science and Experimental Foods, Ganesh and Company.
14. Handbook of Analytical Techniques Vol. I, Gunzler and Williams, Wiley-VCH, 2002.
15. Instrumental analysis, Skoog, Holler, CrouchBrooks/Cole, 2007.
16. Bioanalysis Principles & Practices -Richard F Venn.
17. Chromatography: Liquid Chromatography, Mass Spectrometry, W M A Niesson, 2nd and 3rd Ed.
18. Chromatography: Gas Chromatography (Basic)-Harhold M Mcnair, James M Miller.

Programme	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Food Chemistry**					
Type of Course	DSE					
Course Code	M24CH3DSE201					
Course Level	**200-299**					
Course Summary	This course covers the scientific principles behind the composition, structure, properties, and reactions of food components. It also deals with topics related to the various substances added to foods to preserve flavour, enhance taste, improve texture, and prolong shelf life.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Analyse the chemical composition of various food components, such as proteins, carbohydrates, lipids, vitamins, and minerals.	An	1,2,3
2	Apply principles of food chemistry to understand and predict the behaviour of food during processing, storage, and cooking.	A	1,2,3
3	Explain the relationship between chemical reactions, food additives, and food preservation methods.	U	1,2,3
4	Educate and enlighten the public with respect to food and dietary practices.	A	4,5
5	Apply the principles of food chemistry to conduct simple laboratory experiments.	A	4,

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

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1. Food Additives	1.1	Food additives – definition. Preservatives- Natural food preservatives, Traditional food preservation methods, Artificial preservative agents, Modern food preservation techniques, Safety concerns of food preservatives.	3	2,3
	1.2	Food Colours- Classification, Chemistry of food colourants, non-permitted food colours, Quality assurance of food colourants.	2	2,3
	1.3	Fragrances, Flavouring Agents and Enhancers- Classification, chemistry, Quality control of flavour compounds.	2	2,3
	1.4	Emulsifiers- Mechanism. Role, Types with examples.	1	2,3
	1.5	Stabilisers, Gums, Thickeners and Gelling Agents	1	2,3
	1.6	Antioxidants and Radical Scavengers- Chemistry of free radicals and antioxidants, Types of antioxidants, Safety concerns of antioxidants.	2	2,3
	1.7	Food Acids and Acidity Regulators, Flour Treatment/Improving Agents, Leavening agents, Anticaking Agents, Minerals and Mineral Salts, Dietary Supplements- Vitamins	3	2,3
	1.8	FSSAI, Food Safety and Standards Act	1	2,3
2. **Role of Water, Carbohydrates, Lipids and Proteins in Food**				
	2.1	Structure and chemical properties of water, Solute effects on water: state of water in foods, Water activity: principles, measurement, control, effects, related concepts.	4	1
	2.2	Carbohydrates- Basic chemistry, reactivity and sweetness of simple sugars and oligosaccharides, Sugar derivatives: sugar alcohols, glycosides, etc. Browning and related reactions. Polysaccharides- starches, celluloses, gums.	4	1,2
	2.3	Lipids- Content and role in foods, Chemical, nutritional and physical properties, Processing of fats and oils, Degradation reactions.	3	1,2

	2.4	Proteins- Amino Acids and proteins, Physical properties of proteins, Basic properties: hydration, ionization, colloidal behaviour, Functional properties, Effects of food processing: changes occurring in chemical, functional & nutritional properties of proteins	4	1,2
3. **Enzymes, Vitamins and Minerals**				
	3.1	Enzymes- Catalysis by enzymes, Oxidoreductases, Glucose Oxidase, Hydrolases, Peptidases, Food Enzymes.	3	1,2
	3.2	Vitamins- Fat-Soluble Vitamins, Water-Soluble Vitamins, Toxicity of Vitamins, Sources of Vitamins, General Causes of Variation/Losses of Vitamins in Food, Biological function of vitamins.	5	1,2
	3.3	Minerals- Nutritional Aspects of Minerals, Essential Mineral Elements, Bioavailability, Effect of Processing on Mineral Bioavailability, Chemical and Functional Properties of Minerals in Foods.	5	1,2
	3.4	Societal Role of Food Chemists	2	4
4. **Practicals**	1. Threshold concentrations of primary tastes. 2. Use refractometer to determine the soluble solid content of sucrose solutions of different compositions. 3. Determine the elevation of boiling point by adding NaCl to water. 4. Compare the effectiveness of various emulsifying agents.		30	5
	5. Test the solubility of vegetable oils in different solvents and determination of specific gravity of oils. 6. Fehling's test for reducing sugars. 7. Influence of added ingredients on gluten development. 8. Determination of the moisture content of corn syrup and milk (liquid) using a microwave drying oven. 9. Determination of the ash content of a variety of food products by the dry ashing technique. 10. Determination the total carbohydrate content of soft drinks. 11. Determination of the vitamin C content of various orange juice products using 2,6-dichloroindophenol titration method. 12. Determination of the saponification value of oils. 13. Separation and identification of lipids in some common foods using thin-layer			

	chromatography (TLC). **(Conduct and record any six experiments)**		
5	**Teacher Specific contents** (This content will be evaluated internally.)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture-Based Approach, Interactive Discussions, Laboratory Sessions, Flipped Classroom, and Peer Teaching and Collaborative Learning.

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. S Damodaran, K L Parkin, Fennema's Food Chemistry, 5th Edition, CRC Press 2017.
2. H D Belitz, W Grosch, P. Schieberle, Food Chemistry, 4th Edition, Springer, 2009.
3. T Coultate, Food: The Chemistry of Its Components, 6th Edition, RSC. 2015.
4. T A M Msagati, Chemistry of Food Additives and Preservatives, John Wiley & Sons, 2013.
5. V Kontogiorgos, Introduction to Food Chemistry, Springer, 2021.
6. N Agarwal and A Srivastava, Food Chemistry, Anu Books, 2023.
7. C M Weaver, J R Daniel, The Food chemistry Laboratory, CRC Press, 2005.
8. S S Nielsen, Food Analysis Laboratory Manual, Third Edition, Springer, 2019.
9. D D Miller, C K Yeung, Food Chemistry A Laboratory Manual, Wiley, 2022.
10. A V. Ramani, Food Chemistry, Mjp Publishers. 2011.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Food Chemistry and Nutrition**
Type of Course	MDC
Course Code	M24CH3MDC200
Course Level	**200-299**
Course Summary	This course provides a comprehensive understanding of the composition and health implications of various food items.

Semester	3	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		0		45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the concept of Nutrition	U	1
2	Demonstrate a sound knowledge of various food additives	An	1
3	Describe the health effects of Food Adulterants	E	1,4
4	Evaluate different adulterants in food	E	1,3,4
5	Apply the concept of food chemistry to conduct simple laboratory experiments.	A	1,4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. **Introduction to Nutrition and Food Additives (15 hours)**	1.1	Functions of Food, Nutrients in food- Energy yielding nutrients (Carbohydrates, Proteins and Lipids) and Protective nutrients (Vitamins and Minerals)	3	1
	1.2	Food Additives- Definition, importance of food additives, Types of Additives -Natural, Synthetic and Artificial- with one example. E- Number	4	2
	1.3	Preservatives, Food colours, Flavour enhancer, Sweetners, Emulsifier, Stabilizer, Glazing Agents, Thickeners, Gelling agents. (Definition, Aim with examples)	8	2
2. **Food Adulteration and Safety (15 hours)**	2.1	Definition, Types (Intentional, Incidental and metallic contamination) and Health effects.	3	3
	2.2	Common Adulterants in different foods, their Health Effects and Detection: Milk, Ghee, Butter, Honey, Sweets, Chilli powder, Turmeric, Tea, Sugar and Salt, black pepper, Wheat and rice.	7	3
	2.3	Food Adulteration Act- Objectives	1	4
	2.4	Modern food habits- An introduction, Health effects of fast food, Junk food and instant food. Composition and health effects of Carbonated water and soft drinks. A comparative study of Traditional food habit and modern food habits	4	
3. Activity		1. Detection of adulterants in various food items 2. Demonstration of preparation of various value added food products- Jam, Squash. 3. To find out the moisture content from a given food sample by Lab oven method 4. Determination of threshold concentrations of primary tastes. 5. Test the solubility of vegetable oils in different solvents and determination of specific gravity of oils.	15	4,5
4.	**Teacher specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture Sessions, Interactive Sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. Swaminathan M., Food Science and Experimental foods, Ganesh and Company, 2005.
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers, 2010.
3. Thankamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences, Macmillan, 2015 .
4. B. Sreelakshmi, Food Science, New Age, 2018.
5. S Roday, Food Science And Nutrition, 3rd Edition, Oxford University Press, 2018.
6. C M Weaver, J R Daniel, The Food chemistry Laboratory, CRC Press, 2005.
7. I Bevier, Food and Nutrition Laboratory Manual, Forgotten Books, 2018.
8. S Sehgal, A Laboratory Manual of Food Analysis, International Publishing, 2016

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Forensic Chemistry**
Type of Course	**VAC**
Course Code	M24CH3VAC200
Course Level	**200 – 299**
Course Summary	This course aims to provide a comprehensive understanding of the basic principles of chemistry as they apply to forensic science. It focuses on enabling non-chemists to comprehend and utilize chemical concepts in forensic analysis.

Semester	**3**	Credits			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				**45**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Recognize various types of chemical substances, their properties, and their relevance in forensic contexts	U	1
2	Utilize fundamental chemical principles to understand forensic analysis techniques	A	1, 2
3	Evaluate and interpret chemical evidence commonly encountered in forensic investigations	An, E	1, 2
4	Articulate the role of chemistry in forensic science, including its impact on legal proceedings and criminal investigations	U, A	1, 2
5	Extract meaningful conclusions from chemical data obtained during forensic analysis	U, C	1, 2

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Poisons (15 Hours)	1.1	Poisons-types and classification- diagnosis of poisons in the living and the dead – clinical symptoms - post-mortem appearances.	4	1,2,3,4,5
	1.2	Heavy metal contamination (Hg, Pb, Cd) of sea foods.	3	1,2,3,4,5
	1.3	Use of neutron activation analysis in detecting Arsenic in human hair	2	1,2,3,4,5
	1.4	Treatment in cases of poisoning - use of antidotes for common poisons.	3	1,2,3,4,5
	1.5	Analysis of biological substances - blood, saliva, urine and hair	3	1,2,3,4,5
2. Crime Detection (15 Hours)	2.1	Accidental explosion during manufacture of matches and fireworks.	2	1,2,3,4,5
	2.2	Human bombs- possible explosives (gelatine sticks and RDX)	3	1,2,3,4,5
	2.3	Metal detector devices and other security measures for VVIP	2	1,2,3,4,5
	2.4	Composition of bullets and detecting powder burn	2	1,2,3,4,5
	2.5	Analysis of incendiary and timed bombs - spill of toxic and corrosive chemicals from tankers.	3	1,2,3,4,5
	2.6	DNA Finger printing for tissue identification in dismembered bodies -Detecting steroid consumption in athletes and race horses	3	1,2,3,4,5
3. Forgery and Counterfeiting (15 Hours)	3.1	Documents - different types of forged signatures-simulated and traced forgeries – inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays - comparison of type written letters	5	1,2,3,4,5
	3.2	Checking silver line water mark in currency notes, alloy analysis using AAS to detect counterfeit coins	4	1,2,3,4,5
	3.3	Detection of gold purity in 22 carat ornaments -	3	1,2,3,4,5

		detecting gold plated jewels - authenticity of diamond.		
	3.4	Tracks and traces - small tracks and police dogs-foot prints- walking pattern or tyre marks. Glass fracture – tool mark paints – fibres.	3	1,2,3,4,5
4.	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions • Visual aids like videos and models to enhance understanding. • Peer discussions.			

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. T.H.James, Forensic Sciences, Stanley Thornes Ltd, 1987.
2. Richard, Criminalistics - An Introduction to Forensic Science (College Version), 8th Edition, Sofestein, Prentice Hall, 2003.
3. B R Sharma, Forensic Science in Criminal Investigation And Trials, 6th Edn., Lexis Nexis, 2020.
4. B.S. Nabar, Forensic Science in Crime Investigation, Asia Law House, 2022.
5. Glencoe, Forensic Laboratory Manual, McGraw Hill, 2001.
6. S Bell, Forensic Chemistry, CRC Press, 2022.
7. K M Elkins, Introduction to Forensic Chemistry, CRC Press, 2019.

Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Inorganic and Organic Chemistry**					
Type of Course	Discipline Specific Course (DSC) /Minor (For students who have opted Life Sciences and Family & Community Science as core).					
Course Code	M24CH3DSC202					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the various aspects of bio inorganic chemistry and chemistry of biomolecules.					
Semester	3	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Describe the classification, properties and structure of amino acids, proteins and carbohydrates.	U	1
2	Describe the basic principles of bioinorganic chemistry and the importance of metals in biological systems.	Ap	1
3	Investigate the food adulterants present in the food items we use in our daily lives and give an idea about the fundamentals of terpenoids, steroids, vitamins, lipids, and alkaloids.	An	1
4	Investigate and characterize various functional groups present in different organic compounds and identify them.	S	1,4
5	Describe the characterization and identification of various functional groups present in organic compounds and analyze the compounds using micro scale methods.	S	1,4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Biomolecules (15 Hours)	1.1	Amino acids and proteins: Classification of amino acids, zwitter ion, properties of amino acids, Peptides – peptide bond, Proteins- amino acids as building block of proteins, prosthetic group, properties, denaturation. Structure of proteins.	8	1
	1.2	Carbohydrates – Classification- Mono and disaccharides, Properties of glucose, fructose and lactose. Mutarotation. Starch and cellulose. Industrial applications of cellulose.	7	1
2. Bioinorganic Chemistry (15 Hours)	2.1	Haemoglobin and myoglobin, pH of blood, cytochromes, Ferredoxine - Mechanism of O_2 and CO_2 transportation - Chlorophyll and photosynthesis (mechanism not expected) elementary idea of photophosphorylation.	7	2
	2.2	Photosynthesis and respiration - comparison. Elementary idea of structure and mechanism of action of sodium-potassium pump. Biochemistry of zinc and cobalt.	8	2

3. **Food Additives and Natural products** **(15 Hours)**	3.1	*Food Additives*: Common food adulterants in various food materials and their identification: Milk, vegetable oils, tea, coffee powder and chilli powder. Food preservatives, artificial sweeteners, emulsifying agents, antioxidants, leavening agents and flavour enhancers. Commonly used permitted and non-permitted food colours. Fast foods and junk foods & their health effects - Soft drinks and their health effects.	8	3
	3.2	Terpenoids: Essential oils - isoprene rule. Alkaloids- Isolation, general properties. Lipids: Simple lipids and compound lipids- isolation- properties. Vitamins: Structure and biological activity of vitamins A and C. Steroids: general introduction, cholesterol and bile acids.	7	3
4. **Organic Chemistry Practicals** **(30 Hrs)**	4.1	**Microscale analysis of organic compounds** a. Tests for elements: Nitrogen and Halogen b. Study of reactions of common functional groups	15	4,5
	4.2	Qualitative analysis with a view to the characterisation of functional groups and identification of the following compounds: Naphthalene, benzyl alcohol, phenol, benzaldehyde, acetophenone,	15	4,5

		benzoic acid, phthalic acid, cinnamic acid, benzamide, urea, aniline, and glucose.		
5.	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. T.P. Coultate, Food- The Chemistry of its components. Royal Society of Chemistry, London.
2. I.L. Finar, *Organic Chemistry* Vol. 1 & 2, 6th edn., Pearson, 2002.
3. Puri and Sharma. Advanced Organic Chemistry.
4. R. T. Morrison, R. N. Boyd, Organic Chemistry, 7th Edn., Pearson Education, New Delhi, 2013.
5. I.L. Finar, Organic Chemistry, Vol. I, 5 th Edn., Pearson Education, New Delhi, 2013. 3.
6. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, 3 rd Edn., Vishal Publishing Company Co., 2010.
7. Swaminathan M., Food Science and Experimental Foods, Ganesh and Company.
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9. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi, 2003.
10. A.I Vogel, A Text Book of Practical Organic Chemistry, Longman.

11. F. G. Mann and B.C. Saunders, ‘Practical Organic Chemistry’ Fourth Edition, Pearson Education.
12. V. K. Ahluwalia and S. Dhingra , Comprehensive Practical Organic Chemistry, Universities Press.

SEMESTER 4

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/Discipline	**B.Sc. CHEMISTRY (Honours)**

Course Name	**Organic Chemistry-2**					
Type of Course	**DSC**					
Course Code	M24CH4DSC200					
Course Level	**200 -299**					
Course Summary	This course delves into the intricate world of bioorganic chemistry, focusing on fundamental classes of organic compounds: carboxylic acids, and nitrogen-containing compounds, amino acids, proteins and nucleic acid. The course also provides practical experience in microscale qualitative analysis of various organic compounds. First module study the properties and reactivity of carboxylic acids, derivaties of carboxylic acids including their acidity, nucleophilic substitution, and esterification reactions etc. Second modules covers the preparation and chemical properties of nitocompounds,amines, diazo compounds, cyanides and isocyanides. Third module discuss about the chemical properties of amino acid, proteins and Nucleic acids.						
Semester	**4**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		**1**		**75**
Pre- requisites, if any	Basic understanding about the classification of organic compounds					

CO No.	Expected Course Outcome	Learning Domains *	PSO No

1	Understand the preparation and properties of carboxylic acids, derivatives of carboxylic axids, nitrocompounds, amines and diazo compounds, cyanides and isocyanides, Amino acids, Proteins and Nucleic acids	U, K	1,2
2	Predict the product and reasonable mechanism for reactions of Amino acids, Nitrogen containing compounds, carboxylic acids, and its derivatives	A, An, E	2,3
3	Design synthetic pathways to higher and lower homologous series in acids	A, C, S	2,3
4	Analyse various organic compounds using documented procedures by microscale analysis	A, S	1, 4
5	Determine the physical constants of organic compounds and systematically record the observations	A, S	1, 4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Carboxylic acids				

	2.1	Structure and Acidity of Carboxylic acids- effects of substituents on the acid strength of carboxylic acids- Physical properties and Chemical reactions including Reduction, decarboxylation , Kolbe's electrolysis. Hell-Volhard-Zelinsky reaction. Ascending and descending in acid series, Arndt-Eistert synthesis (Wolff rearrangement to be mentioned)	8	1,2,3
	2.2	Acid derivatives-Conversion of acid to acid chlorides, amides, esters and anhydrides Comparative study of nucleophilicity of acyl derivatives. Reactions of acid derivatives acid chlorides, amides, esters and anhydrides with mechanisms	7	1,2,3
2. Nitrogen Containing Compounds	3.1	Nitro Compounds: Preparation of aliphatic and aromatic nitro compounds by nitration, Tautomerism of nitromethane. Reactions of nitro compounds: Reduction products of nitrobenzene in acidic, neutral and alkaline media. Electrolytic reduction, and selective reduction of polynitro compounds. Formation of charge transfer complexes	3	1,2
	3.2	Amines:- Isomerism- basicity of aliphatic and aromatic amines- Preparation- Gabriel-Phthalimide reaction, Hoffmann bromamide reaction-Reactions of amines - Separation and identification of a mixture of primary, secondary and tertiary amines- Hinsberg test - Quaternary amine salts as phase-transfer catalysts.	4	1,2
	3.3	Diazo compounds:- Preparation of diazonium salts from aromatic amines, conversion diazonium salts to benzene, phenol, chloro, bromo, iodo, fluoro benzenes, nitro benzene and azo dyes with mechanisms (Sandmeyers and Gattermann reactions-Schiemann and Gomberg reactions)	4	1,2
	3.4	Cyanides/Isocyanides:-Preparation cyanides from alkyl halides and carboxylic acids-Reactions of	4	1,2

		cyanides: Hydrolysis, reduction, reaction with Grignard reagent-Preparation isocyanides from alkyl halides and primary amines-Reactions of isocyanides: Hydrolysis, Reduction.		
3. Amino Acids, Peptides, Proteins and Nucleic Acids	3.1	Amino Acids Classification of amino acids. Synthesis-Gabriel phthalimides synthesis , Strecker synthesis, Ionic properties and Ninhydrin reaction. Zwitterion structure and Isoelectric point.	4	1,2
	3.2	Polypeptides. Synthesis of polypeptides - DCC method. Merrifield's solid phase peptide synthesis.	3	1,2
	3.3	Primary, secondary, tertiary and quaternary structure of proteins: α- helix and β-pleated sheets. Denaturation of proteins.	4	1,2
	3.4	Nucleicacids: Components of nucleic acids, nucleosides and nucleotides. Importance of purines and pyrimidines in biological systems-Adenine. Thymine, Guanine, Cytosine and Uracil -Structure of DNA, Watson, and Crick model. Differences between DNA and RNA. Protein biosynthesis, Replication of DNA	4	1,2
4. **Qualitative Organic Analysis**	4.1	Microscale organic analysis- test for aromatic character- ignition test, nitration test, picrate test for aromatic compounds, tests for unsaturation. Determination of physical constants-melting point, boiling point.	15	4,5
	4.2	Systematic and microscale qualitative analysis of the following organic compounds and characterization with its physical constant and a derivative Polynuclear hydrocarbons, reducing sugars, phenol and halogen compounds Aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, unsaturated acid, phenol, phenolic acid, ester, Aromatic primary amines, amide, diamide, nitro compounds	15	4,5
5.		**Teacher Specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in laboratory		

