SEMESTER I

University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE100**				
Course Title	**INORGANIC CHEMISTRY I**				
Type of Course	**DSC**				
Semester	I				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	This course provides an understanding of atomic structure, chemical bonding theories, environmental chemistry focusing on air, water, and soil pollution, and basics of analytical chemistry including volumetric analysis techniques. Through theoretical concepts, practical experiments, and case studies, students gain knowledge and skills essential for addressing complex issues in chemistry and environmental science.				

Detailed Syllabus:

Module	Unit	Content INORGANIC CHEMISTRY I	Hrs 75
I	**ATOMIC STRUCTURE & PERIODICITY**		**9**
	1	Introduction to structure of atom, Rutherford and Bohr model of atom	1
	2	Dual nature of electron-de Broglie equation-matter waves and electromagnetic waves. Experimental verification by Davis and Germer method, Heisenberg's uncertainty principle- expression and significance.	1
	3	Wave mechanical concept of the atom-Schrodinger equation and its significance (derivation not required.)	1
	4	Quantum numbers- Pauli's Exclusion principle- Aufbau Principle- Hund's rule- Electronic configuration of atoms, classification of elements into s, p, d and f blocks	2
	5	Electronegativity- Pauling's scale, Mulliken and Allred- Rochow scale (including numerical problems),	2
	6	Effective nuclear charge, Slaters rule and its applications, diagonal relationship and anomalous behaviour of first element with other elements	2
II	**CHEMICAL BONDING**		**15**

	7	Overview of Chemical Bonding Theories: - Definition of chemical bonding. - Importance of understanding chemical bonding in chemistry and related fields.	1
	8	Valence Shell Electron Pair Repulsion (VSEPR) Theory - Explanation of VSEPR theory. - Predicting molecular geometry for molecules with bond pairs only. - Predicting molecular geometry for molecules with both bond pairs and lone pairs. - Application of VSEPR theory in predicting molecular properties.	2
	9	Valence Bond Theory (VBT) - Conditions of overlapping in VBT. - Types of overlapping (sigma, pi, delta). - Hybridization in molecules: sp, sp^2, sp^3, sp^3d, sp^3d^2. - Limitations of VBT and its application to simple molecules.	2
	10	Molecular Orbital (MO) Theory - Introduction to MO theory. - Linear Combination of Atomic Orbitals (LCAO) method. - Formation of molecular orbitals in homonuclear diatomic molecules (C_2, B_2, N_2, O_2) and ions (O_2^+, O_2^-). - Formation of molecular orbitals in heteronuclear diatomic molecules (HF, NO, CO). - Calculations of bond order and its applications.	3
	11	Ionic Bonding - Explanation of ionic bonding, Ionic lattice energy of ionic compounds. - Bond-Lande equation and Born-Haber cycle. - Solvation energy and solubility of ionic solids. - Covalent character of ionic bonds. - Fajan's rules and their applications. - Polarity of covalent bonds. - Dipole moment and percentage of ionic character. - Relationship between dipole moment and molecular structure.	3
	12	Metallic Bonding - Overview of metallic bonding. - Free electron theory and band theory. - Explanation of conductance and malleability in metals.	1
	13	Secondary Forces - Explanation of hydrogen bonding. - Inter and intramolecular hydrogen bonding. - Applications of hydrogen bonding in biology, chemistry, and materials science. - Intermolecular interactions: ion-dipole interactions, van der Waals forces (dispersion forces, dipole-dipole interactions, ion-induced dipole interactions, dipole-induced dipole interactions).	2

	14	Case studies and Problem-solving Session Group problem-solving exercises related to molecular geometry, hybridization, bond calculations, and properties of molecules based on their bonding.	1
III	**ENVIRONMENTAL CHEMISTRY- AIR, WATER AND SOIL POLLUTION**		**9**
	15	Air pollution- Air pollution caused by fireworks, harmful effects of fireworks, acid rain, greenhouse effect, smog-classic and photochemical smog Ozone layer depletion, ozone hole, protection of ozone umbrella. Management of air pollution.	2
	16	Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants Treatment of industrial waste water- Activated charcoal, synthetic resins, reverse osmosis and electro dialysis (Mention Only), Quality of drinking water- Indian Standard and WHO standard- Dissolved oxygen- BOD, COD.	3
	17	Soil pollution: pesticides, fertilizers, Industrial waste, Plastic. Control of Plastic threat- importance of Plastic identification codes and Plastic recycling, use of biodegradable plastics (PGA, PLA and PHBV (mention only)	2
	18	Control of pollution. Pollution Control Board – Duties and responsibilities Mention environmental movements (Plachimada, Silent valley, movement against Endosulfan, *Narmada Bachavo Andolan* and Chipko movement)	2
IV	**BASICS OF ANALYTICAL CHEMISTRY**		**12**
	19	Measurement of physical properties: International system of units and definitions, scientific notation, significant figures.	2
	20	Mole concept and molar mass, Concentration of solutions: Molarity, Normality, Molality, Mole fraction.	2
	21	Principles of volumetric analysis, primary standard, secondary standard, standard solution. Accuracy, precision, sensitivity, and selectivity	1
	22	Theory of Acid- Base titration: Acidimetry, Alkalimetry: Basic concepts, principle and illustration with suitable example. Theory of acid-base indicators	3
	23	Definition of Redox Reactions, Balancing of redox equations, Theory of Redox titration: Titration of Fe^{2+} with $KMnO_4$ and $K_2Cr_2O_7$ and theory of redox indicators.	2
	24	Theory of complexometric titration: metal ion-EDTA titration. Theory of metallochromic indicators Precipitation titration: NaCl- $AgNO_3$ titration and use of potassium chromate as adsorption indicator.	2
V	**VOLUMETRIC ANALYSIS**		**30**
	25	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions. 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base	15

		c. Weak acid – Strong base 3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.	
	26	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References:

1. B.R. Puri L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2010.
2. J.D. Lee, *Concise Inorganic Chemistry*, 5th Edn., Wiley India Pvt. Ltd., 2008.
3. R. Gopalan, V.Ramalingam, *Concise Coordination Chemistry*, 1st Edn.,Vikas Publishing House, New Delhi, 2001.
4. S. Prakash, G. D. Tuli, S. K. Basu, R. D. Madan, *Advanced Inorganic Chemistry*, 5th Edn., Vol. I, S Chand, 2012.
5. G. S. Manku, *Theoretical Principles of Inorganic Chemistry*. McGraw-Hill Education; New edition (1 August 1982)
6. M.C. Day, J. Selbin, *Theoretical Inorganic Chemistry*, East West Press, New Delhi, 2002.
7. J. E. Huheey, E.A. Keitler, R. L. Keitler, *Inorganic Chemistry-Principles of Structure and Reactivity*, 4th Edn., Pearson Education, New Delhi,2013.
8. B.K. Sharma, *Industrial chemistry*, 11th Edn., Goel publishing House, Meerut, 2000.
9. M.N. Greenwood, A. Earnshaw, *Chemistry of elements*, 2nd Edn., Butterworth,1997.
10. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edn., Pearson Education, Noida, 2013.
11. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brooks/Cole, Thomson Learning, Inc., USA, 2004.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Critically analyse atomic structure theories, quantum mechanical concepts, periodic properties, and periodic classification to predict and explain the electronic configuration, chemical behaviour, and trends in the properties of elements using theoretical models, principles,	An	PSO -1

	and numerical applications.		
CO-2	Analyze the fundamental and advanced chemical bonding theories—including VSEPR, VBT, MO theory, and bonding models for ionic, metallic, and secondary forces—to predict molecular structure, properties, and reactivity through case studies and problem-solving approaches.	An	PSO -1,2,3
CO-3	Critically evaluate the causes, effects, and control strategies of air, water, and soil pollution, assess national and global standards for environmental quality, and appraise the significance of environmental movements and regulatory frameworks in sustainable pollution management.	E	PSO -1,2,3
CO-4	Design and perform quantitative analytical procedures by applying fundamental principles of solution chemistry, titrimetric methods, and relevant indicators with accuracy, precision, and scientific rigor.	C	PSO -2,3,4
CO-5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO -2,3.4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INORGANIC CHEMISTRY 1

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO – 1 PSO -1	An	F, C	L	-
2	CO-2	PO -1, 2, 3, 6 PSO -1,2,3	An	F, C	L	-
3	CO-3	PO – 1, 2, 6 PSO -1,2,3	E	F, C	L	-
4	CO-4	PO – 2,3,8	C	F, C	L	-

		PSO -2,3,4				
5	CO-5	PO – 1,2,3,6 PSO -1,2,3,4,5	C	C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO 1	2	-	-	-	-	1	-	-	-	-	-	-	-
CO 2	2	2	3	-	-	1	1	1	-	-	2	-	-
CO 3	2	3	3	-	-	1	1	-	-	-	2	-	-
CO 4	-	2	3	2	-	-	2	2	-	-	-	-	3
CO 5	3	2	3	2	3	1	2	2	-	-	3	-	-

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓		✓	✓

University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE101**				
Course Title	**FUNDAMENTALS OF CHEMISTRY I**				
Type of Course	**DSC**				
Semester	I				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	The course covers fundamental principles in the periodic classification of elements, chemical bonding, thermodynamics and thermochemistry, analytical principles, and lab safety, providing students with a comprehensive understanding of key concepts in chemistry. Through both theoretical learning and hands-on practicals in volumetric analysis, students develop essential skills for analytical chemistry and gain practical experience in experimental techniques.				

Detailed Syllabus:

Module	Unit	Contents FUNDAMENTALS OF CHEMISTRY I	Hrs 75
I	**PERIODIC CLASSIFICATION OF ELEMENTS**		**9**
	1	Quantum numbers and their significance, Concept of orbitals.	2
	2	Orbital wise electron configuration, energy sequence rule – Pauli's principle, Hund's rule, stability of filled and half-filled orbitals	2
	3	Electronic configuration and classification of elements in to s, p, d and f blocks.	1
	4	Periodic properties, Ionisation energy, Electronegativity and Electron affinity. Diagonal relationship.	2
	5	Important characteristics of representative elements: valency, oxidation states, ionic and covalent bond formation Important characteristics of transition elements: variable valency and oxidation states, formation of Complex compounds.	2
II	**CHEMICAL BONDING**		**9**
	6	Energetic of bond formation – Types of Chemical bonds – Energetics of ionic bond formation – Lattice energy – Born Haber Cycle - Fajan's rules.	2