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Physical Chemistry I**					
Type of Course	DSC					
Course Code	M24CH4DSC201					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the gaseous state, ionic and phase equilibria and different types of solutions.					
Semester	4	Credits			4	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3		1		75

Pre-requisites, if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Interpret the properties of real and ideal gases and calculate the critical constants theoretically.	An	1,4
2	Distinguish the different types of molecular velocities and define various terms involved on molecular motion.	An	1,3
3	Utilize the concepts of acids, bases and buffer solutions to calculate ionic product, pH, and ionic strength.	A	1,2,3,4
4	Distinguish and interpret different phases co-existed in phase diagram.	E	1,4
5	Understand different types of solutions and its properties. Students apply the laws to describe the properties of solutions.	E, S	1,4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Gaseous state(15 Hours)	1.1	Deviation of real gases from ideal behaviour: causes of deviation, van der Waals equation of state for real gases- derivation and application in explaining real gas behaviour- Virial equation of state, van der Waals equation expressed in Virial form- Boyle temperature. Critical phenomena and Andrew's isotherms of CO_2, continuity of states, critical constants and their calculation from van der Waals equation.	5	1

	1.2	Maxwell distribution law of molecular velocities (graphical representation – derivation not required), Temperature dependence of the Maxwell distribution, molecular velocities- most probable, average and root mean square velocities (no derivation)	5	2
	1.3	Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules (No derivation). Relation between mean free path and coefficient of viscosity.	5	2
2. Ionic and phase equillibria (15 Hours)	2.1	Introduction – Concepts (Lowry-Bronsted and Lewis concept) of acids and bases, relative strength of acid-base pairs, influence of solvents, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law.	3	3
	2.2	Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water- pH. Effects of solvents on ionic strength.	3	3
	2.3	Buffer solutions – Mechanism of buffer action, Henderson equation. Hydrolysis of salts (concepts only).	3	3
	2.4	The phase rule (no-derivation). One component system – water and sulphur systems. Two component systems- Simple Eutectic; Lead Silver system. Application to metallurgy Pattinson's process.	6	4
3. Solutions (15 Hours)	3.1	Introduction – Binary liquid solutions – Raoult's law- ideal and non-ideal solutions, Vapour pressure – composition and temperature – composition curves of ideal and non-ideal binary liquid solutions.	5	5
	3.2	Critical solution temperature (CST). Solubility of gases in liquids – Henry's law and applications. Distribution of a solute between two solvents– Nernst distribution law.	5	5

	3.3	Colligative properties of dilute solutions – vapour pressure lowering, Boiling point elevation and freezing point depression. Molar mass determination (no derivation) -related problems – Osmotic pressure –laws of osmotic pressure – Reverse osmosis – purification of sea water. Abnormal molecular masses – van't Hoff factor – Degree of association and Degree of dissociation.	5	5
4. Practicals (30 Hrs)	4.1	1. Determination of CST of Phenol water system 2. Effect of KCl/Succinic acid on Critical Solution Temperature of phenol water system. 3. Determination of unknown concentration of KCl/Succinic acid using CST method. 4. Transition temperature of salt hydrates. (Sodium thiosulphate, sodium acetate). 5. Construction of phase diagram of simple eutectics (Naphthalene-Biphenyl System) 6. Determination of mass of solvent/molecular mass of solute using transition temperature. 7. Molecular weight determination by Rast's method. (Using naphthalene, camphor or biphenyl as solvent and acetanilide, p-dichlorobenzene etc. as solute.)	30	4,5
5.	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

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7. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
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Suggested Readings

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4. Glasstone and Lewis, Elements of Physical Chemistry, Macmillan

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme/ Disciple	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Chemistry of Materials**					
Type of Course	DSE					
Course Code	M24CH4DSE200					
Course Level	200-299					
Course Summary	This course provides a comprehensive understanding of the various aspects of different materials					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if						

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Disciple	**B.Sc. CHEMISTRY (Honours)**
any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the structure and properties of metals and ceramics and its important applications.	U	1,2
2	Understand the concept of polymers, different polymerization technique, classification properties and applications of important polymers	Ap	1,2,5
3	Will understand different classes of composite, reinforcement methods, fillers and their applications	An	1,2
4	To learn about important biomaterials specifically smart materials and their mode of interaction to the cells. The toxicity of the biomaterials can be understood.	S	1,2,5
5	To learn about different classification of semiconductors, its property and function	U	1,2

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
	1.1	Metals:Metallic bonding; structure of materials: fundamentals of crystallography, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions; structures of metals, stainless steels, cobalt based alloys,	7	1

1. Metals and ceramics:		titanium based alloys,		
	1.2	Introduction to ceramic materials; Classification of ceramics, Crystal structure and bonding of common advanced ceramic materials; Atomic defects in ceramics: intrinsic and extrinsic point defects, mechanical behaviour of ceramics, Glass and glass ceramics, Preparation of ceramics, electrical, dielectric and magnetic properties of ceramics	8	1
2. Polymers	2.1	**Polymers:** Introduction and classification. Polymerization reactions - Addition and condensation, Ring-opening polymerization and block copolymers, Mechanism of free radical, cationic and anionic polymerizations, Nomenclature, Tacticity, Co-polymerization-random, alternating, Glass transition and melting temperatures, crystallinity of polymers, Polymerization Techniques: Bulk, Solution, Suspension and Emulsion polymerizations	7	2
	2.2	Molecular weight of polymers: Number average, weight average and viscosity average molecular weights of polymers, Bio-polymers, Bio-degradable polymers, Fire retardant / Thermally stable polymers, Conducting Polymers, Applications of plastics – thermosetting, thermosoftening, Fibres, Natural and Synthetic rubbers, Environmental hazards and biodegradability of polymers. Recycling of plastics	8	2

3. Composite	3.1	**Composite** :Definition of composites, Classification of composites; General characteristics of reinforcement- classification, Polymer matrix composites: Thermoplastic and thermosetting resins; Commonly used matrix reinforcement system; Fibre, Flake and particulate reinforced composites, Function of matrix, Function of fibers, Polymer-fibre interface, Factors influencing the performance of composite, Coupling agents, Bonding agents, Short fiber composites, Continuous fiber composites: Analysis of long fiber composites, Nanocomposites: Nanoparticle dispersion in polymer matrix, Applications of composites	8	3
	3.2	Commonly used matrix reinforcement system; Fibre, Flake and particulate reinforced composites, Function of matrix, Function of fibers, Polymer-fibre interface, Factors influencing the performance of composite, Coupling agents, Bonding agents, Short fiber composites, Continuous fiber composites: Analysis of long fiber composites, Nanocomposites: Nanoparticle dispersion in polymer matrix, Applications of composites	7	3
4. Biomaterials:	4.1	**Biomaterials:** Introduction and importance of biomaterials; Types of biomaterials: Metallic, polymeric, and composite biomaterials. Classification according to the physiological response of biomaterials: bioinert, bioactive, and bioresorbable biomaterials; Surface modifications; Surface-protein interactions; Material-cell interactions: biocompatibility and rejection; Implants and infection; Testing of biomaterials: In Vitro and in vivo assessment of tissue compatibilityApplications of biomaterials in Tissue engineering, Drug delivery, Biosensing and Diagnostics.	8	4

	4.2	**Toxicology**: cytotoxicity, systemic effects, genotoxicity, carcinogenicity, sensitization & irritation, tissue compatibility and inflammatory response, **Smart biomaterials:** Stimuli-responsive polymers (pH, temperature, light) and their applications as biomaterials. **Tissue engineering:** Introduction to the basic concepts of scaffolds in tissue engineering. Functions and requirements of scaffolds in tissue engineering.	7	4
5	**Teacher specific contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture, Practical, Discussion**			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

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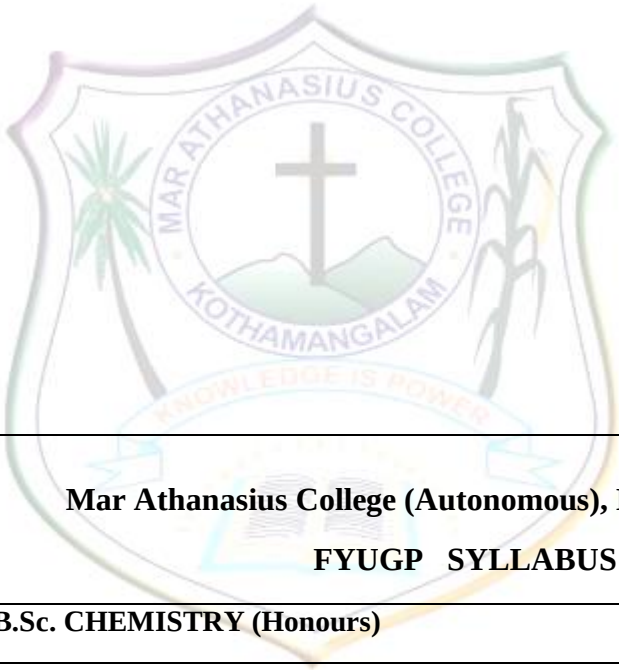

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Medicinal Chemistry**					
Type of Course	**DSE**					
Course Code	M24CH4DSE201					
Course Level	**200-299**					
Course Summary	Medicinal Chemistry is a multidisciplinary field at the intersection of chemistry, pharmacology, biology, and pharmaceutical science. This course focuses on the design, synthesis, and development of pharmaceutical drugs. The primary goal is to understand the chemical principles underlying the creation of effective and safe medications for the treatment of diseases					
Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60

Pre-requisites, if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the evolution of medicinal chemistry with special reference to allopathic medicines	U	1, 2
2	Acquire sufficient knowledge and basic understanding in molecular pharmacology familiarizing with medicinal terminology	U	1, 2
3	Analyze the various drug targets and their relationship with therapeutics.	An	1, 2
4	Evaluate the role of enzymes as drug targets and understand the action of membrane transporters and channels.	E	1, 2
5	Explain the mechanism of action and uses of antibiotics, antiviral, anticancer and cardiovascular drugs.	An	1, 2
6	Illustrate different phases of drug metabolism and different drug delivery systems.	A	1,2,3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Introduction to Medicinal Chemistry	1.1	Overview of Medicinal Chemistry: Definition and scope of medicinal chemistry, Important milestones of allopathic medicinal chemistry	3	1
	1.2	General concepts of toxicity, teratogenicity & carcinogenicity, LD50, ED50, MIC- anti infectives, habituation & addiction of narcotic analgesics and barbiturates	8	1
	1.3	Basics of Molecular Pharmacology: ADME (Absorption, Distribution, Metabolism and Excretion) – A general outline, ADME of metformin (Antidiabetic Drug), Methotrexate (Anticancer Drug)	4	2
	2.1	Introduction to Drug Targets: Definition and importance of drug targets, Types of drug targets- Proteins, nucleic acids, Cellular structure, Relationship between drug target and therapeutic effects (DNA binders- application of C2B10 for Drug Design)	3	3

2 Drug Targets and Receptors	2.2	Types of Receptors in Drug Action: Introduction to receptors and signalling, Types of receptors- G Protein coupled receptors, Ionotropic receptors, Metabotropic receptors and Kinase linked receptors.	4	3
	2.3	Enzymes as Drug Targets: Enzymes: active sites, mechanism of catalysis, Enzyme inhibitors, Enzyme selectivity	4	4
	2.4	Membrane Transporters and Channels: Active transporters and passive transporters.	4	4
3 Medicinal Chemistry of Major Drug Classes	3.1	Antibiotics- Classification, mechanism of action and therapeutic uses- Penicillin, Cephalosporins, Quinolones, Aminoglycosides. Structure Activity Relationship of penicillin	5	5
	3.2	Antiviral drugs- mode of action and therapeutic uses of amatidine and ribavirin	2	5
	3.3	Anticancer Drugs: Role of alkylating agents, antimetabolites and folate antagonists in the treatment of cancer. Carcinolytic antibiotics and mitotic inhibitors. Plant derived drugs- vincristine, taxol, Hormones and their antagonists.	4	5
	3.4	Cardiovascular Drugs: Cardiotonic drugs: cardiac glycosides-their chemistry digoxin and digitoxin, Calcium channel blockers-verapamil, β-blockers-propranolol	4	5
4 Advanced Topics in Medicinal Chemistry	4.1	Drug Metabolism and Pharmacokinetics: Phases of Drug Metabolism (Phase I and II)	5	6
	4.2	Drug Delivery Systems: Introduction to **Passive targeting and active targeting, Introduction to** molecular-level drug delivery methods- **Nanoparticles, Liposomes, Micelles, Dendrimers and Carbon nanotubes. Gene therapy**	5	6
	4.3	Case Studies: Analysis of Successful Drug Development Cases (Non evaluative)	5	6
5	**Teacher specific contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture (Chalk& Board, PowerPoint presentation) • Group Discussion • Peer teaching • Demonstration of experiments			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	B**. End Semester Examination**
Theory Total = 30 marks Quiz, Test Papers, seminar	Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. G. Patrick, Medicinal Chemistry, BIOS. 2001.
2. A. Kar, Medicinal Chemistry, New Age International, 2007.
3. Sriram , P. Yogeswari, Medicinal Chemistry, Pearson Education India, 2010.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Chemistry in Daily Life**					
Type of Course	**SEC**					
Course Code	M24CH4SEC200					
Course Level	**200 – 299**					
Course Summary	This course covers hand care, nail, personal hygiene, and oral care product formulation along with an introduction to Analytical Chemistry. Emphasizing practical skills in product formulation and analytical techniques, it prepares students for roles in the cosmetic and pharmaceutical industries.					
Semester	**4**	Credits			**3**	
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Total Hours
		3				**45**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Understand the chemistry behind hand care and hygiene products	U	1
2	Skills in formulating a range of personal care and hygiene products, preparing them for roles in the cosmetic and pharmaceutical industries.	C, S	1, 2, 4
3	Understand the fundamentals of analytical chemistry	U	1
4	Develop skills for soil and water analysis	C, S	1, 4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Hand and Nail Care Products (15 Hours)	1.1	Hand Care Products: Principles of formulation of hand sanitizers and hand wash. General Ingredients and Preparation of: (a) Hand wash (b) Antibacterial hand wash (c) Hand sanitizer	8	1,2
	1.2	Nail preparation: Structure of nail, Nail lacquers, Nail polish remover. General Ingredients and Preparation of: Nail polish and nail polish remover	7	1,2
2. Personal and Oral Hygiene Products (15 Hours)	2.1	Personal hygiene products: Total fatty matter, alkali content, and pH of soaps. Bathing soap and toilet soap. Antiperspirants and deodorants. General Ingredients and preparation of (a) Soaps (b) Cream Soaps (c) Liquid soaps	8	1,2
	2.2	Oral hygiene products: Common problem associated with teeth and gums. Role of herbs in oral care: Neem and clove. Principles of formulation of Oral hygiene products. Flavors and essential oils.	7	1,2
	3.1	Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling.	3	3

3. Analytical Chemistry (15 Hours)		Importance of accuracy, precision, and sources of error in analytical measurements.		
	3.2	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	5	4
	3.3	Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, and water purification methods. a. Determination of pH, acidity, and alkalinity of a water sample. Determination of the Hardness of water.	7	4
4	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions • Visual aids like videos and models to enhance understanding. • Peer discussions. • Hands- On experience.			

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

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2. Flick E W. (2001), Cosmetic and toiletry formulations, Noyes Publications, New York.
3. Skoog, D.A. and Leary, J.J., Instrumental Methods of Analysis, Saunders College Publications, New York, 1992
4. Skoog, D.A.; West, D.M., and Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth, 1992
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York, 2007

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Environmental Chemistry**
Type of Course	**VAC**
Course Code	M24CH4VAC200
Course Level	**200 – 299**
Course Summary	"Environmental Chemistry" explores the interactions between chemicals and the environment. It examines the sources, behaviour, and effects of pollutants in air and water. The course emphasises strategies for monitoring, mitigating, and preventing environmental degradation and emission of greenhouse gases. Students learn about the impact of human activities on ecosystems and the role of chemistry in addressing global environmental challenges. Overall, the course aims to foster an understanding of the interplay between chemistry and the environment, enabling the development of sustainable solutions for a cleaner world.

Semester	**4**	Credits			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				**45**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Communicate effectively about environmental chemistry topics, considering diverse audiences and stakeholders	U	1, 5
2	Describe strategies for the remediation and purification of contaminated soil, air, and water	U, An, A	1, 5
3	Apply principles of green chemistry to propose sustainable solutions for minimizing environmental contamination	A, C	1, 5
4	Discuss the basic chemical processes involved in air and water pollution and global warming identifying key sources.	U, A	1, 5

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Environment and Pollution (15 Hours)	1.1	Classification of the Environment- Troposphere, Stratosphere, Mesosphere, Thermosphere, Exosphere, Hydrosphere, Lithosphere, Biosphere	5	1
	1.2	Water Contamination Causes, Categories Of Water Pollution, The Long-Term Consequences of Water Pollution, Basic idea of waste water purification and disinfection	5	2,3,4
	1.3	Air Pollution: Particulates, Smog, Acid rain, Ozone Depletion- Causes, Basic idea of Air Quality Improvement methods.	5	2,3,4
2. Greenhouse Gases (15 Hours)	2.1	Greenhouse Gases and Global Warming: Natural Occurring Greenhouse Gases, Anthropogenic Greenhouse Gases, Other Greenhouse Gases, Ozone, Global Warming Potential (GWP), Emission Metrics, Influence of Technology on Global Warming.	8	4
	2.2	Schemes to reduce greenhouse gases: Capture and Storage of Carbon Dioxide, Sequestration of CO_2. Other Schemes to Reduce Greenhouse Gases, Removing CO_2 from the Atmosphere: Direct Air Capture, Carbon Dioxide Emissions in the Future	7	2,4
3. Renewable Energy Technologies and Sustainable Materials (15 Hours)	3.1	Renewable Energy Technologies: Hydroelectric, Wind, Solar, Geothermal, and Marine Energy and Their Storage, Energy from Moving Water without Dams. Fuel Cells.	6	3
	3.2	Biomass Energy: Biofuels and Their resources, Decarbonization with Biomass Utilization, Conversion of Biomass to Other Fuels- Ethanol Fuel, Biodiesel Fuel, Fuel from Algae. Biogas	6	3
	3.3	Sustainable Materials: Environmental Effects of Mining and Mineral Extraction, Sustainable Utilization of Geospheric Mineral Resources- Metals and Nonmetal Mineral Resources	3	3

4	**Teacher specific Contents** (To be evaluated internally)

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions • Visual aids like videos and models to enhance understanding. • Peer discussions. • Field visits and case study.

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. A. K. De, Environmental Chemistry. New age International Ltd., 8th Edition 2016.
2. G. Tyler Miller, Scott Spoolman, Living in the Environment. Tomson Brooke/Cole, 20th Edition, 2020.
3. N. Manivasakam, Physico-Chemical Examination of Water, Sewage and Industrial Effluents. Pragati Prakashan 2008.
4. R. K. Khitoliya, Environmental Pollution Management & Control for Sustainable Development. S.Chand & Company Ltd., 2004.
5. S. Mitra and B. B. Kebbekus, Environmental Chemical Analysis. CRC Press, 1998.
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11. James W. Moore and S. Ramamoorthy, Organic Chemicals in Natural Waters-Applied Monitoring and Impact Assessment. Springer-Verlag, 2012.

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14. J. Shivananda, Human Rights: Concepts and Issues. Alfa Publications, New Delhi, 2006.
15. M. Rajawat, Human Rights and Dalits. Anmol Publications, New Delhi, 2006.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Disciple	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Physical Chemistry**
Type of Course	**DSC C/Minor (**For students who have opted Physical Sciences and Geology as Main)
Course Code	M24CH4DSC202
Course Level	**200-299**
Course Summary	This course provides the student a thorough knowledge about solids and surface chemistry. It also gives basic information on green chemistry along with an introduction on spectroscopy.

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Build a perspective on adsorption and different adsorption isotherms.	U	1
2	Evaluate the properties and applications of colloids	E	1,3,4
3	Describe the basic principles of Spectroscopic techniques like UV/ Vis, IR and NMR	U	1,4
4	Discuss the importance of green chemistry and green approaches	U	1,5

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 **Surface chemistry and colloids**	1.1	Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required).	3	1
	1.2	True solution, colloidal solution and suspension. Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples. Purification of colloids by electrodialysis and ultrafiltration.	4	2
	1.3	Properties of colloids: Brownian movement – Tyndall effect – Electrophoresis. Origin of charge and stability of colloids – Zeta potential – Coagulation - Hardy Schulze rule – Protective colloids - Gold number. Emulsions.	5	2
	1.4	Applications of colloids: Delta formation, medicines, emulsification, cleaning action of detergents and soaps.	3	2
2 Introduction to Spectroscopy	2.1	Interaction of electromagnetic radiation with matter, electromagnetic spectrum, quantization of energy, electronic, vibrational and rotational energy levels, Boltzmann distribution of energy (formula only).	3	3
	2.2	*UV-Visible Spectroscopy:* Introduction – Beer-Lambert's law – Electronic transitions in molecules ($\sigma\rightarrow\sigma^*$, $n\rightarrow\sigma^*$, $\pi\rightarrow\pi^*$ and $n\rightarrow\pi^*$) – molar extinction coefficient and its importance. Chromophore and auxochrome – Red shift and blue shift.	4	3
	2.3	*IR Spectroscopy:* Introduction – vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending. Group frequency concept – Characteristic stretching frequencies of O-H, N-H, C-H, C=C, C=N and C=O functional groups – Fingerprint region in IR spectra	4	3
	2.4	*NMR Spectroscopy:* Introduction - Chemical shift and spin-spin coupling - Application in elucidating the structure of ethanol, dimethyl ether, propanal and acetone (detailed study not required)	4	3
3				4

New vistas in chemistry	3.1	*Green Chemistry*: Definition and Importance of green chemistry, Limitations/ Obstacles in the pursuit of the goals of Green Chemistry	4	
	3.2	Twelve principles of Green Chemistry. Prevention of Waste/ by-products; Atom Economy and E factor.	3	4
	3.3	Use of safer solvents and auxiliaries (e.g. separating agent) - green solvents (supercritical CO2, water, ionic liquids), solventless processes, immobilized solvents.	5	4
	3.4	Microwave assisted reactions, green synthesis of Ibuprofen	3	4
4.Practicals		1. Determination of Partition coefficient of a non volatile solute. 2. Transition temperature of salt hydrates, eg. Sodium thiosulphate, Sodium acetate etc. 3. Critical solution temperature of phenol water system. 4. Heat of Solution KNO3, NH4Cl 5. Heat of neutralization 6. Determination of equivalent conductance of an electrolyte. 7. Conductometric titration of strong acid Vs. strong base. 8. Potentiometric titrations : Fe2+ vs. Cr2O72-and Fe2+P vs. KMnO4 9. Determination of molecular weight by Rast's method. (using naphthalene, camphor or biphenyl as solvent and acetanilide, p–dichlorobenzene etc. as solute) 10. Kinetics of simple reactions, eg. Acid hydrolysis of methyl acetate	30	
5	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction) Lecture** **Discussion** Lecture Sessions, Interactive Sessions including discussions, demonstrations, and experiments to engage students.			

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry, 46th Edn., Vishal Publishing Company, New Delhi, 2013.
2. F. Daniels, R. A. Alberty, *Physical Chemistry*, 5th Edn., John Wiley and Sons, Canada, 1980
3. P. S. Kalsi, *Applications of Spectroscopic Techniques in Organic Chemistry*, 6th Edn., New Age International (P) Ltd., New Delhi, 2004
4. C. N. Banwell, E. M. Mc Cash, *Fundamentals* of *Molecular Spectroscopy*, 4th Edn.,
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SEMESTER V

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Physical Chemistry II**
Type of Course	MAJOR
Course Code	M24CH5DSC300
Course Level	**300-399**

Course Summary	This course covers a detailed understanding of the solid state chemistry and its importance in various aspects. The course introduces photochemical laws and different photochemical processes. It also explains thermodynamical principles and its different states.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Illustrate the basic aspects of ionic solids and identify the crystal structure.	An	1,4
2	Explain the types of defects, causes and semiconductor properties in ionic solids.	E	1
3	Evaluate different symmetry operations and elements. Analyze different molecular point groups based on symmetry elements	An,C	1,3,4
4	Remember the fundamental principles of photochemistry and photochemical processes and explain the nature of different photochemical reactions.	U	1
5	Explain the fundamental laws of thermodynamics and its application in isothermal, adiabatic and Joule-Thomson expansion processes.	U	1,4
6	Apply the principles of chemical thermodynamics to thermochemical processes and systems of variable compositions.	A	1,2,4
7	Describe the entropy and free energy criterion for equilibrium and spontaneity and explain third law of thermodynamics.	A	1

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
	UNIT 1: SOLID STATE (15 HRS)			

1	1.1	Anisotropy in crystals, Laws of Crystallography – Law of constancy of interfacial angles, Law of rational indices. Weiss and Miller indices. X–Ray diffraction by crystals, Bragg's law	4	1
	1.2	Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX2 (CaF2, Na_2O) Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, semiconductors, n-type, p-type,	6	2
	1.3	Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, molecular point groups, Determination of point groups of simple molecules	5	3
2. Photochemistry and Thermodynamics 1(15 hrs)	2.1	Laws of photochemistry-Grothus-Draper law, Stark-Einstein law. Jablonski diagram-qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing).	3	4
	2.2	Quantum yield, examples of low and high quantum yields, photochemical reactions (decomposition of HBr, isomerisation of maleic acid to fumaric acid), photosensitized reactions(photosynthesis, isomerization of 2-butene), chemiluminescence, bioluminescence.	3	**4**
	2.3	Zeroth law of thermodynamics. Definition of internal energy and enthalpy. Heat capacities at constant volume (C_V) and at constant pressure (C_p), relationship between C_p, C_V and R First law of thermodynamics –Mathematical statement of first law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition.	6	5
	2.4	The Joule-Thomson effect – derivation of the expression for Joule-Thomson coefficient. Significance of Joule-Thomson coefficient, inversion temperature.	3	5

3. Thermodynamics 11	3.1	Second law: Limitations of first law – Different statements of second law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem. Concept of entropy – Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criterion of spontaneity and equilibrium. Gibbs and Helmholtz free energies and their significances- criteria of equilibrium and spontaneity. Gibbs-Helmholtz equation	10	6
	3.2	Third law of thermodynamics-statement and determination of absolute entropies of substances. Partial molar quantities – Chemical potential – Gibbs–Duhem equation	5	7
4. Practicals		1. Heat of neutralization 2. Heat of solution – KNO3, NH4Cl (Determination of heat of solution from solubility measurements) 3. Surface tension - Determination of the surface tension of a liquid (Drop number method or Drop weight method). 4. Surface tension - Determination of Parachor values 5. Determination of the composition of two liquids by surface tension measurements 6. Determination of CMC of surfactants by surface tension Measurements		
5.		**Teacher specific Contents** (To be evaluated internally)		
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, Power point presentation) • Interactive Sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks

Lab performance, record, field report etc.	Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. K. J. Laidler, Chemical kinetics, 3rdedn, Pearson education, 2004.
2. L V Azaroff, "Introduction to Solids", McGraw Hill.
3. N B Hannay, "Solid State Chemistry", Prentice Hall.
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7. K. L. Kapoor, "A Textbook of Physical chemistry", Volume 5, 4th edition, Macmillan India Ltd.,
8. Puri, Sharma and Pathania, "Principles of Physical Chemistry", 48th Edition, Vishal Publishing Company

Suggested Readings

1. R P W Atkins, "Physical Chemistry", Oxford University Press (12th Edition)
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3. Glasstone and Lewis, Elements of Physical Chemistry, Macmillan
4. I.N. Levine, Physical Chemistry, Tata McGraw Hil

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Organic Chemistry-3**
Type of Course	**DSC**
Course Code	M24CH5DSC301
Course Level	**300-399**
Course Summary	The course covers stereochemistry, confirmation and chemical reactions of carbohydrates and heterocyclic compounds. First module discusses the geometrical isomerism, optical isomerism and conformational analysis. Module 1 will cover the structures of carbohydrates, including monosaccharides, disaccharides, and polysaccharides along with their chemical properties and application. Final module discusses the classification and reactions of heterocyclic compounds. In the Basic Laboratory Skills module, students will develop essential techniques for organic compound extraction, purification, and identification.

Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Basic idea about isomerism and types of isomerism					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the classification, structure, chemical properties and applications of carbohydrates	U, K, A	1,2
2	Know the classification and method of synthesis of heterocyclic compounds	U, K	1, 2
3	Understand the basic concepts of stereochemistry and conformational analysis of organic molecules	U	1,2, 3
4	Develop basic skills in techniques of crystallisation, distillation and solvent extraction	S, A, I	1,3,4
5	Learn the chromatographic techniques TLC Paper Chromatography and column chromatography and Develop essential techniques for organic compound extraction, purification, and identification.	S, A	1,3,4

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

COURSE CONTENT

Content for Classroom Transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Stereo chemistry	1.1	Stereoisomerism - definition - classification.Introduction to molecular symmetry and chirality: examples from common objects to molecules. Axis, plane, center, alternating axis of symmetry.	2	3
	1.2	Geometrical isomerism - Cis-trans, syn-anti and E-Z notations - geometrical isomerism in unsaturated compounds , cyclic compounds, aldoximes and ketoximes- Interconversion of cis-trans isomers.	4	3
	1.3	Optical isomerism - Optical activity - conditions for optical activity - asymmetric centre - Enantiomers, Diastereomers, Meso compounds-optical isomers in glyceraldehyde, lactic acid and tartaric acid. D ,L notation-cahn-Ingold-Prelog rules – R,S notations for optical isomers with one and two asymmetric carbon atoms-erythro and threo representation. Racemisation - methods of racemisation -Resolution - methods of resolution - Asymmetric synthesis	4	3
		Conformational analysis – conformers-configuration-factors affecting the stability of organic molecules-Conformational analysis of ethane and n-butane including energy diagrams – Cyclo alkanes relative stabilities-Baeyers strain theory-conformation of cyclohexane (chair, boat and skew boat forms) - axial and equatorial bonds- ring	5	3

		flipping showing axial equatorial interconversions, conformation of methylcyclohexane.		
2. Carbohydrates	2.1	Classification of carbohydrates. Fischer and Haworth projections of glucose and fructose. Cyclic structure of glucose. Reactions of glucose and fructose – osazone formation, Tollen's reagent. Epimers, mutarotation and anomers.	8	1
	2.2	Chain lengthening and chain shortening of aldoses - Kiliani- Fischer synthesis and Wohl degradation. Interconversion of aldoses and ketoses. Structure of sucrose Reactions and uses of sucrose Structure and properties of starch and cellulose (elementary idea). Industrial applications of cellulose.	7	1
3. Heterocyclic Compounds	**3.1**	Classification of heterocyclic compounds, structure and aromaticity of furan, pyrrole, pyridine-	3	2
	3.2	Synthesis and reactions of: Furan, thiophene, pyrrole (Paal Knorr synthesis and Knorr pyrrole synthesis), Pyridine (Hantzsch synthesis), Indole (Fischer Indole Synthesis), Quinoline and Isoquinoline, Bischler Napieralsky reaction, Pictet-Spengler reaction	12	2
4. **Basic Laboratory Skills**	4.1	Solvent extraction – aniline from water - using ether- Crystallisation –using ethanol, and water Distillation- Purification of water and ethyl acetate	15	4
	4.2	Chromatography - TLC – Paper Chromatography-Separation and identification- Determination of Rf value of *o*- and *p*- nitroanilines - *o*-and *p*- nitrophenol- *ortho* and *para* chloroanilines, any two amino acids- Column Chromatography	15	5

5.		**Teacher Specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in the laboratory		

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. Nasipuri, D. *Stereochemistry of Organic Compounds: Principles and Applications;* New Age International publishers, 2018.
2. Gupta, S. S. *Basic Stereochemistry of Organic Molecules;* 2nd *ed.;* Oxford University Press, 2018.
3. Talapatra, S. K.; Talapatra, B. *Basic Concepts in Organic Stereochemistry;* Springer Nature, 2023.
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11. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3rd Edition, Visal Publishing Company Co. (Chapter-22)

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18. 'Vogel's Textbook of Practical Organic Chemistry' Pearson Education

19. G. Mann and B. C. Saunders, 'Practical Organic Chemistry' *Fourth Edition,* Pearson Education.

20. V.K.Ahluwalia and S. Dhingra ' Comprehensive Practical Organic Chemistry' Universities

21. I. Vogel, 'A Text Book of Practical Organic Chemistry', Longman.

22. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn

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25. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi, 2003.

Programme	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Environmental Chemistry and Human Rights**					
Type of Course	**DSC**					
Course Code	M24CH5DSC302					
Course Level	**300 – 399**					
Course Summary	The course outlines the importance of ecosystems and natural resources and their conservation. It is also aimed to make the students understand the causes and consequences of various types of pollution and implement necessary control measures. It also provides insight into important human right issues and concerned acts.					
Semester	**5**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				**60**
Pre-requisites, if any	The students are expected to be aware of the fundamentals of general, inorganic and organic chemistry. It is also desirable that they have a keen understanding of the current environmental problems.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Understanding of ecosystems, energy resources, their conservation and associated problems	U, An, A, E	5
2	Understanding and analyzing of various types of pollution and make the disciples interpret the causes and consequences of pollutions. This may help them to take necessary steps to control the pollutions.	U, E, An, A, C	5
3	To study the green chemistry principles and the need for a sustainable development and to make an understanding of waste management and the latest green initiatives	U , A	5
4	To make aware about the human rights and concerned acts	U	5

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Ecosystems and Natural Resources **(15 Hours)**	1.1	Ecosystems: Concept, structure and functions, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem. Producers, Consumers and Decomposers, Energy Flow in the Ecosystem, Food Chains and Ecological Pyramids.	5	1
	1.2	Renewable and Non – renewable Resources, Land resources: Land degradation, soil erosion and desertification. Forest Resources: Deforestation, Timber Extraction, Mining, Dams, and their Effects on Forests and Tribal People. Water Resources:: Use and over – exploitation of surface and ground water, floods, droughts, conflicts over water, Dams – Benefits and Problems. Mineral Resources: Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources. Energy resources: Renewable and non renewable energy sources, growing energy needs, use of alternate energy sources. Food Resources: World Food Problems, Changes Caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer-Pesticide Problems, Water Logging, Salinity.	10	1
2. Environmental Pollution and Chemical Toxicology **(15 Hours)**	2.1	Water pollution: Sources of water pollution-Pesticide pollution, Thermal pollution, Methods to control water pollution. Water quality parameters- pH, TDS, salinity, COD, BOD, DO, Effluent treatment methods-physical, chemical, and biological.	5	2
	2.2	Air pollution: Primary and secondary pollutants, PAN, chlorofluoro hydrocarbons, photochemical smog, major pollutants in automobile exhaust, Effects of atmospheric pollution -acid rain, smog; green-house effect, global warming- ozone layer depletion, climate change. Regional Episodes: Bhopal gas tragedy; Endosulfan tragedy in Kasaragod.	4	2
	2.3	Radioactive Pollution: Types of reactor waste; Health hazards of radioactive fallouts; Disposal of radioactive waste (royal waste) - dilute and disperse method, delay and decay method, concentrate and contain method. Recent disposal methods like Reprocessing method, immobilization technique by vitrification. Nuclear power plants in India, Chernobyl disaster. Biochemical effects of heavy metals- As, Cd, Pb, Hg, Co and Ni. Minamata and itaiitai diseases.	6	2

3. Green Chemistry **(15 Hours)**	3.1	Green Chemistry:-Introduction-need of green chemistry-twelve principles of green chemistry, atom economy, sustainable development. Microwave and ultrasound assisted green synthesis (elementary idea only), green solvents-supercritical fluids.	6	3
	3.2	Solid waste Management; Zero waste concept; sanitary landfill and secured landfill, incineration, pyrolysis, biological reprocessing. Significance of 3R - Reduce, Reuse and Recycling.	4	3
	3.3	Fuel of the future- Hydrogen; Fuel Cells; Biofuels; Green Building; Green materials for building construction; Green Building Certification- LEED, GRIHA. Environmental management Standards: ISO 14000 Series; Life Cycle Analysis (LCA); Bio-mimicking; Environmental Impact Assessment (EIA); Environment Protection Act (EPA).	5	3
4. Introduction to Human Rights **(15 Hours)**	4.1	Types and nature of human rights violations faced by vulnerable groups, namely the Scheduled Castes, Scheduled tribes, Women, Children and Minority communities Constitutional provisions and laws protecting the rights of vulnerable groups.	4	4
	4.2	Right to Equality, Right to Freedom, Right against Exploitation.	2	4
	4.3	Salient features of some important Acts like : The Prevention of Atrocities (Against SC/ST) Act, 1989; The Domestic Violence Act, 2005; Vishakha Guidelines for Preventing Sexual Harassment at Workplace, 1997; The Child Labour (Prohibition and Regulation) Act, 1986; The Persons With Disabilities (Equal Opportunities, Protection of Rights and Full Participation)Act, 1995.	5	4
	4.4	Redressal mechanisms at the National and State levels: The National Human Rights Commission (NHRC), the SC/ST Commission, the National Commission for Women; the Minorities Commission	4	4
5.	**Teacher specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions • Visual aids like videos and models to enhance understanding. • Peer discussions. • Field visits and case study

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

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1. A. K. De, Environmental Chemistry. New age International Ltd., 8th Edition 2016.
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Course Name	**Fats, Oils and Waxes**					
Type of Course	DSE					
Course Code	M24CH5DSE300					
Course Level	300-399					
Course Summary	This course provides a comprehensive understanding of the various types of oils, fats, and waxes, their extraction, and their properties.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Describe the sources, composition, characteristics, and utilisation of commercially important oils and fats and their extraction.	U	1,4
2	Illustrate the use of fats and oils as food materials and give an idea about fat-related diseases.	A	1,4
3	Discuss the importance of glyceride structure and describe the different test methods for physical and chemical properties.	An	1,4
4	Investigate the types of waxes and fatty alcohols and describe the concept of autoxidation.	Ap	1,4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.

1 **Commercially important oils and fats and their extraction** **(15 hours)**	1.1	Study of the sources, composition, characteristics, and utilisation of commercially important oils and fats - butter, tallow, lard, coconut oil, palm oil, cocoa butter, olive oil, cotton seed oil, rice bran oil, sesame oil, soybean oil, sunflower oil, linseed oil, mustard oil, castor oil, and marine oils.	8	1
	1.2	Mechanical pretreatment and heat treatment of oil-bearing materials. Rendering of animal fats and cooking of oil seeds. Mechanical expression of oils. Solvent extraction, type of extractors, supercritical fluid extraction of oils and fats.	7	1
2. **Oils and fats as food materials** **(15 hours)**	2.1	Cooking oil, salad oil, and salad dressings. Margarine and Shortenings	4	2
	2.2	Essential fatty acids: ω-3 and ω-6 fatty acids and their dietary sources, significance to human nutrition and health.	6	2
	2.3	Fat-related diseases: atherosclerosis, arthritis. Nutritional significance of EFA, HDL, LDL, and VLDL.	5	2
3. **Glyceride structure; Analysis of fats and oils** **(15 hours)**	3.1	Glyceride composition of natural fats. Methods of investigation of glycerides. Theories of glyceride structure.	5	3
	3.2	Test methods for physical properties: melting point, softening point, titer, flow test, cloud test, consistency test, liquid and solid fatty acid determination, solid fat index, specific gravity, refractive index, and viscosity.	5	3
	3.3	Test methods for chemical properties: Iodine value, thiocyanogen number, saponification value, acid value and free fatty acid, peroxide value, Reichert-Meissel value, Polenski value, and Kirschner value. Adulteration of oils fats – detection of adulteration.	5	3

4. Waxes, Fatty Alcohols, Rancidity in oils and fats **(15 hours)**	4.1	Occurrence, classification, properties, and composition of waxes. Synthetic waxes.	4	4
	4.2	Naturally occurring fatty alcohols - production, uses, and applications.	5	4
	4.3	Concept of autoxidation, tests for rancidity, stability of oils, induction period, antioxidants, drying, semi-drying, and nondrying oils	6	4
5	**Teacher Specific contents** This content will be evaluated internally.			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture Discussion Presentation			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

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their Glycerides, Chapman and Hall, 2008.