	7	Polarity of covalent bond its relation with electronegativity - Electro negativity scale – Pauling approach, Dipole moment – its relation to geometry.	2
	8	Hydrogen bond – inter and intra molecular – its consequences on boiling point, volatility and solubility.	1
	9	Concept of Hybridisation– sp, sp^2, sp^3, dsp^2, dsp^3, sp^3d^2, and sp^3d^3 with examples Explanation of bond angle in water and ammonia- VSEPR theory, geometry of molecules with bond pairs of electrons, bond pairs and lone pairs of electrons, limitations of VSEPR Theory.	2
	10	A brief review of molecular orbital approach, LCAO method – bond order, bond distance and stability of O_2, O_2^{2+}, O_2^{2-} , NO, NO^+, CO and HF.	2
III	**THERMODYNAMICS AND THERMOCHEMISTRY**		**18**
	11	First law of thermodynamics, mathematical form, intrinsic energy, enthalpy, reversible, process and maximum work, work of expansion of an ideal gas in reversible isothermal process.	3
	12	Heat capacity of gases at constant volume and constant pressure, derivation of $C_P - C_V = R$.	2
	13	Second law of thermodynamics, entropy and free energies Significance of ΔG, ΔH and available work Criteria of equilibrium, and spontaneity on the basis of entropy and free energy, Gibbs - Helmholtz equation.	4
	14	Enthalpies of formation, combustion, neutralization, solution and hydration	2
	15	Relation between heat of reaction at constant volume and constant pressure Variation of heat of reaction with temperature- Kirchoff's equation	3
	16	Hess's law and application – bond dissociation energies and bond energies of different types of bonds, their calculation and enthalpies of reaction	4
IV	**ANALYTICAL PRINCIPLES & LAB SAFETY**		**9**
	17	Analytical methods in Chemistry – Principles of volumetric analysis, primary standard, standard solution, Calculation of normality, molality and molarity of solutions	2
	18	Theory of acid - base titrations: Strong acid - Strong Base, Strong acid - weak base, Weak acid Strong base and weak acid-strong base (Explanation with titration curves) Redox titrations: Permanganometry-Fe^{2+} and $KMnO_4$ and dichrometry - Fe^{2+} and $K_2Cr_2O_7$, Theory of acid – base and redox indicators.	2
	19	Inorganic qualitative analysis, common ion effect- solubility product-precipitation and inter group separation of cations. Salting out process	2
	20	Chromatography- principle and applications of paper and thin layer chromatography,	2
	21	Lab safety - Risk, Hazard, Chemical Hazard**.**	1
V	**VOLUMETRIC ANALYSIS**		**30**

	22	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions. 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base c. Weak acid – Strong base 3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.	15
	23	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References

1. B.R Puri, L R Sharma K C Kalia, *Principles of Inorganic Chemistry*, Sobhanlal Nagin Chand & Co. New Delhi
2. Manas chanda, *Atomic structure and Chemical bonding in molecular spectroscopy*, Tata Mc Graw Hill.
3. S Glasstone, *Thermodynamics for Chemists*, Affiliated East West Publishers
4. J D Lee, *Concise Inorganic Chemistry*, ELBS.
5. R P Rastogi and R R Misra, *An Introduction to Chemical Thermodynamics*, Vikas Publishing House Pvt Ltd, Sixth Edition, 2018.
6. D.A Skoog, D M West, F J, Holler, S R Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brookes/Cole, Thomson Learning, Inc, USA, 2004.
7. Day and Underwood, *Quantitative analysis: Laboratory manual*.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyse the electronic configuration of elements and interpret periodic trends to explain the chemical behaviour, bonding patterns, and unique properties of representative and transition elements.	An	PSO - 1

CO-2	Analyze the nature, formation, geometry, polarity, and stability of chemical bonds using concepts of bond energetics, hybridization, VSEPR theory, molecular orbital theory, and related empirical rules.	An	PSO - 1
CO3	Evaluate thermodynamic principles, including the laws of thermodynamics, enthalpy and entropy changes, heat capacities, free energy functions, and their interrelations, to predict spontaneity, equilibrium, and energy transformations in chemical processes.	E	PSO – 1,2,3
CO 4	Critically design, perform, and analyze volumetric and redox titrations, apply principles of qualitative inorganic analysis and chromatography, and implement comprehensive laboratory safety protocols to solve complex chemical problems innovatively and accurately.	C	PSO – 1,2,3
CO 5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO – 1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FUNDAMENTALS OF CHEMISTRY I

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO- 1,6 PSO - 1	An	F, C	L	-
2	CO-2	PO – 1,6 PSO - 1	An	F, C	L	-
3	CO3	PO-1,2,6 PSO – 1,2,3	E	F, C	L	-

4	CO 4	PO-1,6 PSO – 1,2,3	C	F, C	L	-
5	CO 5	PO-1,2,6 PSO – 1,2,3,4	C	F, C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO 1	2	-	-	-	-	1	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	1	-	-	-	-	2	-	-
CO 3	2	1	3	-	-	1	1	-	-	-	2	-	-
CO 4	2	3	2	-	-	1	-	-	-	-	2	-	-
CO 5	1	2	3	2	-	1	2	-	-	-	2	-	-

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓			✓
CO 5	✓	✓		✓

University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE102**				
Course Title	**CHEMICAL FRONTIERS – BONDING TO ENVIRONMENTAL PERSPECTIVES**				
Type of Course	**DSC**				
Semester	1				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	The course covers the periodic classification of elements, chemical bonding, organometallic chemistry, environmental pollution, and analytical principles, including volumetric analysis. Students learn about quantum numbers, orbital concepts, electron configuration, bond energetics, molecular geometry, and various analytical techniques for qualitative and quantitative analysis. They also gain an understanding of the biological, environmental, and industrial applications of chemistry.				

Detailed Syllabus:

Module	Unit	Content CHEMICAL FRONTIERS – BONDING TO ENVIRONMENTAL PERSPECTIVES	Hrs 75
1	**PERIODIC CLASSIFICATION OF ELEMENTS**		**9**
	1	Quantum numbers and their significance, Concept of orbitals.	2
	2	Orbital wise electron configuration, energy sequence rule – Pauli's principle, Hund's rule, stability of filled and half-filled orbitals.	2
	3	Electronic configuration and classification of elements in to s, p, d and f blocks	1
	4	Periodic properties, Ionisation energy, Electronegativity and Electron affinity. Diagonal relationship.	2
	5	Important characteristics of representative elements: valency, oxidation states, ionic and covalent bond formation Important characteristics of transition elements: variable valency and oxidation states, formation of Complex compounds.	2
II	**CHEMICAL BONDING**		**9**