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B Sc Chemistry (Honours)**
Course Name	**Spectroscopic Techniques**
Type of Course	**DSE**
Course Code	M24CH5DSE301

Course Level	**300-399**					
Course Summary	The spectroscopic Methods of Chemical Analysis course covers various spectroscopic methods, including instrumentation of UV-Visible, infrared, and nuclear magnetic resonance (NMR) spectroscopy and principles and applications of Raman, EPR, Mossbauer, Fluorescence, X-ray, Atomic Absorption, Atomic Emission and Flame Emission Spectroscopic techniques. Students delve into theoretical foundations, instrumentation, and practical aspects of spectroscopic analysis, exploring how these techniques are utilized in chemical, biological, and material sciences.					
Semester	5	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Discuss general theory of spectroscopy and interpret rotational and vibrational spectroscopic techniques.	U,An	1,2,4
2	Describe the fundamental principles of Raman, Electronic and Mass spectroscopic techniques in chemical analysis.	U,An	1,2,4
3	Evaluate the advantages and limitations of Raman spectroscopy, Electronic and Mass spectroscopy in different scientific and industrial applications.	E	1,2,3
4	Assess the utility of NMR, ESR and Mössbauer spectroscopy, in various fields.	E	1,2
5	Describe the fundamental principles of AAS, AES and FES.	U	1,2
6	Compare and contrast the advantages and limitations of AAS, AES, and FES in elemental analysis.	U	1,2

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.

1. Rotational and vibrational spectroscopy	1.1	Electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, various types of molecular spectroscopic techniques, Born-Oppenheimer approximation.	2	1
	1.2	Rotational spectrum: diatomic molecules, energy levels of a rigid rotator, selection rules, determination of bond length.	3	1
	1.3	Vibrational spectrum: the simple harmonic oscillator – energy levels, force constant, selection rules. Anharmonic oscillator, Morse function and Morse curve – pure vibrational spectra of diatomic molecules, selection rules, fundamental frequencies, overtones, hot bands, combination and difference bands, Fermi resonance. Degrees of freedom for polyatomic molecules, concept of group frequencies, finger print region – frequencies of common functional groups in organic compounds..	10	1
2 Raman, Electronic and Mass Spectroscopy	2.1	Raman spectrum: Stokes and antistokes lines, quantum theory of Raman Effect (elementary idea), concept of polarizability, qualitative treatment of pure vibrational Raman spectra of diatomic molecules, selection rules, rule of mutual exclusion. .	5	2,3
	2.2	Electronic spectrum: concept of potential energy curves for bonding and anti-bonding molecular orbitals, electronic transition, the Frank-Condon principle, dissociation energy. Polyatomic molecules – qualitative description of σ, π and n- molecular orbitals, their energy levels and the respective transitions.	6	2,3
	2.3	Mass spectrometry: Basic principle-ionization, fragmentation, separation of ions and representation of the spectrum, application in molecular mass determination	4	2,3
2. NMR, ESR and Mossbauer, Spectroscopy	3.1	Basic principles of NMR spectroscopy – nuclear spin, Larmor precession. Proton magnetic resonance (^{1}H NMR or PMR) – nuclear shielding and deshielding, chemical shift and molecular structure. Spin-spin splitting and coupling constant. First order spectra – interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone.	8	4
	3.2	ESR spectroscopy- basic concepts	2	4
	3.3	Mossbauer Spectroscopy: Principle, Doppler effect, recording of spectrum, chemical shift, factors determining chemical shift, application to metal complexes.	5	4

4 Atomic Spectroscopic Techniques	4.1	Atomic absorption spectroscopy (AAS), principle of AAS, absorption of radiant energy by atoms, measurement of atomic absorption, instrumentation: Radiation Sources, Atomizers, Detectors. Analytical Applications of AAS.	5	5,6
	4.2	Atomic emission spectroscopy (AES), advantages and disadvantages of AES, origin of spectra, principle and instrumentation, applications.	5	5,6
	4.3	Flame emission spectroscopy (FES), flames and flame temperature, spectra of metals in flame, instrumentation, applications.	5	5,6
5		**Teacher specific Contents** (To be evaluated internally)		
Teaching and Learning Approach		**Classroom Procedure (Mode of transaction)** Lecture Sessions, Interactive Sessions including discussions and demonstrations, to engage students actively and visual aids like presentations and videos to enhance understanding. Utilize case studies from various scientific fields (like environmental science, pharmaceuticals, forensics) to illustrate how spectroscopy is applied practically. Form study groups to discuss concepts, compare approaches, and explain concepts to one another.		

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	B**. End Semester Examination**
Theory Total = 30 marks Quiz, Test Papers, seminar	Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. J W. Robinson, E M S Frame, and G M. Frame II, Instrumental Analytical Chemistry, CRC Press, 2021.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Polymer Chemistry**
TypeofCourse	**DSE**
Course Code	M24CH5DSE302
CourseLevel	**200 – 299**

Course Summary	The course 'Polymer chemistry' covers the synthesis, structure, and properties of polymers. It examines polymerization techniques, exploring both natural and synthetic polymers' molecular structures and behaviours. The course emphasizes polymerization mechanisms, properties of polymers and their applications in various fields. Discussions on applications across industries, from materials science to biomedical fields, highlight the practical significance of polymer chemistry.					
Semester	**5**	Credits			**4**	Total Hours
CourseDetails	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				**60**
Pre-requisites, if any						

COURSEOUTCOMES(CO)

CO No.	ExpectedCourseOutcome	Learning Domains*	PSO No.
1	Describe the fundamental concepts of polymers, polymerisation reactions and polymerisation techniques	U	1
2	Analyse basic determinants of polymer properties	An	1, 2
3	Develop a comprehensive idea of tacticity in polypropylene and Ziegler-Natta polymerisation of alkenes.	A	1, 2
4	Understand different polymerization techniques and types of polymer degradation.	U, E	1, 2
5	Examine the structures, properties, and applications of addition polymers, condensation polymers and polymer resins	A	1, 2, 4
6	Identify the importance of vulcanization process and the practical aspects of formulating rubber compounds	An	4

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

COURSECONTENT

Content for Classroom transaction(Units)

Module	Units	CourseDescription	Hrs	CO No.
1.	1.1	History of Polymers, Terminology, Monomers, oligomers and polymers. Degree of polymerization, Poly Dispersity Index, Constitutional Repeat Units Classification of polymers-based on origin, structure, intermolecular forces and type of monomers. Polymer nomenclature. Importance of polymers.	9	1

Introduction to polymers and polymerisation reactions **(15 Hours)**	1.2	Addition and condensation polymerization. Chain polymerization, ring opening polymerization, Co-ordination polymerization, group transfer polymerization.	6	1
2. **Polymerisation Techniques** **(15 Hours)**	2.1	Advantages, disadvantages and examples of Bulk polymerisations, solution polymerization, Suspension polymerisation and Emulsion polymerisation. Melt Polycondensation Polymerisation, Interfacial polycondensation Polymerisation.	5	1
	2.2	Structure-Property relationships of polymers, crystallization and crystallinity, crystalline melting point. Crystallization Mechanisms. Determination of Crystalline Melting Point and Degree of Crystallinity. Morphology of Crystalline Polymers. Tacticity in polymers–Isotactic, Syndiotactic and Atactic. Ziegler-Natta polymerisation of alkenes.	6	2, 3
	2.3	Molecular weight of polymers: Number average (Mn), and weight average (Mw), Sedimentation (Mz)and Viscosity Average Molecular Weights (Mv). Determination of Average Molecular Weights. Glass Transition Temperature (Tg): Definition. Factors influencing glass transition temperature (Tg). Importance of Tg.	4	2
3. **Polymer Processing and Degradation**	3.1	Compression moulding, Injection Moulding, Blow Moulding, Extrusion moulding, Thermoforming, Die casting, Film casting, Rotational casting, Polymer Calendering, Spinning of Polymers	9	1, 4
	3.2	Polymer degradation Thermal degradation, mechanical degradation, photodegradation, Oxidative degradation. High temperature-resistant and flame retardant polymers. Biomedical applications of polymers.	6	4
4. **Chemistry of Commercial Polymer**s **(15 Hours)**	4.1	Brief introduction to the structure, properties and applications of the following addition polymers: , polyolefins (LDPE, HDPE and PP), poly(vinyl chloride), polystyrene, poly (vinyl acetate), acrylic polymers (PAN and PMMA), fluoropolymers (PTFE).	5	5
	4.2	Brief introduction to the structure, properties and applications of the following Condensation polymers: aliphatic polyamides (Nylon 6,6 and Nylon 6), aromatic polyamides	4	5

		(Kevlar), polyesters (PET).		
	4.3	Brief introduction to structure, properties and applications of the following Resins: Formaldehyde resins (PF, UF and MF), polyurethanes, polycarbonates, epoxy resins.	3	5
	4.4	Introduction to vulcanisation of natural rubber-types of vulcanisations (EV, semi-EV and CV), activator system, accelerator system. Formulation of a rubber compound – rubber mat.	3	6
5	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture (Chalk& Board, Power point presentation) Group Discussion Peer teaching Industrial Visit			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. Gowariker, V. R.; Viswanathan, N. V.; Sreedhar, J. *Polymer Science*; Wiley, 1986.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Industrial Inorganic Chemistry and Nuclear Chemistry**
Type of Course	**DSE**
Course Code	M24CH5DSE303
Course Level	**300 – 399**
Course Summary	The course 'Polymer chemistry' covers the synthesis, structure, and properties of polymers. It examines polymerization techniques, exploring both natural and synthetic polymers' molecular structures and behaviours. The course emphasizes polymerization mechanisms, properties of polymers and their applications in various fields. Discussions on applications across industries, from materials science to biomedical fields, highlight the practical significance of polymer chemistry.

Semester	**5**	Credits			**4**	Total Hours
CourseDetails	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				**60**
Pre-requisites, if any						

COURSEOUTCOMES(CO)

CO No.	ExpectedCourseOutcome	Learning Domains*	PSO No.
1	Analyse different Industrially important inorganic materials	An	1, 2
2	Evaluate the important processes involved in Metallurgy	E	1, 2
3	Explain the catalytic properties of inorganic materials	E	1, 2,4
4	Understate the basics of chemical explosives and rocket propellants	U	1, 2, 4
5	Analyse different aspects involved in Nuclear chemistry, its applications, nuclear reactors, applications and problems associated	A	1, 2, 3, 4

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

COURSECONTENT

Content for Classroom transaction(Units)

Module	Units	CourseDescription	Hrs	CO No.
1. Glass, Ceramic and Cements **(15 Hours)**	1.1	**Glass**-Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.	5	1
	1.2	**Ceramics** -Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, super conducting and semiconducting oxides, fullerenes carbon nanotubes and carbon Fiber. Bioceramics,	5	1

		Biocement- Living building materials.		
	1.3	**Cement**-Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.	5	1
2. **Metallurgy** **(15 Hours)**	2.1	Minerals in India, Mineral processing, Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent.	5	2
	2.2	Electrolytic Reduction, Hydrometallurgy with reference to cyanide process for silver and gold. Methods of purification of metals: Electrolytic process, van Arkel-de Boer process and Mond's process, Zone refining.	5	2
	2.3	Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology.	5	2
3. Introduction to Chemical Explosives, rocket propellants and catalysis **(15 Hours)**	3.1	General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation, or regeneration of catalysts. Phase transfer catalysts, application of zeolites and Metal organic Frameworks as catalysts.	7	3
	3.2	Origin of explosive properties in inorganic compounds. Categorisation of explosives (low explosives – high explosives – primary, secondary, intermediary,tertiary) . Explosive properties of Gun powder, lead azide, TNT , PETN, cyclonite (RDX).	6	4
	3.3	A Brief History and introduction of chemical rocket propellants. Liquid propellants, ecofriendly propellants and solid propellants	2	4
4. Nuclear Chemistry	4.1	Nucleus and its classification, nuclear forces, nuclear stability, binding energy, nuclear models. Radioactive decay (Radioactive elements, general characteristics of radioactive decay, decay kinetics - decay constant, half life, mean life period), units of radioactivity.	5	5
	4.2	Measurement of radioactivity, Geiger-Muller detector, Scintillaton detectors, Nuclear reactor: classification of reactors, uranium reactor, breeder reactor. Nuclear reactors in India (Brief Idea). Nuclear fusion and stellar energy. Units of	5	5

		radiation energy (Rad, Gray, Rontgen)		
	4.3	Nuclear pollution and Radiological safety: Interaction of radiation with matter, Radiolysis of water, Radiation dosimetry. Radioactive isotopes and their applications, Isotopic dilution analysis, Neutron activation analysis, Disposal of nuclear waste, nuclear disaster (nuclear accidents– discussion about case studies).	5	5
5	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture (Chalk& Board, Power point presentation) Group Discussion** **Peer teaching** **Industrial Visit**			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. E. Stocchi: Industrial Chemistry, Vol-I, , Ellis Horwood Ltd. UK.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**			
Programme	**B Sc Chemistry (Honours)**			
Course Name	**Analytical Chemistry and Professional skills**			
Type of Course	SEC			
Course Code	M24CH5SEC300			
Course Level	**300-399**			
Course Summary	This course provides a comprehensive introduction to Analytical Chemistry, focusing on interdisciplinary concepts, precision in analysis, and practical applications in soil and water studies. It incorporates hands-on experiences, including workshops, interview training, industrial visits, and expert interactions, culminating in a career-oriented project for enhanced professional readiness.			
Semester	5	Credits	3	Total

Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	Hours
		2		1		60
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamentals of analytical chemistry	U	1
2	Develop skills for soil and water analysis	C	1,3,4
3	Understand the principles of chromatographic techniques	U	1,4
4	Apply the principles of Thin Layer Chromatography and column chromatography for purification and separation purposes.	A	1,4
5	Support students with the tools and insights to navigate the professional landscape effectively and contribute meaningfully to their chosen fields.	E	1,3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate I, Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1 Analytical Chemistr	1.1	**Introduction**: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling..	2	1
	1.2	**Analysis of soil:** Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	6	2,5

y	1.3	**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, and water purification methods. a. Determination of pH, acidity, and alkalinity of a water sample. b. Determination of the Hardness of water.	7	2,5
2 **Chromatographic techniques**	2.1	Introduction of chromatography: Basic principles of chromatography, Types of chromatography	2	3,4,5
	2.2	Theory and Application -Gas chromatography, High-Performance Liquid Chromatography (HPLC)	5	3,4,5
	2.3	Theory, application, and demonstration of Thin Layer Chromatography and Column Chromatography	8	3,4,5

3. Practicals Professional Development		Analysis of soil i) Determination of pH of soil. ii) Determination of total soluble salts. iii) Determination of carbonate and bicarbonate. iv) Determination of calcium, magnesium and iron. **ii)** Determination of adulterant in some common food items i) Chicory in coffee powder ii) Foreign resin in asafetida iii) Chilli powder iv) Turmeric powder v) Pulses **iii)** Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given) (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b)Identify and separate the sugars present in the given mixture by paper chromatography. • Workshop on carrier awareness • Training sessions for interviews • Industrial visit • Interaction with industrial experts • Create Project	15	
4	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lectures, discussions, group activities, seminars, industrial visits, study tours**			

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 15 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 35 marks, Duration 1 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 3 out of 6 x 5 = 15 marks Part C (Long essay) – 1 out of 2 x 10 = 10 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

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SEMESTER VI

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme	**B Sc Chemistry (Honours)**					
Course Name	**Inorganic Chemistry-2**					
Type of Course	DSC					
Course Code	M24CH6DSC300					
Course Level	**300-399**					
Course Summary	This course discusses about theories and reactions coordination chemistry, introduction to organometallic compounds and bioinorganic chemistry. The practical component involves radical analysis and colorimetric estimation.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	**Inorganic Chemistry-1**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basics of coordination Compounds. Learn about IUPAC nomenclature, isomerism and stability of Coordination compounds	A	1,2
2	Understand the important theories of coordination compounds and Explain the mechanisms of substitution reactions	U	1,2
3	Describe the key concepts of inorganic and organometallic chemistry	E	1,2
4	Illustrate stability of organometallic compounds and clusters and their application as industrial catalysts.	U	1, 2,5
5	*Explain* the importance of various metal ions in biological system, structural understanding and biological functions of various biomolecules	E	1,2,5
6	*Evaluate* different complexes based on colourimetry and electronic spectra (Practical)	E	1,2,4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Coordination Chemistry	1.1	Introduction - Types of ligands – Anionic, cationic and neutral – IUPAC Nomenclature - Structural and stereoisomerism in coordination compounds. Chelates and chelate effect- Stability of complexes: Factors influencing stability	2	1
	1.2	Theories of bonding: Werner's theory, Sidgwick's concept of coordination, Valence bond theory - Geometries of coordination numbers 4 and 6 – Inner orbital and outer orbital complexes- Limitations of VBT..	2	2
1	1.3	Crystal field theory - Splitting of *d*-orbitals in octahedral, tetrahedral - CFSE - low spin and high spin complexes. Spectrochemical series - Explanation of geometry, magnetism and spectral properties - Jahn Teller Effect– Splitting of *d*-orbitals in tetragonal and square planar complexes- Factors affecting crystal field splitting - Merits and Merits and demerits of VBT and CFT MO theory, evidence for metal-ligand covalency, The nephelauxetic effect, MO diagram of complexes of octahedral symmetry (sigma bonding only)	6	2
	1.4	Reactivity of metal complexes-Labile and inert complexes	1	2
	1.6	Ligand substitution reactions SN_1 and,SN_2 .ligand substitution reactions in square planar and Octahedral complexes	2	2
	1.7	Trans effect and applications of trans effect Theories of trans effect-polarization and π-bonding theory.	2	2

2. Organometallic Compounds	2.1	**Organometallic Compounds:** Introduction to organometallic compounds, Hapticity in Organometallic compounds	1	3
	2.2	The 18- -electron rule, numerical problems, and stability	2	3
	2.3	Ferrocene: Preparation, structure, aromaticity and reactions (acetylation, alkylation).	2	3
	2.4	Metal-alkene complexes- – Preparation and structure of Zeise's salt	1	3
	2.5	Catalytic properties of organometallic compounds - Zeigler Natta catalyst in the polymerization of alkene. Wilkinson catalyst in the hydrogenation of alkene (mechanism not expected).	2	4
	2.6	Preparation and structure of mononuclear carbonyls- $Mo(CO)_6$, $Fe(CO)_5$ and $Ni(CO)_4$	3	4
	2.7	Polynuclear carbonyls, bridged carbonyls, and bonding in metal carbonyls – $Mn_2(CO)_{10}$ and $Fe_2(CO)_9$.	2	4
	2.8	Synergic effect and use of IR data in metal carbonyls to explain extent of back bonding	1	4
	2.9	Quadruple bond structure of $[Re_2CI_8]^{2-}$ & Quintuple bond structure of $[CrC_6H_3\text{-}2,6\text{-}(C_6H_3\text{-}2,6\text{-}(CHMe_2)_2)_2]_2$	1	4
3. Introduction to Bioinorganic Chemistry	3.1	Essential and non – essential metals	1	5
	3.2	Mechanism of ion transport- Ion pump (Na^+ and K^+)	2	5
	3.3	Porphyrins, Oxygen carriers haemoglobin and myoglobin- structure and functions, oxygen transport mechanism, co- operativity effect, Bohr effect	4	5
	3.4	Cytochromes- Structure and functions of Cytochrome P-450	1	5
	3.5	Non-heme proteins- structure and functions of hemocyanin & hemerythrin	1	5
	3.6	Photosynthesis- Chlorophylls (Structure not needed) – Z- scheme (Only)	2	5

		3.7	Metalloenzymes- specificity and mechanism Vitamin B12-Structure and Functions	2	5
		3.8	Toxicity of metals - Cd, Hg, Pb and Cr toxic effects with specific examples.	1	5
		3.9	Treatment of metal toxicity by chelation therapy by EDTA	1	5
4. Inorganic practical-II		4.1	Colorimetric estimation of Fe, Cu, Ni, Mn, Cr, NH_4^+, nitrate and phosphate ions. Or Demonstrate the UV- Visible spectra studies of different coordination compounds	15	6
		4.2	Study of the reactions of the following radicals with a view to their identification and confirmation. Pb^{2+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+, CO_3^{2-}, SO_4^{2-}, Cl^-, Br^-, CH_3COO^- 2. Systematic qualitative analysis of mixtures containing two acid and two basic radicals from the above list without interfering radical by Semi- micro method only. (Minimum of 5 mixtures to be analysed)	15	6
	3.9				
5		**Teachers Specific Content** (To be Evaluated Internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ● Lecture (Chalk& Board, Powerpoint presentation) ● Group Discussion ● Peer teaching ● Demonstration of experiments ● Hands-on training

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6th Edition, Wiley India Pvt. Ltd., New Delhi, 2009 (Reprint).
2. J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry–Principles of Structure and Reactivity, 4th Edition, Pearson Education, New Delhi, 2013.
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3. Catherine E. Housecroft , Alan G. Sharpe C. E. Barnes, Inorganic Chemistry 4th Ed. Journal of Chemical Education, 2003.
4. Synthesis of a Stable Compound with Fivefold Bonding Between Two Chromium(I) Centers. SCIENCE, 4 Nov 2005 844-847, 10.1126/science.1116789

Programme	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Physical Chemistry III**					
Type of Course	**DSC**					
Course Code	M24CH6DSC301					
Course Level	**300 – 399**					
Course Summary	The course aims to provide fundamentals of surface chemistry, chemical kinetics and electrochemistry along with their applications in various fields.					
Semester	**6**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		**75**
Pre-requisites, if any	It is advisable that the students should be aware of the fundamentals of general chemistry and physical chemistry including chemical bonding, chemical equilibrium and redox reactions.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PSO No.
1	Assess different kinds of adsorption and adsorption isotherms.	U,E	1, 2
2	Differentiate different types of colloidal systems and its purification methods. Explain the electronic and optical properties of colloidal particles.	A, An	1
3	Students interpret nature of various chemical reactions and describe their kinetics.	An,E	1, 2, 3
4	Make use of the principles of chemical kinetics to study the mechanism of homogeneous and heterogenous catalysis.	K,A	1
5	Describe the mechanism and factors affecting electrolytic conductance. Analyse properties of electrolytic conductance.	U,A	1, 3
6	Utilize conductance measurements in quantitative analysis	U,A	1, 2, 4
7	Apply Nernst equation to calculate electrode potential	A	1, 3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1. Surface Chemistry and Colloidal State **(15 Hours)**	1.1	Adsorption–types, adsorption of gases by solids – factors influencing adsorption – Freundlich adsorption isotherm – Langmuir adsorption isotherm –derivation of Langmuir adsorption isotherm. Use of Langmuir for surface area determination.	5	1
	1.2	Types of solutions– true, colloid and suspensions, Classification of colloids: Lyophilic, lyophobic, macromolecular, multimolecular and associated colloids with examples, Purification of colloids – Ultra filtration and electrodialysis.	4	2
	1.3	Optical and electrical properties of colloids: Brownian movement, Tyndall effect, Electrophoresis. Electrical double layer and zeta potential. Coagulation of colloids, Hardy-Schulz rule. Micelles and critical micelle concentration, sedimentation and streaming potential. Applications of colloids.	6	2
2. Chemical Kinetics **(15 Hours)**	2.1	Rate of reaction, rate equation, molecularity and order and of reactions, determination of order of the reactions, Integrated rate expressions for first and second order reactions. Zero order reactions, pseudo order reactions, half life.	5	3
	2.2	Effect of temperature on the rate of reaction Arrhenius equation, concept of activation energy. Theories of chemical kinetics: Collision theory - kinetic theory of collisions, steric factor. Types of complex reactions - consecutive reactions, opposing reactions, parallel reactions, Chain reactions, steady state approximation.	6	3
	2.3	Catalysis: Homogeneous catalysis, enzyme catalysis – Heterogeneous catalysis – Surface catalysis, Elementary idea about Autocatalysis.	4	4
	3.1	Introduction- Faraday's laws of electrolysis, electrochemical equivalent, electrolytic conductivity, molar conductivity - Variation of molar conductivity with concentration. Kohlrausch's law – applications	4	5

3. Electrochemistry **(15 Hours)**	3.2	Ionic mobility: - relation with ionic conductance, influence of temperature on ionic conductance, ionic conductance and viscosity–Walden's rule. Abnormal ionic conductance of H^+ and OH^- (Grotthus mechanism).	3	5
	3.3	Discharge of ions during electrolysis – Hittorf's theoretical device. Transport Numbers – determination by Hittorf's method and moving boundary method. Applications of conductance measurements – Determinations of degree of dissociation of weak electrolytes, solubility of sparingly soluble salts, conductometric titrations.	4	6
	3.4	Introduction to Galvanic cells, electrode potential – electrochemical series. Representation of cells – e.m.f of cell. Thermodynamics of reversible cells and reversible electrodes – Determination of ΔG, ΔH and ΔS of cell reaction. E.M.F and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and e.m.f -Nernst equation.	4	7
4. Practicals		1.Viscosity– Determination of viscosity of sucrose/glycerol. 2.Determination ofcomposition of binaryliquid mixture using viscometry(toluene-nitrobenzene) 3.Determinationofmolecularweight ofapolymer using viscometry(polystyreneintoluene) 4.Viscometry:VerificationofKendallsequation-fullexperiment 5. Computationalchemistryexperiments-Experimentsillustrating the capabilities of modern open source/ free computational chemistry packages in computing. • Singlepointenergy • Geometryoptimization • Vibrationalfrequencies • Population analysis • Conformationalanalysisofethane ,transitionstate search • Molecular orbitals, ionization energy, electron affinity • Dipole moment, free valence, bond order • Determinationofinversionbarrierofsimplemolecules like NH_3, H_2O, H_2O_2 • DeterminationofZ-matrices/Cartesiancoordinatesof furan, thiophene, pyrrole and	30	

		benzene using structure Drawing programs like Chemsketch and wwMacMolPlt. 6. Conductometry • Determinationofequivalentc onductanceofan electrolyte • Determinationofdissociationconsta ntanddegreeof dissociation of a weak acid • VerificationofOnsagerequation 7. Adsorption: • VerificationofFreundlichandLang muiradsorption isotherm - Charcoal Acetic acid or Charcoal-Oxalic acid system. Determinationofconcentrationofgivenacidusingthe isotherm		

5.	**Teachers Specific Content** (To be Evaluated Internally)
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, PowerPoint presentation) • Interactive Sessions Visual aids like videos and models to enhance understanding. • Peer discussions. • Problem Solving Sessions • Laboratory experiments and hands-on training

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. Glasstone S, An Introduction to Electrochemistry, East-West Press (Pvt.) Ltd., 2006.
2. Gurdeep Raj, Advanced Physical Chemistry, Goel publishing house, 2016.
3. Glasstone and Lewis, Elements of Physical Chemistry, London Macmillan, 1964.
4. Marronand S.H. and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Ltd., 1974.
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7. Castellan, G.W. "Physical Chemistry", Narosa Publishing House, 2004.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Discipline	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Chemistry of Aromatics and Essential Oil Constituents**
Type of Course	DSE
Course Code	M24CH6DSE300
Course Level	300-399
Course Summary	This course provides a comprehensive understanding of the various types of oils, fats, and waxes, their extraction, and their properties.

Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Describe the sources, production, nature, chemical constituents, and uses of common spices and condiments and the methods of production and chemistry of the constituents.	K	1
2	Illustrate the use of Natural Sources, production, and chemistry of aromatics and essential oil constituents like alcohols, aldehydes and phenols.	U, S	1, 4
3	Discuss the Natural Sources, production, and chemistry of aromatics and essential oil constituents like acids and esters.	U, S	1
4	Investigate the types of perfumes and flavours and their composition.	Ap, I	1, 4

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1 Spices, Spice Oils and Oleoresins (15 hours)	1.1	Study of the sources, production, nature, chemical constituents, and uses of common spices and condiments such as Cardamom, Pepper, Clove, Nutmeg, Mace, Cinnamon, Ginger, Turmeric, Celery, Fennel, Fenugreek, Coriander, Garlic, Vanilla, Saffron, Allspices, Curry leaves, Mint and Mustard.	8	1
	1.2	Methods of production, chemistry of the constituents, and uses of the following: Pepper, Ginger, Turmeric.	7	1
2. Production and Chemistry of Aromatics and Essential Oil Constituents -I (15 hours)	2.1	Natural Sources, production, and chemistry of aromatics and essential oil constituents such as: a) Alcohols: Benzyl alcohol, phenylethyl alcohol, Cinnamyl alcohol. b) Aldehyde: Benzaldehyde, Cinnamic aldehyde, Salicylaldehyde, Vanillin, Piperonal. c) Phenols: Thymol, Carvacrol, Eugenol, Isoeugenol, Methyleugenol.	15	2
3. Production and Chemistry of Aromatics and Essential Oil Constituents -II (15 hours)	3.1	Natural Sources, production, and chemistry of aromatics and essential oil constituents such as: a) Acids and Esters: Benzoic acid, Cinnamic acid, Salicylic acid, Anthranilic acid, Benzyl benzoate, Cinnamylacetate, Geranylacetate, Amylacetate. b) Miscellaneous Compounds- Coumarin, Cineoles, Indole, Muscone, Civetone, Artificial Musk.	15	3
	4.1	Concept of flavour, the difference between perfumes and flavour. Flavour Characterisation. Sensory analysis- descriptive and discriminant Sensory Analysis.	3	4

4. Flavours and Perfumes **(15 hours)**	4.2	The flavour of Coffee, Tea, Cocoa, Onion and Garlic. Synthetic ingredients of food flavourings.	3	4
	4.3	Perfumes: Odour, Odorants, Olfaction, Classification of odour. General Physiology of Olfaction. Perfume Raw materials- Terpeneles and Sesqueterenles oils, Concrete oils, Absolute oils, Isolates from essential oils, and Tincture.	4	4
	4.4	Source and Chemical nature of commercially important Gums, Balsams and Resins.	2	4
	4.5	Perfume Technology- blending and formulation of perfumes. Aerosol Spray Perfumes.	3	4
5	**Teacher Specific contents** This content will be evaluated internally.			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture Discussion Presentation

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

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01. F. Rosengarten, The Book of Spices, Jove, 1981.
02. J.W. Parry, Hand Book of Spices, Chemical Publishing, 1969
03. J.S. Pruthi, Spices and Condiments Chemistry, Microbiology and Technology, Academic Press, 1980.
04. E. Guenther, The Essential Oils, Vol I-VI, Van Nostrand, 1972.

05. M. Billot, F.V. Wells, Perfumery Technology: Art, Science and Industry, E. Horwood, 1975.

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07. L. Appell, Cosmetics, Fragrances and Flavours, Novox, 1982.

08. N. Groom, The Perfume Handbook, Chapman and Hall, 1992.

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**					
Programme/ Disciple	**B.Sc. CHEMISTRY (Honours)**					
Course Name	**Nanoscience and Nanotechnology**					
Type of Course	DSE					
Course Code	M24CH6DSE301					
Course Level	300-399					
Course Summary	This course provides a comprehensive understanding of the various aspects of different materials					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	The students will be aware of the fundamentals of nanomaterials, their unique physiochemical and optical properties, and their classifications	U	1,2
2	Understand different physical and chemical methods of synthesis of nanomaterials	Ap	1,2,
3	Will understand the importance of different functional nanomaterials, synthesis, and its properties	An	1,2
4	Will understand the applications of nanomaterials in energy, environment, and biology. Toxicity of nanomaterials will understand	S	1,2,5
	**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*		

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. General introduction and theory of nanomaterials	1.1	**General introduction and theory of nanomaterials:** History of nanomaterials; Size and shape dependant properties and their uniqueness; Nucleation and growth of nano systems, Energy at nanoscale - surface characteristics and electrostatic and steric stabilization	7	1
	1.2	classification of nanomaterials based on dimension- zero-dimensional, one dimensional and two dimensional nanostructures with suitable examples, origin of charge on colloidal sols, zeta potential	8	1
2. Synthesis of Nanomaterials:	2.1	**Synthesis of Nanomaterials:** Synthesis of nanomaterials- top down approach, bottom up approach, Physical Methods; Vacuum Evaporation, Electron beam evaporation, Cathodic Arc Deposition, Vapour Deposition techniques, mechanical milling, Chemical Methods; Sol-Gel technique, colloidal method, hydro-thermal method, microwave method, wet chemical methods.	15	2
3. Functional nanomaterials	3.1	**Functional nanomaterials** Carbon Nanomaterials: Introduction to Carbon allotropes and Carbon nanomaterials-Fullerenes: Background, Synthesis, Properties and Applications CNTs (SWNTs and MWCNTs,): Background, Synthesis, and Properties, Graphene: Background, Synthesis, Properties and Applications Metal Nanoparticles: Background, Synthesis, and Properties, Quantum dots: Background, Synthesis, and Properties, Nano chalcogenides: Background, Synthesis, and Properties,	15	3

4. **Applications of Nanomaterials**	4.1	**Applications of Nanomaterials** Application of nanomaterials in biomedicine: biosensor, cancer therapy, Drug delivery, Nanomaterials for energy conversion and storage: fuel cell, battery, super capacitor, solar cell, photocatalysis, Nanomaterials for Environment: water purification, coatings environment, agriculture, textile.	8	4
	4.2	Nanotoxicology and Biosafety: Nanoparticles in the human body: lungs, intestinal tract and skin, Deposition and translocation in the body, Attributes contribute to nanomaterials toxicity. Mechanisms of nanomaterial toxicity: oxidative stress, ecotoxicity, genotoxicity, hemolytic toxicity, mutagenicity and immunotoxicity, Ethics in Nanomedicine	7	4
5		**Teacher specific Contents** (To be evaluated internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

Reference:

1. K. J. Klabunde and R.M. Richards (Eds.), Nanoscale Materials in Chemistry, 2nd Edn., John Wiley & Sons, 2009.

2. T. Pradeep, Nano: The Essentials, McGraw-Hill (India) Pvt Limited, 2008.

3. Bharat Bhushan, (Ed.), Handbook of Nanotechnology, Springer, 2007.

4. Carl C. Koch (Ed.), Nanostructured Materials: Processing Propertiesand Applications, William Andrew Inc., 2007.

5. Anke Krueger, Carbon Materials and Nanotechnology, Wiley-VCH Verlag GmbH & Co. KGaA, 2010.

6. Cao, G., Nanostructures and Nanomaterials Synthesis, Properties, and Applications, Imperial College Press, 2004.

7. Wang, Z. L., (Ed.), Characterization of nanophase materials, Wiley-VCH Verlag GmbH, 2000.

8. Garcia-Martinez, J., (Ed.), Nanotechnology for the Energy Challenge. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2009.

9. Goddard III W.A., et. al.,(Ed.), Handbook of Nanoscience, Engineering, and Technology, Taylor & Francis Group, 2007.

10. B.P.S. Chauhan (Ed), Hybrid Nanomaterials: Synthesis, Characterization, and Applications,Wiley-VCH Verlag GmbH, 2011.

Type of Course	DSE					
Course Code	M24CH6DSE302					
Course Level	**300-399**					
Course Summary	This course deals with various energy applications of nanomaterials.					
Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Basic understanding of synthesis and properties of nanomaterials.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Develop a comprehensive knowledge base regarding global energy needs, consumption patterns, classification of energy sources and the energy conservation.	K, U	1, 2
2	Differentiate between conventional and non-conventional energy sources.	U, An	3
3	Analyze various photovoltaic technologies, including Solar Cells.	An	1,3
4	Develop a comprehensive knowledge of nanostructured materials	U	1, 2
5	Build a strong foundation in the role of MoFs and two diamensional materials in energy related applications	U, An	1,3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
		Global energy requirements and consumption.		1,2

1 Introduction to energy technologies	1.1	Classification of renewable and non-renewable energy technologies. Conventional energy sources – pros and cons (*with relevant case studies*). Challenges in the development and implementation of renewable energy technologies	9	
	1.2	Non-conventional sources of energy: Tidal energy, geothermal energy, biomass.	2	1,2
	1.3	Energy conversion, transport, and storage- challenges and outlooks	4	1,2
2 Nanomaterials for Energy Conversion	2.1	Principles of photovoltaic energy conversion (PV): Types of Solar cells: DSSC, Bulk Hetero Junction (BHJ- SC) Solar cells, Quantum dots, Si-solar cells, Perovskites.	8	3
	2.2	Nano, micro, and poly crystalline and amorphous silicon for solar cells. Nano-micro Si-composite structure, various techniques of Si deposition.	4	4
	2.3	Fuel Cells: Working principle and architecture, Micro- fuel cell technologies.	3	4
3 Nanomaterials for Storage Technology	3.1	Introduction to Battery technology (*working principle* *and architecture*), Primary and Secondary Batteries (Lithium-ion Batteries), Cathode and anode materials.	5	1,4
	3.2	Capacitors- Principles and materials design. Electrical double layer model. Electrochemical supercapacitors.	5	1,4
	3.3	Hydrogen storage: Materials and methods, MOFs, metal hydrides, hydrogen storage capacity, hydriding/dehydriding kinetics	5	1,4
4 State-of-the-art materials in Energy storage and conversion	4.1	Nanostructured Carbon-based materials, Nano-Oxides, Novel hybrid electrode materials.	5	1,5
	4.2	Introduction to MOFs and its role in energy storage and conversion. COFs (*elementary idea only*).	5	1,5
	4.3	Elementary idea of the state-of-the-art two-dimensional materials: graphene, boron nitride, carbon nitride, metal	5	1,5
		chalcogenides (MoS_2, $MoSe_2$, etc.).		
5.	**Teacher specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. Baldev Raj, Marcel Van de Voorde, Yashwant Mahajan, "Nanotechnology for Energy Sustainability (Applications of Nanotechnology)", 1st Edition, Kindle Edition, Wiley-VCH, 2017.
2. Twidell. J. and Weir. T "Renewable Energy Resources", E & F N Spon Ltd, 1986.
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4. Martin A Green, "Solar cells: Operating principles, technology and system applications", Prentice Hall Inc, Englewood Cliffs, 1981.
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   C. Linden Ed., Handbook of Batteries, 2nd edition, McGraw- Hill, New York (1995).
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8. J. Larmine and A, Dicks, Fuel Cell System Explained, John Wiley, New York (2000).
9. Science and Technology of Lithium Batteries-Materials Aspects: An Overview, A. Manthiram, Kulwer Academic Publisher (2000).
10. Hydrogen from Renewable Energy Sources by D. Infield 2004

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Biochemistry**
Type of Course	DSE
Course Code	M24CH6DSE303
Course Level	**300-399**
Course Summary	This course investigates the complex world of biological molecules and their functions within living organisms. This course equips students with a strong foundation in understanding the molecular mechanisms that underpin life processes, providing insights into the functioning of biological systems at a molecular level.

Semester	6	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Basic biological concepts and knowledge of biochemistry concepts, basic thermodynamics.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understanding of biochemical principles and biomolecular structures and functions, emphasizing detailed knowledge of protein structures and their folding dynamics for stability.	U	1,2
2	Apply knowledge by illustrating the structure and function of nucleic acids (DNA and RNA), showcasing an understanding of the double helix model and the significance of base pairing.	U, A	1,2,3
3	Analyze enzyme structures and functions, categorizing them based on classification and nomenclature, and critically	An	1,2
	evaluate the mechanisms of enzyme catalysis, including substrate binding and specificity.		
4	Evaluate enzyme kinetics and regulation, appraising the Michaelis-Menten kinetics and discerning the factors influencing enzyme activity, such as pH, temperature, and cofactors.	E	1,2

5	Analyze metabolic pathways, differentiate anabolism from catabolism, synthesize knowledge to understand hormonal and allosteric regulation, and identify critical checkpoints for energy homeostasis.	An	1,2,4
6	Evaluate the complexity of protein synthesis and amino acid metabolism.	E	1,2
7	Describe the principles of clinical and applied biochemistry.	U	1,2,4
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. Foundations of Biochemistry	1.1	Introduction to Biochemistry: Scope of biochemistry, Historical development and significance	2	1
	1.2	Biomolecular Structure and Function: Protein structure and function – Primary, secondary, tertiary, and quaternary structures of proteins; Protein folding and stability Nucleic acid structure and function – DNA and RNA, Double helix and base pairing Lipid structure and classification, Membrane structure and function, Role of carbohydrates in cell recognition and signalling	8	2
	1.3	Enzyme Structure and Function: Enzyme classification and nomenclature Mechanisms of enzyme catalysis – Substrate binding and specificity, Transition state theory Enzyme kinetics and regulation – Michaelis Menten kinetics, Factors influencing enzyme activity: pH, temperature, cofactors.	5	3
2. Metabolic Pathways	2.1	Overview of Metabolism: Anabolism vs. catabolism – Overview of metabolic pathways	3	4
	2.2	Carbohydrate Metabolism: Glycolysis and gluconeogenesis, Citric acid cycle Pentose phosphate pathway	6	4
	2.3	Lipid Metabolism: Fatty acid oxidation and synthesis, Triglyceride metabolism, Cholesterol biosynthesis and regulation	6	4

3. Amino Acid and Protein Metabolism	3.1	Protein Synthesis and Degradation: Transcription and Translation – Overview of the central dogma of molecular biology, RNA synthesis (transcription) and processing, Ribosomes and the translation process Protein targeting and trafficking.	8	5
	3.2	Amino Acid Metabolism: Nitrogen metabolism and balance, Ammonia detoxification and the urea cycle, Disorders related to amino acid metabolism	7	5
4. Clinical and Applied Biochemistry	4.1	Regulation of Blood Glucose; Insulin and Diabetes Mellitus, Hyperglycemic hormones, Glucagon.	3	6
	4.2	Liver and Gastric Function Tests: Functions of liver, Clinical manifestations of liver dysfunction, Studies on malabsorption.	3	6
	4.3	Kidney Function Tests: Renal function tests, Abnormal constituents of urine, Tests for tubular function.	3	6
	4.4	Acid-Base Balance and pH: Acids and bases, Buffers, Acid-base balance, Buffers of the body fluids, Respiratory regulation of pH, Renal regulation of pH, Cellular buffers, Disturbances in acid-base balance.	3	6
	4.5	General Techniques for Separation, Purification and Quantitation: Electrophoresis, Chromatography, Radioimmunoassay, ELISA test, Colorimeter, Autoanalyzer, Mass spectrometry.	3	6
5.	**Teacher specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture Sessions, Interactive Sessions including discussions and demonstrations, to engage students actively and visual aids like presentations and videos to enhance understanding.			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry, 7th ed., W. H. Freeman., 2021.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. Biochemistry. 9th Edition. W.H. Freeman and Co., 2019.
3. U. Satyanarayana, U. Chakrapani. Biochemistry. 6th Edition. Elsevier India Pvt. Ltd, 2021.
4. D M Vasudevan, S Sreekumari, Textbook of Biochemistry for Medical Students, Jaypee Brothers Medical Publishers, 2023.
5. P.J. Kennelly, Harper's Illustrated Biochemistry, 32 Edition, McGraw Hill, 2022.
6. R Singh, R Goyal, Lippincott's Illustrated Reviews – Biochemistry, 2020.
7. P Naik, Biochemistry, Jaypee Brothers Medical Publishers, 2022.