	6	Energetic of bond formation – Types of Chemical bonds – Energetics of ionic bond formation – Lattice energy – Born Haber Cycle - Fajan's rules.	2
	7	Polarity of covalent bond its relation with electronegativity - Electro negativity scale – Pauling approach, Dipole moment – its relation to geometry.	2
	8	Hydrogen bond – inter and intra molecular – its consequences on boiling point, volatility and solubility.	1
	9	Concept of Hybridisation– sp, sp^2, sp^3, dsp^2, dsp^3, sp^3d^2, and sp^3d^3 with examples Explanation of bond angle in water and ammonia - VSEPR theory, geometry of molecules with bond pairs of electrons, bond pairs and lone pairs of electrons, limitations of VSEPR Theory.	2
	10	A brief review of molecular orbital approach, LCAO method – bond order, bond distance and stability of O_2, O_2^{2+}, O_2^{2-} , NO, NO^+, CO and HF.	2
III	**ORGANOMETALLICS**		**9**
	11	Definition and classification, Organo metallic compounds of Mg, Sn, Li, Hg, Fe and their synthesis, applications	3
	12	Biological and environmental aspects of organic compounds – organometallic compounds in medicines – organomercury, organoboron, organosilicon and organoarsenic compounds	2
	13	Outline of preparation and uses Antitumour drugs, silylated derivatives of bioactive organic compounds in agriculture and horticulture	3
	14	Environmental aspects of Organometallic compounds	1
IV	**ENVIRONMENTAL POLLUTION AND ANALYTICAL PRINCIPLES**		**18**
	15	Air pollution: Composition of air, major causes of air pollution	2
	16	Pollutants in air-carbon monoxide, carbon dioxide, oxides of Nitrogen and sulphur, chlorofluoro carbons- effect of using refrigerators and air conditioners, Particulate matter- Acid rain, Greenhouse effect, Ozone layer and its depletion	2
	17	Water pollution: causes- heat, industrial waste, sewage water, detergents, agricultural pollutants	2
	18	Treatment of industrial waste water- Activated charcoal, Reverse osmosis Quality of drinking water- Indian Standard and WHO standard- Dissolved oxygen- BOD, COD	2
	19	Soil pollution: pesticides, fertilizers, Industrial waste, Plastic.	1
	20	Principles of volumetric analysis- primary standard – standard solutions - normality and molarity	2
	21	Theory of acid - base titrations, permanganometric and dichrometric titrations, iodometric and complexometric titrations	2
	22	Theory of acid – base and redox indicators	2
	23	Beer- Lambert law- Principles of colorimetry – Estimation of Iron and phosphate	2
	24	Lab safety - Risk, Hazard, Chemical Hazard.	1
V	**VOLUMETRIC ANALYSIS**		**30**

	25	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions. 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base c. Weak acid – Strong base 3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.	15
	26	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References

1. B.R Puri, L R Sharma K C Kalia, Principles of Inorganic Chemistry, Sobhanlal Nagin Chand & Co. New Delhi
2. Manas chanda, Atomic structure and Chemical bonding in molecular Spectroscopy, Tata Mc Graw Hill.
3. Malik, Tuli, Madan, Selected Topics in Inorganic chemistry, S Chand.
4. J D Lee, Concise Inorganic Chemistry, ELBS
5. D.A Skoog, D M West, F J, Holler, S R Crouch, Fundamentals of Analytical Chemistry,8th Edn., Brookes/Cole, Thomson Learning, Inc, USA, 2004.
6. A. I. Vogel, Quantitative Analysis.
7. Day and Underwood, Quantitative analysis: Laboratory manual.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyze the principles of quantum numbers and orbital concepts, apply electronic configuration and energy rules to classify elements into s, p, d, and f blocks, and critically evaluate periodic properties, bonding behavior, and characteristic oxidation states of representative and transition elements.	An	PSO-1
CO-2	Analyze the concepts of chemical bonding by evaluating the energetics of bond formation, ionic and covalent bond	An	PSO-1,2

	characteristics, hybridization types, molecular geometry using VSEPR theory, and molecular orbital theory to predict bond order, stability, and physical properties of molecules.		
CO3	Evaluate the synthesis, classification, and applications of organometallic compounds of key metals, assess their biological and environmental impacts, and critically analyze the role of organometallic compounds in medicine, agriculture, and environmental sustainability.	E	PSO-1,2,3
CO 4	Critically analyze the sources, effects, and mitigation techniques of air, water, and soil pollution, apply volumetric and colorimetric analytical methods including acid-base, redox, and complexometric titrations, and demonstrate comprehensive understanding of lab safety protocols to design effective environmental pollution management and chemical analysis strategies.	C	PSO-1,2,3
CO 5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CHEMICAL FRONTIERS – BONDING TO ENVIRONMENTAL PERSPECTIVES

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1	An	F, C	L	-
2	CO-2	PO-1,6 PSO-1,2	An	F, C	L	-
3	CO3	PO-1,3,6 PSO-1,2,3	E	F, C, P	L	-
4	CO 4	PO-1,6 PSO-1,2,3	C	F, C	L	-

5	CO 5	PO-1,2,3,6 PSO-1,2,3	C	F, C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO 1	2	-	-	-	-	1	-	-	-	-	2	-	-
CO 2	2	1	-	-	-	1	-	-	-	-	2	-	-
CO 3	2	2	3	-	-	1	-	1	-	-	2	-	-
CO 4	2	1	3	-	-	1	-	-	-	-	2	-	-
CO 5	2	2	2	3	2	1	-	-	-	-	2	-	-

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓	✓	✓
CO 5	✓			✓

University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE103**				
Course Title	**FOUNDATIONS OF INORGANIC & POLYMER CHEMISTRY**				
Type of Course	**DSC**				
Semester	1				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	The course covers fundamental topics in chemistry, including atomic structure, periodicity, environmental pollution, polymers, and analytical principles. Students will gain a comprehensive understanding of these concepts, along with practical skills in volumetric analysis, preparing them for careers in fields such as chemistry, environmental science, and materials science with an emphasis on theoretical knowledge and hands-on laboratory experience.				