SUGGESTED READINGS

1. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. CHEMISTRY (Honours)**
Course Name	**Dairy Chemistry**
Type of Course	SEC
Course Code	M24CH6SEC300
Course Level	**300-399**
Course Summary	This course will enable students to understand about various types of milk, processing methods and the production of various dairy products.

Semester	6	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Critically evaluate the quality and nutritive value of milk by knowing the general chemical composition	E	1,4
2	Understand the techniques of milk processing	U	1,4
3	Evaluate different physicochemical properties of milk	E	1
4	Create a thorough knowledge about different types of milk.	C	1,4
5	Classify various types of Milk products based on their composition and processing methods	An	1

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 **Composition and processing of Milk**	1.1	Milk- Definition, General composition of Milk- Water, Protein, Lactose and Fat (Cow, Buffalo, Goat and Human). Nutritive value of milk. (4) Colostrum: Significance, Composition, difference between normal milk and colostrum. (2) Adulteration of Milk and Detection. Preservatives and Neutralizers. (3) Quality assurance – FSSAI, PFA, AGMARK. (1)	12	1
	1.2	Importance of Milk processing- Filtration, Clarification, Boiling, Homogenization and Pasteurization. (2) Types of Pasteurization- LTLT and HTST. (1)	3	2
2**.** **Physicochemical properties of Milk**	2.1	– Colour, Flavour, Density, Specific gravity, Freezing point, Boiling point, Surface tension, Viscosity, Specific heat, Refractive index, Electrical conductivity, Germicidal property, pH and acidity.	15	
3. **Special milk and Milk products**	3.1	Standardised milk – definition – merits. (1) Homogenised Milk, Flavoured Milk, Vitaminised Milk, Toned Milk, Incitation Milk, Vegetable Toned Milk, Condensed Milk – Definition Composition and Nutritive Value. (3)	4	2
	3.2	Butter – definition – composition – theory of churning – desibutter – salted butter.(2) Ghee – major constituents – common adulterants added to ghee and their detection – rancidity – definition – prevention. (2) Cream- definition-composition-chemistry of creaming process. (2)	6	2
	3.3	Fermented milk products – Fermentation of milk – Definition, Conditions.(1) Yogurt and Curd (Introduction- methods of production). (1) Khoa And Chana -Definition – Preparation Of Khoa and Chana- Sweets – Peda, Burfi, Gulab jamun , Rasogolla. (2) Milk powder – Definition – Need For Making milk powder	5	

		- Drying Process – Types of Drying(1)		
4		**Teacher specific Contents** (To be evaluated internally)		
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture Sessions, Interactive Sessions including discussions, demonstrations, and experiments to engage students actively and visual aids like presentations, videos, and models to enhance understanding. Encourage students to ask questions during or after the lectures. Begin with safety instructions and guidelines for lab work. Allow students to conduct experiments under supervision (for lab work).**			

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. R Jenness and Patom S., Principles of Dairy Chemistry, Wiley, 2017.
2. K.S.Rangappa and K.T Acharya., Indian Dairy Products, Asia Publishing House, 1975.
3. F.P. Wong., Fundamentals of Dairy Chemistry, Springer, 2012.
4. L.M. Lampert., Modern Dairy products, Chemical Publishing Company Inc., 1998.
5. J N Warner, Principles of Dairy Procesing, Wiley, 1976.
6. Sukumar De, Outlines of Dairy technology, Oxford, 2001.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Research Methodology for Chemistry**
Type of Course	VAC
Course Code	M24CH6VAC300
Course Level	**300-399**
Course Summary	This course covers a wide range of topics aimed at preparing students to conduct a scientific project in chemistry. Throughout the course, students might engage in practical exercises, case studies, and laboratory work to apply theoretical knowledge to real-world situations. The aim is to equip students with the skills and knowledge necessary to design, conduct, analyse, and communicate scientific research effectively in the field of chemistry.

Semester	6	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3				45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply the tools for literature survey in chemistry in doing and reporting a chemistry project.	A	1,2,6
2	Describe the methodology of scientific research.	U	1,6
3	Apply the knowledge of scientific writing in preparing a project report.	A	1,6
4	Discuss the ethical aspects of chemistry research.	U	1,3,6
5	Apply the basic principles of research methodology in the conducting, reporting and presenting a chemistry project.	A	1,6

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. **Literature Survey**	1.1	Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples	6	1
	1.2	Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, SciFinder, Scopus.	6	1
	1.3	Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information.	3	1
2. **Methods of Scientific Research and Writing Scientific Papers**	2.1	Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation.	5	2,3
	2.2	Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work.	5	2,3
	2.3	Ethical challenges in chemistry research, Responsible conduct of research, Writing Ethics, Avoiding plagiarism.	5	4
	Project			

3	3.1	**Training on writing a project report:** ➢ Project selection ➢ Literature Survey ➢ Conducting the project ➢ Preparing a report ➢ Preparing and displaying a poster ➢ ICT enabled oral presentation	15	1,2,3,4,5
4	**Teacher specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, discussions, group activities, presentations by students.

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. A T Tyowua, A Practical Guide to Scientific Writing in Chemistry: Scientific Papers, Research Grants and Book Proposals, CRC Press. 2023.
2. F. H. Jardine, How to do your Student Project in Chemistry, Springer, 1994.
3. A M. Coghill and L R Garson, The ACS Style Guide: Effective Communication of Scientific Information, Oxford University Press, 2006.
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6. D Angelo, G John, Ethics in Science: Ethical Misconduct in Scientific Research, Chapman and Hall/CRC, 2018.
7. https://www-library.ch.cam.ac.uk/list-useful-databases
8. https://fordham.libguides.com/Chemistry/Databases

SEMESTER VII

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Coordination and Organometallic Chemistry-1**
Type of Course	DCC
Course Code	M24CH7DCC400
Course Level	**400-499**
Course Summary	This course provides a comprehensive understanding of the structure, bonding, and reactivity of coordination complexes, electronic spectral properties, synthesis, and catalytic applications of organometallic compounds.

Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	**Inorganic Chemistry-2**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	***Compare*** **the stability of metal complexes**	E	1,2
2	***Examine*** **the structure and bonding in coordination and organometallic compounds using the concepts of crystal field theory and Molecular orbital theory**	An	1,2
3	***Construct correlation diagrams and explain*** **the spectral properties of metal complexes**	A	1,2
4	***Analyze*** **the reactions of organometallic compounds**	An	1,2
5	***Examine*** **the catalytic properties of various organometallic compounds and their applications**	An	1,2,4

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.Structure and Bonding in Coordination Complexes	1.1	Classification of complexes based on coordination numbers and possible geometries, σ and π bonding ligands such as CO, NO, CN^-, R_3P, and Ar_3P.	2	1
	1.2	Stability of complexes, kinetic and thermodynamic aspects of complex formation - Irving William order of stability.	2	1
	1.3	Splitting of *d* orbitals in octahedral, tetrahedral, square planar, square pyramidal and triagonal bipyramidal fields.	2	1
	1.4	Crystal Field Stabilization Energy (CFSE) and Dq values, Jahn Teller (JT) distortion (d_1 – d_{10} systems), static and dynamic JT distortion, consequences of JT distortion, theoretical failure of crystal field theory, Ligand Field Stabilization Energy (LFSE) evidence of covalency in the metal-ligand bond.	4	1
	1.5	Ligand field theory and Molecular Orbital theory - diagrams for octahedral and tetrahedral complexes without and with π-bonding, experimental evidences for π -bonding.	5	2
2.Electronic spectra of complexes	2.1	Electronic Spectra of complexes: Term symbols and microstates of d_n systems, Racah parameters, splitting of terms in weak and strong octahedral and tetrahedral fields, selection rules for electronic transitions - effect of spin-orbit coupling and vibronic coupling.	5	3
	2.2	Correlation diagrams: Orgel and Tanabe – Sugano diagrams.	3	3
	2.3	Electronic spectra of metal complexes and their interpretation. Charge transfer spectra, luminescence spectra.	5	3
	2.6	Electronic spectra of lanthanide and actinide complexes.	2	3
		Organometallic Compounds-Synthesis, Structure and Bonding		

3	3.1	Ligands and their bonding with metals: CO, CN, NO, N_2, H_2, alkene, alkyne, PR_3, arenes, dienes, allyl, carbenes – carbynes (Fischer and Schrock), alkyl	5	1
	3.2	Preparation of metal nitrosyl, dinitrogen, alkyl, aryl, alkene, alkyne, carbenes - carbynes (Fischer & Schrock), arene and phosphine complexes	3	1
	3.3	18 electron rule	1	1
	3.4	Bridging and non-bridging (Polynuclear) metal carbonyls, IR spectra of metal carbonyls, carbonyl clusters, Wade-Mingos rules.	3	1
	3.5	Isolobal analogy	1	1
	3.6	Cyclopentadienyl complexes - fluxionality	1	1
	3.7	Ferrocene: Structure and bonding	1	1
4. Reactions of Organometallic Compounds and Catalysis	4.1	Unique reactions in organometallic chemistry: Oxidative addition (concerted and step-wise, C_{aryl}-H activation – orthometallation), reductive elimination, migratory insertion (1,1 and 1,2), β-hydride abstraction/elimination. Agostic interactions, σ-bond metathesis (Zr(IV) and Lu(III)	6	4
	4.2	Homogeneous/Heterogeneous catalysis: Tolman catalytic loops, Hydrogenation by Wilkinson Catalyst, Olefin isomerization, Wacker process, Hydroformylation (Co & Rh), Monsanto & Cativa acetic acid process, Ziegler-Natta Polymerization	7	5

		including metallocene based Zr catalyst, Water gas shift reaction, the Fischer-Tropsch reaction (synthesis of gasoline)		
	4.3	Grubbs (I generation & II Generation) and Schrock catalysts – Preparation and characteristics, Olefin metathesis, ROMP	2	5
5.		**Teacher specific Contents** (To be evaluated internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry: A Comprehensive Text, 3rdEdn., Interscience,1972.
2. J.E. Huheey, E.A. Keiter, R.A. Keiter, Inorganic Chemistry Principles of Structure and Reactivity, 4thEdn., Pearson Education India, 2006.
3. K.F. Purcell, J.C. Kotz, Inorganic Chemistry, Holt-Saunders, 1977.
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5. B.E. Douglas, D.H. McDaniel, J.J. Alexander, Concepts and Models of Inorganic Chemistry, 3rdEdn., Wiley-India, 2007.
6. R.S. Drago, Physical Methods in Chemistry, Saunders College, 1992.
7. B.N. Figgis, M.A. Hitchman, Ligand Field Theory and its Applications, Wiley-India, 2010.
8. J.D. Lee, Concise Inorganic Chemistry, 4thEdn., Wiley-India, 2008
9. R. G. Wilkins, Kinetics and Mechanisms of Reactions of Transition Metal Complexes, Wiley VCH, 2002.
10. G. A. Lawrance, Introduction to Coordination Chemistry, John Wiley & Sons Ltd, 2010.
11. C. E. Housecroft, A. G. Sharpe, Inorganic Chemistry, Pearson, 2012.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/ Discipline	**B.Sc. (honours) Chemistry**
Course Name	**Organic Chemistry-4**
Type of Course	DCC
Course Code	M24CH7DCC401
Course Level	**400 -499**
Course Summary	The course discusses organic reaction mechanism of aliphatic/aromatic nucleophilic substitution reactions, Elimination reactions, esterification and ester hydrolysis. Physical organic chemistry explains free energy relationship and methods of determining reaction mechanism. Practical part of the course synthesis of biologically important molecule and using software to draw and manipulate different organic chemistry structures and reactions

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Predict the reaction mechanism and rationalize the outcome of various organic reactions and obtain practical experience	A	1,2
2	Illustrate and practice the transformations and rearrangements of reactive intermediates	An	1,2,3
3	Suggest a method to determine or verify an organic reaction mechanism	S, C	1,3
4	Understand mechanism of various organic reactions and correlate physical chemistry with organic reactions	E, U	1,3
5	Performs raw mechanisms and schemes using chemistry software and Prepare different organic molecule	S, A	1,4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 Organic Reaction mechanism and Physical Organic Chemistry	1.1	Organic reaction mechanisms of aliphatic/Aromatic nucleophilic substitution reactions: SN^1, SN^2, SE^1, SE^2- SN^2Ar, SN^1Ar, S_{RN}^1 and Benzyne mechanisms Elimination reactions: $E^1$and E^2, E^1CB A comprehensive study on the effect of substrate, reagent, leaving group, solvent, neighbouring group participation, salt effect and special salt effect on nucleophilic substitution (SN^2 and SN^1) and elimination (E^1 and E^2) reactions. Stereochemistry of Elimination-Elimination at bridge head carbon-Bredt's rule-Chugav reaction-elimination vs substitution	6	1,4
	1.2	Mechanisms of esterification and ester hydrolysis-acyl oxygen and alkyl oxygen cleavage: AAC^2, AAC^1, AAL^1, BAC^2 and BAL^1 mechanisms	4	1,4
	1.3	Methods of determining reaction mechanisms-primary and secondary kinetic isotope effects-kinetic versus thermodynamic control of product formation-linear free energy relationship-Hammet and Taft equation-Curtin-Hammett principle-Hammond postulate	5	3,4

2. Organic reactions and Intermediates	**2.1**	Wagner-Meerwein, semi-pinacol, Dienone-phenol, Benzilic acid, Noyori annulation, Prins reaction**.** Dieckmann, Stobbe, Darzen and acyloin condensations (radical), Shapiro reaction and Julia elimination, Woodward and Prevost hydroxylation reactions. Wittig and related reactions, Peterson olefination.	8	2
	2.2	Carbenes , Nitrenes, Free radicals Structure of carbenes: singlet and triplet-generation of carbenes-reactions of carbine-addition and insertion reactions. Structure, generation and reactions of nitrene and related electron deficient nitrene intermediates. Curtius, Lossen, Schmidt reactions. Named reactions involving radical intermediates: Barton Mc Combi deoxygenation and decarboxylation, McMurry coupling- Autooxidation reaction	**7**	2
3. Activity 1	3.1	i) Practice Chemdraw (Use ChemDraw / other software to draw and manipulate different organic chemistry structures and reactions) ii)Virtual Synthesis of aspirin (enable students to undertake an aspirin synthesis, perform recrystallization, Thin Layer Chromatography and calculation of yield using a digital resource). iii)Synthesis of aspirin iv) Experiment on Hammett equation (Experimentally determine the acid dissociation constant (Ka) of a series of substituted benzoic Acids, correlate the Ka values with known substituent constants (σx) and use the correlation generated above to calculate the substituent constants for 'unknown' substituted benzoic acid compounds.	15	5

4.Activity 2	3.2	Preparation of Organic Compounds 1) Acetanilide - p-nitroacetanilide - p-nitroaniline 2) Methyl benzoate - m-nitromethylbenzoate - m-nitrobenzoic acid 3) Acetanilide - p-bromoacetanilide - p-bromoaniline 4) Benzophenone – benzophenone oxime - benzanilide 5) Aniline - 2,4,6-tribromoaniline - 1,3,5-tribromoaniline 6) Benzaldehyde-benzoin-benzilic acid 7) Aniline-sulphanilic acid-methylorange 8) O-Toluidine-o-methyl acetanilide-N-acetyl anthranilic acid 9) Aniline-acetanilide-p-nitroacetanilide	15	5
5.	**Teacher Specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in laboratory

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

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7. Bahl, A.; Bahl, B.S. *Advanced Organic Chemistry*; S. Chand, 2010.
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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Physical Chemistry 4**
Type of Course	**DCC**
Course Code	M24CH7DCC402
Course Level	**400-499**
Course Summary	This course deals with various aspects of surface chemistry,gaseous state and different types of reactions based on chemical kinetics.

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Students can understand the molecular velocities of gasses and describe its distribution with temperature and comprehends the terms mean free path, collision diameter, effusion, etc.	K, U	1,2
2	Illustrate the theories of reaction rates and correlate the thermodynamically measurable parameters.	U, A	1,2
3	Compare the nature of reactions in gas as well as in solvent phase. Interpret the effect of ionic strength and dipole moment on reaction rate.	U, An	1,2
4	Describe the theories and applications of adsorption with the help of adsorption isotherms. Could evaluate the surface area.	K, A	1,2,4
5	Explain different methods for the molar mass determination of macromolecules.	A, An	1,2

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1.Kinetic theory of gases	1.1	Derivation of Maxwell's law of distribution of velocities, graphical representation, experimental verification of the law, most probable velocity, derivation of average, RMS and most probable velocities.	5	1
	1.2	collision diameter, collision frequency in a single gas and in a mixture of two gases, mean free path, frequency of collision, effusion, the rate of effusion, time dependence of pressure of an effusing gas, the law of corresponding states, transport properties of gases.	5	1
	2.1	Theories of reaction rates: - potential energy surfaces. Conventional transition state theory, Comparison of the collision theory and conventional transition theories.	4	2
	2.2	Thermodynamic formulation of the reaction rate-Eyring equation. Significance of $\Delta G^{\neq}$, $\Delta H^{\neq}$ and $\Delta S^{\neq}$, volume of activation. Effect of pressure and volume on velocity of gas reactions. Reactions in solution: Effect of solvent on reaction rate, cage effect, effect of dielectric constant and ionic strength on reaction rate - Bronsted-Bjerrum equation.	6	2,3
3. Surface Chemistry	3.1	Multilayer adsorption-BET theory, Use of BET isotherms for surface area determination.	3	4
	3.2	Application of Langmuir adsorption isotherm in surface catalysed reactions, the Eley-Rideal mechanism and the Langmuir-Hinshelwood mechanism, flash desorption. Macromolecules: Different averages, methods of molecular mass determination - osmotic, viscosity, sedimentation and light scattering methods.	7	4,5

4. Activity		1. Construction of phase diagram of three component system with one pair of partially miscible liquids. 2. Kinetics of simple reactions eg. Acid hydrolysis of methyl/ethyl acetate. 3. Kinetics of reaction between $K_2S_2O_8$ and KI. 4. Data analysis of kinetic experiments using spreadsheet program (determination of rate constant) 5. Polarimetry: a. Kinetics of the inversion of sucrose in presence of HCl. b. Determination of the concentration of a sugar solution 6. Refractometry: a. Identification of pure organic liquids and oils b. Determination of molar refractions of pure liquids c. Determination of concentration of solutions (KCl- Water, Glycerol—water) d. Determination of molar refraction of solids e. Study of complex formation between potassium iodide and mercuric iodide system		
5	**Teacher Specific Contents** (To be evaluated internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, Power point presentation) • Interactive Sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training

MODE OF ASSESSMENT

A. **Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B. **End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

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6. Puri, Sharma and Pathania, "Principles of Physical Chemistry", 48th Edition, Vishal Publishing Company
7. Barrow, G.M. "Physical Chemistry", Tata McGraw-Hill (2007).
8. Castellan, G.W. "Physical Chemistry",4th Ed. Narosa Publishing House (2018).