Detailed Syllabus:

Module	Unit	Content FOUNDATIONS OF INORGANIC & POLYMER CHEMISTRY	Hrs 75
I	**ATOMIC STRUCTURE & PERIODICITY**		**18**
	1	Atomic structure – Introduction - Atomic spectrum of Hydrogen – different series, Rydberg equation, Bohr theory –postulates – statement of Bohr energy equation, limitations of Bohr model	4
	2	Dual nature of matter and radiation, Photoelectric effect, de Broglie equation, Heisenberg's uncertainty principle	3
	3	Concept of orbital, Quantum numbers, shapes of orbitals (s, p, d)	2
	4	Electronic configuration of atoms - Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.	3
	5	Modern periodic law – Long form of periodic table	1
	6	Periodicity in properties: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale).	3
	7	Atomic mass - Molecular mass – Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency - Equivalent mass.	2
II	**ENVIRONMENT AND POLLUTION**		**9**

	8	Air and soil pollution - Introduction, different types of air and soil pollution, air pollutants SO_2, SO_3, NO, NO_2 and smog.	2
	9	Acid rains, CO_2, CO, Greenhouse effect, O_3, importance of ozone layer, causes and effects of ozone layer depletion.	2
	10	Photochemical oxidants, PAN, hydrocarbons, particulates, dust, smog, asbestos, lead, mercury, cadmium. Control of air pollution	2
	11	Water pollution-Factors affecting the purity of water, sewage water, Industrial waste, agricultural pollution such as pesticides, fertilizers, detergents; treatment of industrial waste water using activated charcoal, synthetic resins, reverse osmosis and electro dialysis (elementary idea only).	3
III	**NATURAL AND SYNTHETIC POLYMERS**		**9**
	12	Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network polymers, plastics, elastomers, fibres; homopolymers and copolymers.	2
	13	Mode of formation - Addition, Condensation Polymerization (definition and examples only)	1
	14	Typical examples: Polyethylene, polypropylene, PVC, phenol-formaldehyde and melamine formaldehyde resins, polyamides (nylons) and polyesters.	3
	15	Natural rubber: structure, latex processing methods, vulcanization and uses. Synthetic rubbers: SBR, nitrile rubber and neoprene.	2
	16	Biodegradability of polymers, environmental hazards. Recycling of plastics.	1
IV	**ANALYTICAL PRINCIPLES**		**9**
	18	Reporting of Analytical Data: Units, significant digits, rounding, Precision and accuracy – Types of errors – Ways of expressing precision – Methods to reduce systematic errors.	2
	19	Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and millimoles.	2
	20	Methods of Analysis: Volumetric method of analysis - General principles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, end point.	2
	21	Acid base, redox and complexometric titrations and corresponding indicators.	2
	22	Separation Techniques: General principles of distillation and solvent extraction.	1
V	**VOLUMETRIC ANALYSIS**		**30**
	23	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base c. Weak acid – Strong base	15

		3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of $Fe^{2+}/FeSO_4.7H_2O$/Mohr's salt.	
	24	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References:

1. *Elements of Physical Chemistry,* B. R. Puri, L. R. Sharma, M.S. Pathania, Vishal Pub. Co.
2. *Inorganic Chemistry,* P. L. Soni.
3. *Atomic Structure and Molecular Spectroscopy,* Manas Chanda.
4. *University General Chemistry*, C. N. R. Rao, Macmillan.
5. *Text Book of Environmental Studies for undergraduate Courses,* Bharucha Erach, University Press.
6. *Polymer Science,* V R Gowariker, N V Viswanathan, Jayadev Sreedhar, New Age International Pvt Ltd, Fourth Edition, 2021.
7. *Vogel's Text Book of Quantitative Chemical Analysis,* J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, Pearson Education.
8. *Analytical Chemistry,* R. Gopalan, S. Chand and Co., New Delhi.
9. *Quantitative Analysis,* R. A. Day Junior, A.L. Underwood, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Critically analyze the fundamental concepts of atomic structure, quantum theory, electronic configuration, and periodicity, applying principles such as Bohr's model, quantum numbers, and periodic trends to explain atomic and molecular properties, as well as interpret related chemical calculations including mole concept, oxidation-reduction, and equivalent mass.	An	PSO-1,2
CO-2	Analyze the sources, types, chemical nature, environmental impacts, and control methods of air, soil, and water pollutants, including acid rain, greenhouse gases, ozone depletion, and industrial/agricultural contaminants, and critically evaluate treatment technologies for pollution	E	PSO-1,2,3

	mitigation.		
CO-3	Analyze the classification, formation mechanisms, structural characteristics, and environmental impact of natural and synthetic polymers, including key examples, rubber processing techniques, and recycling methods.	An	PSO-1,2,4
CO-4	Analyze and report chemical data with proper units and error analysis, apply various concentration expression methods, perform precise volumetric titrations using appropriate standards and indicators, and effectively utilize separation techniques such as distillation and solvent extraction to solve complex analytical problems.	C	PSO-1,2,3,4
CO-5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FOUNDATIONS OF INORGANIC & POLYMER CHEMISTRY

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO- 1,6 PSO-1,2	An	F, C	L	L
2	CO-2	PO- 1,6 PSO-1,2,3	E	F, C	L	L
3	CO-3	PO- 1,6 PSO-1,2,4	An	F, C	L	L
4	CO-4	PO- 1,6 PSO-1,2,3,4	C	F, C	L	L
5	CO-5	PO- 1,2,6 PSO-1,2,3,4,5	C	F, C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2	2	-	-	-	1	-	-	-	-	2	-	-
CO 2	2	2	3	-	-	1	-	-	-	-	2	-	-
CO 3	1	2	-	3	-	1	-	-	-	-	2	-	-
CO 4	2	2	3	3	-	1	-	-	-	-	2	-	-
CO 5	1	2	3	3	3	2	2	-	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓

University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK1DSCCHE104**				
Course Title	**GENERAL INORGANIC CHEMISTRY**				
Type of Course	**DSC**				
Semester	1				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Higher secondary level science knowledge				
Course Summary	The course covers atomic structure, chemical bonding, co-ordination chemistry and secondary bond forces, analytical principles including volumetric analysis and Nuclear Chemistry. Students learn about quantum numbers, orbital concepts, electron configuration, bond energetics, molecular geometry, and fundamentals of analytical chemistry. They also gain a detailed understanding of the radioactivity and nuclear chemistry				

Detailed Syllabus:

Module	Unit	Content GENERAL INORGANIC CHEMISTRY	Hrs 75
1	**ATOMIC STRUCTURE, CHEMICAL BONDING AND SECONDARY BOND FORCES**		**21**
	1	Atomic spectrum of hydrogen - different series, Rydberg equation. Bohr theory – postulates – statement of Bohr energy equation – derivation of spectral frequency from Bohr equation	3
	2	Schrodinger wave equation (mention only, no derivation), concept of orbitals. Quantum numbers and their significances	2
	3	Orbital wise electron configuration, energy sequence rule – Pauli's principle, Hund's rule, Stability of filled and half-filled orbitals.	3
	4	Electronic configuration of lanthanides and actinides	2
	5	Energetics of ionic bond formation – Born-Haber cycle. Fajan's rule.	3
	6	Hybridisation and shape of molecules with examples – sp ($BeCl_2$), sp^2 (BF_3), sp^3 (CH_4), sp^3d (PCl_5), sp^3d^2 (SF_6) and sp^3d^3 (IF_7)	3
	7	VSEPR theory, regular and irregular geometry, H_2O, NH_3, XeF_2, XeF_4. Hydrogen bond – inter and intra molecular – its consequences on boiling point and volatility. Importance of hydrogen bonding in biomolecules – Proteins and nucleic acids.	3
	8	Ionic character of covalent bond – Polar and non-polar covalent compounds.	2

II	**CO-ORDINATION CHEMISTRY**		**6**
	9	Types of ligands, Werner's coordination theory, Valence bond theory of bonding in octahedral and tetrahedral complexes, Drawbacks of valence bond theory.	3
	10	Crystal field theory of octahedral and tetrahedral complexes, examples – high and low spin complexes, magnetic properties, Application in qualitative and quantitative analysis	3
III	**ANALYTICAL PRINCIPLES**		**9**
	11	Principles of volumetric analysis – primary standard – standard solutions normality and molarity	3
	12	Theory of acid-base titrations, permanganometric and dichrometric titrations, iodometry and complexometric titrations. Theory of acid-base indicator – redox indicators	3
	13	Principles of colorimetry – estimation of biomolecules - glucose and chlorophyll.	3
IV	**RADIOACTIVITY AND NUCLEAR CHEMISTRY**		**9**
	14	Radioactive decay series, Radioactive equilibrium, Average life, Half-life. Detection of radio activity-Geiger Muller Counter, Wilson cloud chamber. Units of radioactivity - Curie and Rutherford, Units of radiations.	3
	15	Nuclear Chemistry - stability of nucleus, n/p ratio. Artificial transmutation and radioactivity, mass defect, binding energy.	3
	16	Applications of radio activity- in medicine and agriculture. Biological effects of radiation, pathological and genetic damage.	3
V	**VOLUMETRIC ANALYSIS**		**30**
	18	**Section A: Volumetric Analysis (5 Experiments (double titration) from Section A are compulsory)** 1. Preparation of standard solutions. 2. Neutralization Titrations a. Strong acid – Strong base b. Strong acid – Weak base c. Weak acid – Strong base 3. Redox Titrations - Permanganometry a. Estimation of oxalic acid. b. Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt.	15
	19	**Section B (Open ended: Any 3 experiments are to be conducted - May be selected from the list or the teacher can add related experiments)** 1. Dichrometry 2. Iodometry & Iodimetry 3. Complexometry 4. Colorimetry	15

References

1. *Coordination Chemistry,* Fred Basolo, Ronald C. Johnson, 2nd Edition, Science Reviews, 1986.

2. *Organometallic Chemistry,* R. C. Mehrotra, New Age International, 2007.
3. *J.D. Lee, Concise Inorganic Chemistry, 5th Edn., Wiley India Pvt. Ltd., 2008.*
4. B.R Puri, L R Sharma K C Kalia, Principles of Inorganic Chemistry, Sobhanlal Nagin Chand & Co. New Delhi
5. A.D. Madan, *Modern Inorganic Chemistry*
6. A. I.Vogel, *A text book of Quantitative analysis"*
7. Day & Underwood, *Quantitative analysis: laboratory manual":*

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyze the fundamental principles and theories of atomic structure, bonding, molecular geometry, and intermolecular forces to explain spectral characteristics, electronic configurations, hybridization, molecular shapes, and the impact of bonding interactions on physical and chemical properties of elements and compounds.	An	PSO-1
CO-2	Analyze the bonding, geometry, magnetic properties, and analytical applications of coordination complexes using Werner's theory, Valence Bond Theory, and Crystal Field Theory, distinguishing between high and low spin behaviours in octahedral and tetrahedral environments.	An	PSO-1
CO3	Evaluate the principles and applications of volumetric and colorimetric analytical techniques, including standardization procedures, indicator theories, and the estimation of biomolecules such as glucose and chlorophyll.	C	PSO-1,2,3
CO 4	Design applications and interpret concepts related to radioactivity, including detection methods, nuclear stability, decay processes, and biological impacts, with emphasis on real-world uses in medicine and agriculture.	E	PSO-1
CO 5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: GENERAL INORGANIC CHEMISTRY