Suggested Readings

1. R P W Atkins, "Physical Chemistry", Oxford University Press (12th Edition)
2. R J Silby and R A Alberty, M G Bawendi "Physical Chemistry", (4th Edition) John Wiley & Sons
3. J. Rajaram, J. C. Kuriakose, Chemical thermodynamics: classical, statistical and irreversible, Dorling Kindersley (India), New Delhi, ©2013
4. Glasstone and Lewis, Elements of Physical Chemistry, Macmillan

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Molecular Spectroscopy in Structural Analysis**
Type of Course	**DCE**
Course Code	M24CH7DCE400
Course Level	**400-499**
Course Summary	This course explores different spectroscopic techniques used in the structural determination and their wide applications.

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Illustrate the basic concepts of Infrared spectroscopy	U	1, 2
2	Describe the principles of electronic spectroscopy and apply the principles to systems	A	1, 2
3	Demonstrate the underlying principles of NMR spectroscopy	U	1,2
4	Explain the concepts of mass spectroscopy	U	1,2,3
5	Deduce the structure of organic compounds by means of combined spectral techniques such as IR, UV, NMR and Mass.	E	1, 3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1 **Infrared Spectroscopy and Electronic Spectroscopy**	1.1	Hooke's law, bond properties and absorption trends, Fundamental vibrations, characteristic regions of the spectrum (fingerprint and functional group regions), influence of substituent, ring size, hydrogen bonding & solvent effect.	3	1
	1.2	IR spectra of polar O-H bonds (alcohols and carboxylic acids), C=C bonds (olefins and arenes), C=O (Acids, Aldehydes, Ketones, and Esters) bonds and C-H bonds (alkanes, alkenes, alkynes)	4	1
	1.3	Nature of electronic transitions, Chromophore, Auxochrome, representation of electronic spectra, Bathochromic shift, Hypsochromic shift, Hyperchromic shift, Hypochromic shift,	2	2
	1.4	Influence of substituent, solvent effect, conjugation, ring size and strain on spectral characteristics	2	2
	1.5	Calculations of λ_{max} of enones, aromatic hydrocarbons and conjugated polyenes based on Woodward-Fieser and Fieser- Kuhn rules.	4	2
2 **Nuclear Magnetic Resonance**	2.1	NMR phenomena based on ^{1}H & ^{13}C nuclei, ^{1}H & ^{13}C NMR spectra, Relaxation processes.	3	3
	2.2	Chemical shift, magnetic anisotropy and shielding/deshielding, chemical equivalence and number of	3	3

Spectroscopy		NMR signals. Population densities of nuclear spin states- intensity of the signal.		
	2.3	Spin-spin splitting, coupling constant, geminal coupling, Karplus curve, Pople notation - AX, AX_2, A_2X_3, AB, AB_2 type coupling, first order and non-first order spectra, homotopic, enantiotopic and diastereotopic protons.	4	3
	2.4	Simplification non-first order spectra to first order spectra: spin decoupling and double resonance, off resonance decoupling, NOE and cross polarization, DEPT	5	3
3 **Mass Spectrometry**	3.1	Basic principles. Ionization methods: Gas phase ionization methods– Electron impact ionization (EI) and Chemical Ionization (CI); Desorption ionization methods – Field desorption ionization (FD), Fast atom bombardment (FAB), Matrix assisted laser desorption ionization (MALDI); Plasma desorption ionization (PD). Comparison between EI and CI. Tandem mass spectrometry (MS-MS) (concept only). Separation techniques - Time of Flight analyser and Quadrupole Mass Analyzer. Nitrogen and Ring rules.	7	4
	3.2	Fragmentation rule (EI only), types of peaks involved (molecular ion, quasi molecular ion, isotopic peak, base peak, parent ion, daughter ion, fragment ion, metastable ion). Fragmentation pathways – alkanes, β cleavage (allylic and benzylic), α cleavage (carbonyl and heteroatom like ether), McLafferty rearrangement, Retro Diels Alder (olefins), ortho effect (aryl ring), elimination of neutral molecules (H_2O, CO_2). HRMS.	8	4

4 **Spectrum Analysis**	4.1	Identification of structures of organic compounds based on the data from Mass spectrometry, UV-Vis, IR, ^{1}H NMR and ^{13}C NMR spectroscopy. Interpretation of the given UV-Vis, IR and NMR spectra.	15	5
5	**Teacher Specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture (Chalk & Board, powerpoint presentation, flipped classroom) Group Discussion – Thought problems; mind mapping Peer interaction Demonstration using simulations / models			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. D.L. Pavia, G.M. Lampman, G.S. Kriz, Introduction to Spectroscopy, 3rd Edn., Brooks Cole, 2000.
2. A.U. Rahman, M.I. Choudhary, Solving Problems with NMR Specroscopy, Academic Press, 1996.
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Organic Compounds, 5th Edn., Wiley, 1991.
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Programme/ Discipline	**B.Sc. (honours) Chemistry**					
Course Name	**Organic Chemistry-5**					
Type of Course	DCE					
Course Code	M24CH7DCE401					
Course Level	**400 -499**					
Course Summary	The course provides topics in advanced stereochemistry and confirmation, photochemical reactions, name reactions of carbonyl compounds and pericyclic reactions					
Semester	7	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Master in determining and differentiating chirality, topicity of organic molecules and explore the chemical consequences and applications of conformational equilibria.	C	1,2
2	Understand the basic concepts of organic photochemistry and photochemical reactions	U, K	1,2
3	Know the different reactions of carbonyl compounds	K, U	1,2
4	Distinguish and predict the stereoselectivity, regioselectivity, and feasibility of pericyclic reactions and their applications	E, U	1,3
5	Understand the different methods for interconversion of organic compounds	A, S	1,3

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Advanced Stereochemistry & Conformation	1.1	Axial, planar and helical chirality with examples, stereochemistry and absolute configuration of allenes, biphenyls and binaphthyls, ansa and cyclophanic compounds, spiranes, exo-cyclic alkylidenecycloalkanes. Helicenes (P, M nomenclature)	4	1
	1.2	Topicity and prostereoisomerism, topicity of ligands and faces as well as their nomenclature, NMR distinction of enantiotopic/diastereotopic ligands.	4	1
	1.3	Conformation and reactivity of cyclohexane systems; dehalogenation, dehydrohalogenation, semipinacolic deamination and pyrolytic eliminations, Grob fragmentation. Chemical consequence of conformational equilibrium. Conformation and rate of reaction (rate of acetolysis and saponification)	4	1
	1.4	Chiroptical Properties: ORD, CD, Axial halo ketone rule, octant rule-Application	3	1
2. Organic Photochemistry	2.1	Organic Photochemistry-Introduction. Photochemical versus Thermal reactions. Electronic excitation and fate of excited molecules. Introduction-Jablonski diagram. Fluorescence and phosphorescence, inter system crossing- sensitization and quenching	7	2
	2.2	Photochemical reactions:- -Photo-Fries rearrangement. Photochemical reactions: Norrish type I and II reactions of acyclic ketones, Paterno-Buchi reaction and Photo- Fries reaction (with mechanisms), Barton (Nitrite ester reaction), Di-π methane rearrangement- Hofmann-Loffler-Freytag reaction- cis-trans isomerisation- photochemistry of vision	8	2, 5
	3.1	Mechanisms of Aldol condensation, Perkin's condensation, Claisen condensation, Claisen-Schmidt reaction, Benzoin condensation, Knoevenagel reaction, Cannizzaro reaction	5	3,5

3. Reactions of Aldehydes and Ketones and alpha, beta unsaturated carbonyl compounds	3.2	Oxidation and reduction reactions- Baeyer-Villiger oxidation, Oxidation using Cr (VI) reagents, (Jones oxidation, PDC, PCC oxidation), Fenton Oxidation, Johnson-Leumix oxidation, Peroxide oxidation-Clemmensen, Wolff-Kishner reduction, $LiAlH_4$ and $NaBH_4$reductions, Meerwein-Ponndorf-Verley reduction-Enantio selective reduction-CBS reduction-Heterogeneous reduction using transition metals (Pt, PD, Ru), Reduction using hydrazine. Structure and reactions of α, β- unsaturated carbonyl compounds involving electrophilic and nucleophilic addition-Michael addition, Mannich reaction, Robinson annulations, Ene reaction	10	3,5
4. Concerted Reactions	3.1	Classification: Electrocyclic, Sigmatropic, Cycloaddition, chelotropic, Ene and Dyotropic reactions. Woodward -Hoffmann rules - Frontier orbital and orbital symmetry correlation approaches - PMO method (for electrocyclic and cycloaddition reactions only).	5	**4**
	3.2	Pericyclic reactions in organic synthesis such as Claisen, Cope, Wittig, and Mislow-Evans rearrangements. Diels-Alder and Ene reactions, Patterno Buchi reaction (with stereochemical aspects), dipolar cycloaddition (introductory).	5	
	3.3	Unimolecular pyrolytic elimination reactions: Cheletropic elimination, Cope Elimination reaction, Acetates and Xanthates (Chugaev reaction).	5	**4**
5.		**Teacher Specific Contents** (To be evaluated internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Classroom lecture Demonstration and practical training in laboratory

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. R. Bruckner, Advanced Organic Chemistry: Reaction Mechanisms, Academic Press, 2002.
2. F.A. Carey, R.A. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms, 5th Edn., Springer, 2007.
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6. D.G. Morris, Stereochemistry, RSC, 2001.
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11. Jerry March, M.B. Smith, March's Advanced Organic Chemistry: Reactions,Mechanisms and Structure, 6th Edn., Wiley,2007.
12. R.O.C Norman and J. M. Coxon, Principles of Organic synthesis, third edition.
13. Biswanath Dinda, Essentials of Pericyclic and Photochemical Reaction.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme/Discipline	**B.Sc. (honours) Chemistry**
Course Name	**Quantum Mechanics and Group Theory**
Type of Course	**DCE**
Course Code	M24CH7DCE402
Course Level	**400-499**
Course Summary	This course covers the basic principles of quantum mechanics and group theory and its applications.

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

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Demonstrate the fundamental concepts of quantum mechanics and describe its application to simple systems, and examine the correlation between angular and radial wave functions in determining orbital shapes.	U	1
2	Recognize the most significant and elementary solutions of the Schrodinger equation in molecular quantum mechanics through a study of time-independent perturbation theory, valence bond, and molecular orbital theories.	An	1
3	Deduce various symmetry elements in molecules to classify molecules into various point groups and develop the group theoretical rules to generate group multiplication tables, matrix representations, and classes.	E	1, 4
4	Apply the concept of linear combination of atomic orbitals to hybridization and directed bonding in polyatomic molecules.	A, S	1

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

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1. Quantum Mechanics (15 Hours)	1.1	Classical mechanics: Failures, Black body radiation, Photoelectric effect, Compton effect and Atomic spectra of Hydrogen, Dual nature of matter – de Broglie equation, Heisenberg's uncertainty principle, and its significance. Schrodinger wave equation.	3	1
	1.2	Postulates of quantum mechanics - Well-behaved wave functions, Born's interpretation, Operator algebra. Laplacian and Hamiltonian operators. Eigen values and Eigen functions. Hermitian operators.	3	1
	1.3	Application to simple systems - Particle in 1-D box, normalization of wave function, Schrödinger equation for hydrogen atom – Coordinate system – cartesian and spherical polar coordinates, wave equation in spherical polar coordinates and its components.	3	1
	1.4	The postulates of time-dependent Schrödinger equation of motion, conservative systems, and time-independent Schrödinger equation. Quantization of angular momentum, quantum mechanical operators corresponding to angular momenta ((Lx, Ly, Lz), commutation relations between these operators, Ladder operator method for angular momentum, and space quantization.	3	1
	1.5	Derivation of time-independent SWE–Wave functions and SWE of all simple systems. Free particle in one-dimension, particle in a one-dimensional box with infinite potential walls, particle in a one-dimensional box with finite potential walls-tunneling, particle in a three-dimensional box separation of variables, degeneracy.	3	1
2.	2.1	Vibrational motion: Simple harmonic oscillator – force constant – zero point energy –Hermite equations and Hermite polynomials (qualitative idea only) Rotational		

Application to Exactly Solvable Problems **(15 Hours)**		Motion: coordinate systems, cartesian, The wave equation in spherical polar coordinates. Particle moving in a ring, particle on a sphere - Rigid rotator – reduced mass – moment of inertia rotational energy levels –Legendre equations and Legendre polynomials (qualitative idea only)	5	2
	2.2	The potential energy of hydrogen-like systems. The wave equation in spherical polar coordinates: separation of variables-R, theta, and phi equations and their solutions, wave functions, and energies of hydrogen-like atoms. Orbitals-radial functions, radial distribution functions, angular functions, and their plots.	6	2
	2.3	The postulate of spin by Uhlenbeck and Goldsmith, the discovery of the spin-Stern Gerlach experiment. Spin orbitals-construction of spin orbitals from orbitals and spin functions.	4	2
3. **Group Theory** **(15 Hours)**	3.1	Mathematical groups: Properties, Abelian groups, cyclic groups, sub-groups, Symmetry elements, symmetry operations, determination of distinct symmetry operations of C_n and S_n.	4	3
	3.2	Point group: Determination of point groups of molecules belonging to Cn, Cs, Ci, Cnv, Cnh, C∞v, Dnh, D∞h, Dnd, Td, and O_h point groups. Crystal symmetry.	4	3
	3.3	Similarity transformation, classes - C_{2v} and C_{3v}, GMT- C_{2v} and C_{3v}, Matrix representation of symmetry elements of E, C_n, S_n, i, σ.	3	3
	3.4	Reducible and irreducible representations- construction of irreducible representation by standard reduction formula. Statement of Great Orthogonality Theorem (GOT).	4	3
4. Chemical bonding and	4.1	Properties of irreducible representations. Construction of character tables for C_{2v}, C_{2h}, C_{3v}, C_3 and C_{4v}.	4	3
	4.2	Applications in chemical bonding, construction of hybrid orbitals with BF_3 and CH_4 as examples, and symmetry-adapted linear combinations (SALC) of C_{2v}, C_{2h}, C_{3v}, C_3, and D_{3h} point groups.	4	4

applications of Group Theory **(15 Hours)**	4.3	Transition moment integral, vanishing of integrals, rules for vibrational absorption. Determination of the symmetry of normal modes of H_2O and NH_3, Complementary character of IR and Raman spectra. Electronic transitions due to the carbonyl chromophore in formaldehyde.	7	4
5	**Teacher Specific Contents** (To be evaluated internally)			
Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture (Chalk & Board, PowerPoint presentation, flipped classroom) Group Discussion – Thought problems; mind mapping Peer interaction Demonstration using simulations/models			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar	B**. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A (Short answer) – 10 out of 12 x 2 = 20 marks Part B (Short essay) – 6 out of 9 x 5 = 30 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

References

1. P.W. Atkins, R.S. Friedman, Molecular Quantum Mechanics, 4thEdn., Oxford University Press, 2005.
2. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
3. Mc Quarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books.
4. T. Engel, Quantum Chemistry and Spectroscopy, Pearson Education, 2006.
5. F.A. Cotton, Chemical Applications of Group Theory, 3rdEdn., Wiley Eastern, 1990.
6. S. Swarnalakshmi, T. Saroja, R.M. Ezhilarasi, A Simple Approach to Group Theory in Chemistry, Universities Press, 2008.
7. A.S. Kunju, G. Krishnan, Group Theory and its Applications in Chemistry, PHI Learning, 2010.
8. K.Veera Reddy, Symmetry and Spectroscopy of molecules,New Age International (P) Ltd,1999.
9. C.N. Datta, *Lectures on Chemical Bonding and Quantum Chemistry*, Prism Books Pvt.Ltd., 1998.
10. F.L. Pilar, *Elementary Quantum Chemistry*, McGraw-Hill, second edition, 1990.
11. P.W. Atkins and R.S. Friedman, *Molecular Quantum Mechanics* , 4th Edition, Oxford University Press, 2005.
12. J.P. Lowe, *Quantum Chemistry*, 2nd Edition, Academic Press Inc., 1993.
13. HoriaMetiu, *Physical Chemistry – Quantum Mechanics*, Taylor & Francis, 2006.
14. A.K. Chandra, *Introduction to Quantum Chemistry*, 4th Edition, Tata McGraw-Hill,1994.
15. L. Pauling and E.B. Wilson, *Introduction to Quantum Mechanics*, McGraw-Hill, 2006 (A good source book for many derivations).

SEMESTER VIII

Programme	**B.Sc. (honours) Chemistry**					
Course Name	**Coordination and Organometallic Chemistry-2**					
Type of Course	DCC					
Course Code	M24CH8DCC400					
Course Level	**400-499**					
Course Summary	This course offers a comprehensive exploration of advanced topics in inorganic chemistry, covering magnetic properties, substitution mechanisms, organometallic catalysis, asymmetric versions, practical gravimetric analysis, and the Separation and identification of cation mixture.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Coordination And Organometallic Chemistry 1					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Analyze and explain the magnetic properties of coordination complexes	An	1,2
2	Evaluate the kinetics and mechanism of ligand substitution reactions in coordination complexes	E	1,2
3	Analyze the applications of organometallic compounds in organic synthesis and catalysis	An	1,2
4	Explain the properties and utility of polyferrocenylsilanes	U	1,2
5	Apply gravimetric analysis techniques accurately in estimating metal ions, including nickel (II), copper, iron, and aluminum.	A	1,4
6	Apply qualitative analysis techniques to distinguish and confirm the presence of specific cations, showcasing a comprehensive understanding of cation separation.	A	1,4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1. Magnetic Properties of Coordination complexes	1.1	Magnetic properties of complexes - paramagnetic and diamagnetic complexes, molar susceptibility, Gouy method for the determination of magnetic moment of complexes, spin only magnetic moment.	5	1
	1.2	Anomalous magnetic moments, quenching of magnetic moment. Temperature dependence of magnetism- Curie's law, Curie-Weiss law. Temperature Independent Paramagnetism (TIP), Antiferromagnetism-inter and intra molecular interaction. Structural elucidation of complexes (Co and Ni complexes) using electronic spectra and magnetic moments	10	1
2.Ligand substitution mechanisms in coordination complexes	2.1	Kinetics and mechanism of octahedral substitution- water exchange, dissociative, associative and interchange mechanisms, acid hydrolysis, base hydrolysis, SN_1cB mechanism.	6	2
	2.2	Electron transfer reactions: Outer sphere mechanism – Marcus' theory, inner sphere mechanism- Taube mechanism, mixed outer and inner sphere reactions, two electron transfer and intramolecular electron transfer.	6	2
	2.3	Δ and Λ isomers, Linkage isomerism: Electronic and steric factors affecting linkage isomerism	3	2
3 Organometallic homogeneous catalysis & asymmetric versions	3.1	Organometallic reagents in organic synthesis – Petasis, Schwartz reagents for organic transformations. Reppe reaction, Dötz reaction	4	3
	3.2	Hydrogenation reactions- H_2 hydrogenation and isopropanol transfer hydrogenations catalyzed by Ru(II) complexes, ionic hydrogenation, hydrosilylation	3	3
	3.3	Asymmetric catalysis- Chiral phosphine ligands (Structure only) - P-chiral ligands, BINAP, DIOP, Ferrocene based ligands - Josiphos, Asymmetric hydrogenation, Noyori hydrogenations, Shvo catalyst, transfer hydrogenation of ketones and imines, metal-ligand bifunctional catalysis-cooperative effect, epoxidation (Sharpless & Jacobsen).	5	3

	3.4	Preparation of L-DOPA drug, Matalachlor herbicide	1	3
	3.5	Organometallic polymers: Synthesis, properties and applications of polyferrocenylsilanes.	2	4
4.Inorganic Practical -4		**Part-1** **Gravimetric Analysis:** i. Estimation of nickel (II) using Dimethylglyoxime (DMG). ii. Estimation of copper as CuSCN iii. Estimation of iron as Fe2O3 by precipitating iron as Fe(OH)3. iv. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)3 (aluminium oxinate).	15	5
		Part-2 Separation and identification of a mixture of four cations (a mixture of two familiar ions such as Ag^{+} , Hg2+, Pb2+, Cu2+, Bi2+, Cd2+, As3+, Sn2+, Sb3+, Fe2+, Fe3+, Al3+, Cr3+, Zn2+ , Mn2+, Co2+, Ni2+, Ca2+, Sr2+, Ba2+, Mg2+, Li+ , Na+ , K+ and $NH4^{+}$ and two less familiar metal ions such as Tl, W, Se, Mo, Ce, Th, Ti, Zr, V, U and Li). Minimum four mixtures to be given.	15	6
5	**Teachers Specific Course** (To be evaluated Internally)			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Practical, Discussion

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks

	Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. J.E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry Principles of Structure and Reactivity, 4th Edn., Harper Collins College Publishers,1993.
2. F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorganic Chemistry, 6th edition, Wiley-Interscience, 1999.
3. K.F. Purcell, J.C. Kotz, Inorganic Chemistry, Holt-Saunders, 1977.
4. P. Powell, Principles of Organometallic Chemistry, 2ndEdn., Chapman and Hall, 1988.
5. B.E. Douglas, D.H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rdEdn., Wiley-India, 2007.
6. Sumit Bhaduri, Doble Mukesh, Homogeneous Catalysis: Mechanism and Industrial Applications, Wiley Interscience, 2000.
7. B.D. Guptha, A.J Elias, Basic Organometallic Chemistry, Universities Press, 2010.
8. Astruc, D.; Organometallic Chemistry and Catalysis, Springer Verlag, 2007.
9. Robert H. Crabtree, The Organometallic Chemistry of the Transition Metals, 4thEdn., Wiley Interscience, 2005.
10. J. G. de Vries, C. J. Elsevier, Handbook of Homogeneous Hydrogenations, 3 Volumes, Wiley-VCH, 2006.
11. Catherine E. Housecroft , Alan G. Sharpe C. E. Barnes, Inorganic Chemistry 4th Ed.. Journal of Chemical Education, 2003.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Instrumental Methods of Chemical Analysis**
Type of Course	**DCC**

Course Code	M24CH8DCC401					
Course Level	**400-499**					
Course Summary	Chromatography is a technique used to separate and analyze complex mixtures by passing them through a stationary phase, allowing components to move at different rates. Thermal analysis involves methods to study materials' properties as they change with temperature, including differential scanning calorimetry and thermogravimetric analysis. Surface analysis techniques like X-ray photoelectron spectroscopy and atomic force microscopy examine surface properties and compositions of materials at a microscopic level.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the basic principles and instrumentation of various chromatographic techniques.	U	1,3,4
2	Evaluate the efficiency and effectiveness of different chromatographic methods.	E	1,4
3	Describe basic principles, instrumentation, limitations and applications of various techniques for surface analysis, such as scanning electron microscopy (SEM), atomic force microscopy (AFM), X-ray photoelectron	U	1,2,3,4
	spectroscopy (XPS), Auger electron spectroscopy (AES), and secondary ion mass spectrometry (SIMS).		
4	Explain the basic principles, instrumentation and applications of various thermal analytical techniques.	U	1,2,4

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

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.