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1	An	F, C	L	-
2	CO-2	PO-1,6 PSO-1	An	F, C	L	-
3	CO3	PO-1,6 PSO-1,2,3	C	F, C, P	L	-
4	CO 4	PO-1,6 PSO-1	E	F, C	L	-
5	CO 5	PO-1,2,6 PSO-1,2,3,4,5	C	F, C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	3	-	-	-	-	2	-	-	-	-	2	-	-
CO 2	3	-	-	-	-	2	-	-	-	-	2	-	-
CO 3	3	2	2	-	-	2	-	-	-	-	2	-	-
CO 4	3	-	-	-	-	2	-	-	-	-	2	-	-
CO 5	2	2	2	2	3	2	2	-	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments

- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓
CO 5	✓			✓

University of Kerala

Discipline	CHEMISTRY
Course Code	**UK1DSCCHE105**
Course Title	**GENERAL CHEMISTRY I**

Type of Course	**DSC**				
Semester	1				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Basic knowledge and interest in science				
Course Summary	This course covers the fundamentals of scientific methodology, the evolution of chemistry, the contributions of notable scientists, chemistry's role in everyday life, lab safety, analytical principles, and practical experiments focusing on volumetric analysis and laboratory safety. Through theoretical understanding and hands-on experiments, students will gain essential knowledge and skills for a deeper comprehension of chemistry and its applications in various fields.				

Detailed Syllabus:

Module	Unit	Content GENERAL CHEMISTRY I	Hrs 75
I	**METHODOLOGY OF CHEMISTRY**		**9**
	1	Definition of Science. Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law. Falsification of hypothesis - inductive and deductive reasoning- revision of scientific theories and laws.	3
	2	Evolution of Chemistry-ancient speculation on the nature of matter. Early form of chemistry - alchemy, origin of modern chemistry. Structure of chemical science: Scope, theory and experiment - branches of chemistry.	3
	3	Role of chemistry as a central science connecting physics, biology and other branches of science. Interdisciplinary areas involving chemistry: Nanotechnology and biotechnology.	3
II	**POPULAR SCIENTISTS IN CHEMICAL SCIENCE**		**9**
	4	Some popular scientists and their contributions to the evolution of chemistry - Antoine Lavoisier, Dmitri Mendeleev, Marie Curie, Robert Boyle, John Dalton, Linus Pauling, Joseph Priestley, Friedrich Wöhler, J.J. Thomson, Amedeo Avogadro	6
	5	Women scientists in chemical science - Rosalind Franklin, Alice Ball, Dorothy Hodgkin, Gertrude Elion	3
III	**CHEMISTRY IN EVERYDAY LIFE**		**9**
	6	Household materials – Major chemical ingredients (No structural formula and preparation needed), Match Box-Soap- detergent— cooking gas –tooth paste – shampoo hair - dye- nail polish- whitener-moth balls, house hold bleach	5
	7	Method of action and possible hazards/toxicity of explosive chemicals, propellants –fire crackers.	4
IV	**LAB SAFETY & ANALYTICAL PRINCIPLES**		**18**

	8	Lab safety measurements: Awareness of material safety data sheet (MSDS), safe storage and handling of hazardous chemicals, simple first aids; electric shocks, fire, cut by glass and inhalation of poisonous gas, Accidents due to acids and alkalies, burns due to phenol and bromine, disposal of waste chemicals, Personal protective Equipment (PPE)	6
	9	Atomic mass - Molecular mass - Mole concept – Molar volume - Oxidation and reduction – Equivalent mass. Methods of expressing concentration: Molality, molarity, normality, ppm, and mole fraction. Dilution formula, Theory of volumetric analysis – Acid-base, redox, and complexometric titrations: acid-base, redox, and complexometric indicators. Principles in the separation of cations in qualitative analysis - Applications of common ion effect and solubility product - Microanalysis and its advantages. Accuracy & Precision (mention only).	12
V	**PRACTICALS**		**30**
	10	1. **Laboratory Safety** - Importance of lab safety – Burns – Eye accidents – Cuts – Gas poisoning – Electric shocks –Treatment of fires – First Aid and Treatment of Fires- Precautions and preventive measures. 2. **Volumetric Analysis (Any 5 experiments (double titration))** • Preparation of standard solutions. • Neutralization Titrations (i) Strong acid – strong base (ii) Weak acid – strong base (iii) Strong acid – weak base • Redox Titrations Permanganometry: (i) Estimation of oxalic acid. (ii) Estimation of Fe^{2+}/$FeSO_4.7H_2O$/Mohr's salt. (**Make sure that for students opting chemistry as second minor, the experiments are not overlapping with first minor)**	15
	11	3. **Open-ended experiments (Any 3)** a. Determination of hardness of water. b. Iodimetry and Iodometry: Estimation of Iodine/copper/ chromium. c. Determination of acetic acid content in vinegar by titration with NaOH. d. Determination of alkali content in antacid tablets by titration with HCl. e. Determination of available chlorine in bleaching powder. **(Other related experiments suggested by the teacher may be conducted)**	15

References:

1. C.N.R. Rao, *University General Chemistry*, MacMillan India Ltd.
2. Shashi Chowla; *Engineering Chemistry*, Danpat Rai Publication.