1 **Introduction to chromatography**	1.1	Adsorption and partition column chromatography- Methodology, advantages, limitations and applications.	3	1,2
	1.2	Thin-layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, limitations, and applications.	4	1,2
	1.3	Paper chromatography- Introduction, methodology, development techniques, advantages, limitations, and applications	4	1,2
	1.4	Electrophoresis– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications	4	1,2
2. **GC, HPLC and on exchange chromatography**	2.1	Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, limitations and applications, Hyphenated GC Techniques (GC- MS, GC-IR, GC-GC, or 2D GC).	6	1,2
	2.2	High-performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications, Hyphenated Techniques in HPLC.	5	1,2
	2.3	Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of the ion exchange process, factors	4	1,2
		affecting ion exchange, methodology and applications		
3.Surface and Thermal Analysis	3.1	X-Ray Photoelectron Spectroscopy- Instrumentation and Sample Introduction, Applications.	2	3
	3.2	Auger Electron Spectroscopy- Instrumentation, Applications.	2	3
	3.3	Secondary Ion Mass Spectrometry- Instrumentation, Applications, ToF-SIMS	2	3
	3.4	SEM- basic principles, Instrumentation, Applications.	2	3
	3.5	AFM- basic principles, Instrumentation, Applications	2	3
	3.6	Thermogravimetry- TGA Instrumentation, Analytical Applications of Thermogravimetry, Differential Thermal Analysis- DTA Instrumentation, Analytical Applications of DTA, Differential Scanning Calorimetry- DSC Instrumentation, Applications of DSC.	5	4

4.Practicals		General methods of separation and purification of compounds such as: 1. Solvent extraction 2. Soxhlet extraction 3. Fractional crystallization 4. TLC and Paper Chromatography 5. Column Chromatography Drawing the structures of organic molecules and reaction schemes by ChemDraw, Symyx Draw and Chemsketch. Draw the structures and generate the IR and NMR spectra of the substrates and products in the following reactions: 1. Cycloaddition of diene and dienophile (Diels-Alder reaction) 2. Oxidation of primary alcohol to aldehyde and then to acid 3. Benzoin condensation 4. Esterification of simple carboxylic acids 5. Aldol condensation		
5	**Teachers Specific Content** (To be evaluated Internally)			
Teaching and Learning Approach	Lecture Sessions, Interactive Sessions including discussions and demonstrations, to engage students actively and visual aids like presentations and videos to enhance understanding. Utilize case studies from various scientific fields (like environmental science, pharmaceuticals, forensics) to illustrate how different techniques are applied practically.			

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. J W. Robinson, E M. Skelly Frame, G M. Frame II, Undergraduate Instrumental Analysis, 7th Edition, 2014, Taylor & Francis.
2. M D Graef, M E. McHenry, Introduction to TEM, SEM, and AEM: The Practical Approach to Materials Characterization, 1st Edition, CRC Press, 2018.
3. J W. Robinson, E M S Frame, and G M. Frame II, Instrumental Analytical Chemistry, CRC Press, 2021.
4. F A Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
5. D A. Skoog, F. J Holler, S R. Crouch, Principles of Instrumental Analysis, 7th Edn., Brooks/Cole, 2020.
6. D A. Skoog, D M. West, F. J Holler, S R. Crouch, Fundamentals of Analytical Chemistry, 9th Edn., Brooks/Cole, 2014.
7. P. J. Haines, Principles of Thermal Analysis and Calorimetry, The Royal Society of Chemistry, 2002.
8. E Lundanes, Chromatography: Basic Principles, Sample Preparations and Related Methods, Wiley-VCH, 2013.
9. R Stafford, Chromatography: Principles and Instrumentations, Nyresearch Press, 2020.

Programme	**B.Sc. (honours) Chemistry**					
Course Name	**Computational Chemistry and Molecular Modelling**					
Type of Course	**DCE**					
Course Code	M24CH8DCE400					
Course Level	**400-499**					
Course Summary	This course deals with various aspects of computational chemistry and its applications. It also discuss molecular modelling technique in various fields.					
Semester	**8**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Demonstrate the need for the approximations the Hamiltonian.	U	1,2
2	Classify the different types of basis sets	U	1,2
3	Compare and contrast the different methods of computational chemistry.	An	1,2,3
4	Utilize GAMESS software to solve molecular systems	A	1,2,4
5	Utilize Autodock software to predict protein-ligand interactions	A	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 **Hartree Fock Method & Post Hartree Fock Methods**	1.1	Multi-electron atoms. Hartree method, Spin multiplicity, Slater determinant, properties of Slater determinant, Hartree-Fock (HF) equations. Secular determinant, restricted and unrestricted HF models.	4	1
	1.2	The Fock matrix, Roothan Hall equations, Elements of Fock Matrix (elementary ideas only), Steps for HF calculation, Koopmann theorem.	4	1
	1.3	The need for post HF methods. Electron correlation, post HF methods: Configuration interaction and Møller Plesset perturbation theory (elementary ideas only)	2	1
	1.4	Roothan's concept of basis functions, Basis functions, Slater type orbitals (STO), Gaussian type orbitals (GTO), sketches of STO and GTO. Differences between STOs and GTOs	2	2
	1.5	Classification of basis sets – minimal basis sets; Pople basis sets (with polarization and diffuse functions), Correlation consistent basis sets; double zeta, triple zeta and quadrupole zeta basis sets, split valence basis set, Hartree Fock limit	3	2
2 **Computational methods**	2.1	Semiempirical methods: Introduction, Neglect differential overlap method (NDO), Complete neglect of differential overlap (CNDO), Modified neglect differential overlap (MNDO); Austin Model 1, Parametric Method 3 (PM3), Zero Differential Overlap (ZDO) (All concepts only). Comparison of semiempirical methods. Software used for semiempirical calculations.	3	3

	2.2	Ab Initio method: Introduction, computation of correlation energy, computation of Slater determinant of excited states, Möller-Plesset Perturbation and coupled cluster method.	3	3
	2.3	Density Functional Theory: Introduction, Electron density, development of DFT, The functional, Hohenberg and Kohn Theorem, Kohn and Sham Method, Density Functionals – Exchange and Correlation functionals with examples, DFT methods, applications of DFT, performance of DFT, advantages of DFT in biological chemistry.	5	3
	2.4	Molecular Mechanics (MM): Introduction, Basic theory- bond stretching, angle bending, torsional strain, non bonded interactions. Force fields – MM2, MM3, MM4, AMBER, CHARMM, Merck Molecular Force Field, Consistent Force Field, Parameterization.	3	3
	2.5	Comparison between Semiempirical, Ab Initio, DFT and MM methods – merits and demerits.	1	3
3. Computational Software	3.1	Introduction to GAMESS. Setting up the input file with run type - geometry optimization, frequency calculation and single point energy calculations. $ groups, format for input file. Hands on training in using the software.	5	4
	3.2	Input for molecule – Cartesian coordinates and Z-matrix. Z matrix- Rules, z-matrix for linear molecules like diatomic molecules, acetylene, hydrogen cyanide and polyatomic molecules like water, ammonia, boron hydride, methane,	4	4
	3.3	Introduction to docking (basic ideas only), protein ligand interactions; Setting up the protein and ligand using Babel and Pymol; Predicting ADMET of the molecule using PreADMET application; docking procedures using Autodock software and result analysis with visualization of interactions using Discovery studio. Hands on training in using the software.	6	5
4.Practicals		Experiments illustrating the capabilities of modern open source/free computational chemistry packages in computing single point energy, geometry optimization, vibrational frequencies, population analysis, conformational studies, IR and Raman spectra, transition state search, molecular orbitals, dipole moments etc. Geometry input using Z-matrix for simple systems, obtaining Cartesian coordinates from structure drawing programs like Chemsketch.	30	
5.		Teachers Specific Content (To be evaluated Internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture (Chalk & Board, powerpoint presentation, flipped classroom) Group Discussion – Thought problems; mind mapping Peer interaction Demonstration using simulations / models

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)**	**B. End Semester Examination**
Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. K. I. Ramachandran, G. Deepa, K. Namboori, Computational Chemistry and Molecular Modeling Principles and Applications, Springer, 2008
2. P.W. Atkins, R.S. Friedman, Molecular Quantum Mechanics, 4thEdn., Oxford University Press, 2005.
3. Attila Szabo, Neil S. Ostlund, Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory, Dover Books on Chemistry
4. A. Leach, Molecular Modelling: Principles and Applications, 2nd Edn., Longman, 2001.
5. E.G. Lewars, Computational Chemistry: Introduction to the Theory andApplications of Molecular and Quantum Mechanics, 2nd Edn., Springer, 2011.
6. J.H. Jensen, Molecular Modeling Basics, CRC Press, 2010.
7. F. Jensen, Introduction to computational chemistry, 2nd Edn., John Wiley & Sons, 2007.
8. C.J. Cramer, Essentials of Computational Chemistry: Theories and Models, 2nd Edn., John Wiley & Sons, 2004.
9. Mark Tuckerman, Statistical Mechanics: Theory and Molecular Simulation, Oxford university Press, 2010.

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Crystallography and Electrochemistry**

Type of Course	DCE					
Course Code	M24CH8DCE401					
Course Level	**400-499**					
Course Summary	This course provides a comprehensive understanding of the crystallographic techniques and electrochemistry.					
Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the basic concept of crystal systems like unit cell, lattice and deduce the crystal structure of NaCl and KCl from XRD patterns.	U, An	1,2
2	Distinguish different diffraction methods and correlate the structure factor with the peak intensity.	U, A	1,2
3	Understand the structure of ionic solution and interpret the laws governing ionic conductivity and the features of concentration cells and fuel cells.	U, An	1,3
4	Explain the causes of corrosion and prevention methods. Understand electrode polarisation and related aspects.	A, An	1,2,4
5	Learn the basic principles of voltammetry and Understand the theory behind electroanalytic techniques and apply it for quantitative and qualitative analysis	U, A, An	1,2,4

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.**Crystallography**	1.1	Symmetry in crystals: Symmetry elements – proper rotation (order of axis – 1, 2, 3, 4 and 6 – derivation), mirror plane, rotary inversion axis. 32 crystallographic point groups (derivation not expected), Hermann-Mauguin notation and corresponding schoenflies notations, translational symmetry elements - glide planes and screw axes, fourteen Bravais lattices, space groups (concept only). Space groups of triclinic and monoclinic systems.	5	1
	1.2	Miller indices, inter-planar spacing and method of determining lattice types, reciprocal lattices. X-ray diffractometer: Single crystal and powder pattern methods (experimental part). Analysis of powder diffraction patterns of NaCl and KCl. Debye-Scherrer equation.	6	1
	1.3	Crystal growth techniques. Structure factor: Atomic scattering factor, coordinate expression for structure factor.	4	2
2. Advanced Electrochemistry	2.1	Debye-Huckel theory, derivation of Debye-Huckel-Onsager equation, validity of DHO equation for aqueous and non-aqueous solutions, Debye-Huckel limiting law (no derivation) qualitative and quantitative tests of Debye-Huckel limiting law, deviations from DHLL	10	3
	2.2	Concentration cells – with and without transference, liquid junction potential, electrode double layer, electrode-electrolyte interface, different models of double layer,	10	3

		theory of multilayer capacity, electro capillary, Lippmann equation, membrane potential. Fuel cells- Theory and working of fuel cells- methanol fuel cell, H_2-O_2 fuel cell and solid oxide fuel cells.		
	2.3	Corrosion and methods of prevention, Pourbaix diagram and Evans diagrams. Electrode polarization: - Overvoltage: hydrogen and oxygen overvoltage, theories of overvoltage, Tafel equation and its significance.	10	4
3.Electro analytical techniques	3.1	Electroanalytical techniques: Classification – Interfacial methods and bulk methods; Idea of static and dynamic methods.	1	5
	3.2	Polarography- decomposition potential, residual current, migration current, supporting electrolyte, diffusion current, polarogram, half wave potential, limiting current density, polarograph, explanation of polarographic waves. The dropping mercury electrode, advantages and limitations of DME, quantitative analysis- pilot ion procedure, standard addition methods, qualitative analysis - determination of half wave potential of an ion, advantages of polarography.	8	5
	3.3	Cyclic voltammetry – basic principles and fundamentals; cyclic voltammogram for a reversible and irreversible redox process, Scan rate, Amperometric titrations: General principles of amperometry, instrumentation, application of amperometry in the qualitative analysis of anions and cations in solution, merits and demerits of amperometric titrations.	6	5
4.Practicals		1. Construction of phase diagram of three component system with one pair of partially miscible liquids. 2. Kinetics of simple reactions eg. Acid hydrolysis of methyl/ethyl acetate. 3. Kinetics of reaction between $K_2S_2O_8$ and KI. 4.Data analysis of kinetic experiments using spreadsheet program (determination of rate constant) 5.Polarimetry: a. Kinetics of the inversion of sucrose in presence of HCl. b. Determination of the concentration of a sugar solution 6.Refractometry: a. Identification of pure organic liquids and oils b. Determination of molar refractions of pure liquids c. Determination of concentration of solutions (KCl- Water, Glycerol—water) d. Determination of molar refraction of solids Study of complex formation between potassium iodide and mercuric iodide system		

5.		**Teachers Specific Content** (To be evaluated Internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, Power point presentation) • Interactive Sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

1. R P W Atkins, "Physical Chemistry", Oxford University Press (12th Edition)
2. N B Hannay, "Solid State Chemistry", Prentice Hall.
3. A. McQuarrie, J. D. Simon, "Physical Chemistry – A molecular Approach", Viva Books Pvt. Ltd.
4. Anthony R. West, "Solid State Chemistry and its Applications", Wiley Eastern.
5. Olja Simoska, Shelley D. Minteer, "Techniques in Electroanalytical Chemistry", American Chemical Society, (2022)
6. Glasstone S, An Introduction to Electrochemistry, East-West Press (Pvt.) Ltd. (2006).
7. Gurdeep Raj, Advanced Physical Chemistry, Goel publishing house.
8. R J Silby and R A Alberty, M G Bawendi "Physical Chemistry", (4th Edition) John Wiley & Sons
9. F Daniels and R A Alberty, "Physical Chemistry", 3rd ed. John Wiley and Sons, Inc., New
10. Electrochemical methods: Fundamentals and Applications, Second Edition, Allen J Bard and Larry R Faulkner.

Suggested Readings

1. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd.
2. Glasstone and Lewis, Elements of Physical Chemistry, Macmillan
3. I.N. Levine, Physical Chemistry, Tata McGraw Hill
4. Barrow G.M., Physical Chemistry, Tata McGraw-Hill (2007).

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B.Sc. (honours) Chemistry**
Course Name	**Advanced Organic Chemistry**
Type of Course	DCE
Course Code	M24CH8DCE402
Course Level	**400-499**
Course Summary	This course deals with advanced organic chemistry reactions and various applications.

Semester	8	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the concept of protecting groups in organic synthesis	U, A	1,2
3	Create the skills to plan how to prepare organic molecules.	C, An	1,3
4	Create a range of key reactions for application in organic synthesis.	C, An	1,2,4
5	Evaluate different chemical reagents and reactions used in organic synthesis.	U, E, An	1,2,4

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.**Protecting group chemistry**	1.1	Protection and deprotection of hydroxy, carboxyl, carbonyl, and amino groups. Chemo and regio selective protection and deprotection.	5	1
	1.2	Protection and deprotection in peptide synthesis: common protecting groups used in peptide synthesis, protecting groups used in solution phase and solid phase peptide synthesis (SPPS).	6	1
	1.3	Role of trimethyl silyl group in organic synthesis.	4	1
2. Retrosynthetic Analysis	2.1	Basic principles and terminology of retrosynthesis: synthesis of aromatic compounds, one group and two group C-X disconnections; one group C-C and two group C-C disconnections.	6	2
	2.2	Amine and alkene synthesis: important strategies of retrosynthesis, functional group transposition, important functional group interconversions. Retrosynthesis of luciferin. Umpolung equivalent - Peterson olefination, Ireland-Claisen rearrangement.	9	2

3.Modern synthetic methods and reagents	3.1	Baylis-Hillman reaction, Henry reaction, Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction, Noyori reaction, Brook rearrangement. Tebbe olefination. Metal mediated C-C and C-X coupling reactions: Heck, Stille, Suzuki, Negishi, Sonogashira, Nozaki-Hiyama, Buchwald- Hartwig, Ullmann reactions. Kumuda coupling, Wohl-Ziegler reaction. Reagents such as NBS, DDQ, DCC, Gilmann reagent.	10	3
	3.2	Introduction to multicomponent reactions- Three component reactions (Mannich reaction, Passerini reaction, Biginelli reaction), Four component reactions (Ugi reaction). Click reactions (Triazole synthesis).	5	4
4.Practicals		**Preparation of compounds by two stages.** 1) Acetanilide - p-nitroacetanilide - p-nitroaniline 2) Methyl benzoate - m-nitromethylbenzoate - m-nitrobenzoic acid 3) Acetanilide - p-bromoacetanilide - p-bromoaniline 4) Benzophenone – benzophenone oxime - benzanilide 5) Aniline - 2,4,6-tribromoaniline - 1,3,5-tribromoaniline **Preparation Involving Green Alternatives of Chemical Methods** 1) Acetanilide from aniline 2) Ortho-methyl acetanilide from ortho-toluidine 3) 1,1-Bis-2-Naphthol from 2-Naphthol	30	
5.		**Teachers Specific Content** (To be evaluated Internally)		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Lecture Sessions, (Chalk & Board, Power point presentation) • Interactive Sessions and simulations, • Visual aids like videos and models to enhance understanding. • Peer discussions. • Laboratory experiments and hands-on training

MODE OF ASSESSMENT

A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar Practical Total = 15 marks Lab performance, record, field report etc.	**B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A (Short answer) – 10 out of 12 x1 =10 marks Part B (Short essay) – 4 out of 6 x 5 = 20 marks Part C (Long essay) – 2 out of 4 x 10 = 20 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

References

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3. S. Warren, P. Wyatt, Organic Synthesis: The Disconnection Approach, 2nd Edn.,Wiley, 2008.
4. V.K. Ahluwalia, Oxidation in Organic Synthesis, CRC Press, 2012.
5. I. Ojima, Catalytic Asymmetric Synthesis, 3rd Edn., John Wiley & Sons, 2010.
6. W. Carruthers, I. Coldham, Modern Methods of Organic Synthesis, 4th Edn.,Cambridge University Press, 2004.
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8. R. Noyori, Asymmetric Catalysis in Organic Synthesis, John Wiley & Sons, 1994.
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12. J. Zhu, Q. Wang, M. Wang (Eds), Multicomponent Reactions in Organic Synthesis,Wiley VCH, 2015.
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