3. B.K. Sharma; *Industrial Chemistry*. Goel Publishing House, Meerut, 2003.
4. Singh, K., *Chemistry in Daily Life;* Prentice Hall of India, New Delhi, 2008.
5. 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.
6. 4. J. D. Lee, *Concise Inorganic Chemistry*, 5th edn., Blackwell Science, London, 2010.
7. B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
8. Satya Prakash, *Advanced Inorganic Chemistry*, Volume 1, 5th Edition, S. Chand and Sons, New Delhi, 2012.
9. 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.
10. R. Gopalan, *Inorganic Chemistry for Undergraduates*, Universities Press, Hyderabad, 2009.
11. *Vogels Textbook of Quantitative Chemical Analysis*, 6thEdn., Pearson Education Ltd.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyse the evolution and structure of chemical science, apply scientific methods and reasoning to revise theories, and evaluate the interdisciplinary role of chemistry in connecting and advancing fields such as physics, biology, nanotechnology, and biotechnology.	An	PSO – 3,4,5
CO-2	analyse the pioneering contributions of key scientists, including women scientists, in shaping the evolution of chemical science and critically evaluate their impact on the development of major chemical concepts and discoveries.	An	PSO –3,4
CO-3	Evaluate the chemical composition, functional roles, and potential health or environmental hazards of common household materials and explosive substances, including their methods of action and associated risks.	E	PSO –3,4
CO-4	Design and implement safe and effective laboratory practices by applying foundational chemical concepts such as mole calculations, solution concentration, volumetric analysis, and qualitative separation techniques, while ensuring proper handling of hazardous materials, first aid response, and adherence to safety protocols including PPE, MSDS, and	C	PSO – 1,2,3,4

	chemical waste disposal.		
CO-5	Design and perform standard volumetric and instrumental analytical experiments to prepare solutions, estimate analytes through acid-base, redox, and complexometric titrations, and apply suitable methods for quantitative chemical analysis with scientific reasoning.	C	PSO – 1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: GENERAL CHEMISTRY I

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6,8 PSO –3,4,5	An	M, F	L	-
2	CO-2	PO-1,6,8 PSO –3,4	An	F, C	L	-
3	CO-3	PO-1,5,6,8 PSO –3,4	E	M, F	L	-
4	CO-4	PO-1,8 PSO –1,2,3,4	C	F, C	L	-
5	CO-5	PO-1,2,6 PSO –1,2,3,4,5	C	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	-	-	1	1	1	1	-	-	-	-	1	-	2
CO 2	-	-	1	1	-	1	-	-	-	-	1	-	2
CO 3	-	-	1	1	-	1	-	-	-	1	1	-	2
CO 4	1	1	3	2	-	1	-	-	-	-		-	2
CO 5	2	2	3	3	2	2	-	-	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓		✓	✓
CO 4	✓		✓	✓
CO 5	✓			✓

University of Kerala

Discipline	CHEMISTRY
Course Code	**UK1MDCCHE100**
Course Title	**FUNDAMENTAL ASPECTS OF ENVIRONMENTAL CHEMISTRY**

Type of Course	MDC				
Semester	1				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	1. Basic knowledge and interest in science				
Course Summary	Includes a brief introduction of environmental components, different types of pollution and some major environmental disasters.				

Detailed Syllabus:

Module	Unit	Content FUNDAMENTAL ASPECTS OF ENVIRONMENTAL CHEMISTRY	45 Hrs
I	**BASIC CONCEPTS OF ENVIRONMENT**		**9**
	1	Types of Environments - Biotic and Abiotic, Environmental segments- Lithosphere, Hydrosphere, Biosphere and Atmosphere.	3
	2	Layers of Lithosphere, Layers of Atmosphere- Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere.	3
	3	Meaning of Ecology - Structure and Function of Ecosystem- Producers, Consumers, Decomposers.	2
	4	Ecological Succession- Food Chain and Ecological Pyramids.	1
II	**AIR POLLUTION**		**6**
	5	Pollution, Pollutants and its Classification, Contaminants.	2
	6	Air Pollution - Types of Gaseous Air pollutants-CO, CO_2, NO, NO_2, SO_2, SO_3, Smog - Sources and Effects on Environment.	2
	7	Consequences of Air pollution - Global warming, Greenhouse effect, Acid rain and Importance of Ozone layer.	2
III	**WATER & SOIL POLLUTION**		**12**
	8	Water Quality Parameters- Dissolved Oxygen, BOD, COD, pH, Turbidity, Conductivity, Salinity (Qualitative idea only), Eutrophication.	2
	9	Major Water pollutants – Industrial Wastes, Sewage, Agricultural Pollutants, Radioactive Wastes, Detergents - Sources and Effects.	2
	10	Treatment of Waste Water- Filtration using Activated Charcoal and Ion Exchange Resins, Electrodialysis and Reverse osmosis	2
	11	Composition of soil- Inorganic and Organic Components in Soil- Micro and Macro nutrients,	2
	12	Soil pollutants - Industrial Wastes, Domestic Wastes, Agricultural Wastes and Radioactive Wastes - Sources and Effects.	2
	13	Solid Waste Management - Land Filling, Recycling, Incineration and Composting.	2
IV	**ENVIRONMENTAL DISASTERS**		**9**

	14	Definition and types of disasters – Natural and Manmade.	2
	15	Disaster management - Mitigation, Preparedness, Response and Recovery.	3
	16	Major environmental disasters - Three Miles Island accident, Endosulfan tragedy in Kerala, Chernobyl Incident, Minamata disease.	4
V	**OPEN ENDED MODULE:**		**9**
	17	Case Studies, Debates, Simulation Games, local field Trips, Project-Based Learning, Artistic Expression, Community Engagement, Critical Thinking Exercises etc. **(Or any other activities may be suggested by the teacher)**	

References

1. A.K. De, "*Environmental Chemistry*"
2. H.M. Saxena, "*Environmental Geography*".
3. G.W. Vanloon, S. J. Duffy, "*Environmental Chemistry – A global perspective*".
4. P.K. Gupta, "*Methods in Environmental Analysis Water, Soil and Air*".
5. V.P. Kudesia, "*Environmental Chemistry*".
6. G.S. Sodhi, "*Fundamental Concepts of Environmental Chemistry*".
7. V Subramanian, "*A Text Book of Environmental Chemistry*", Wiley 2020.
8. C. Baird and M. Cann, "*Environmental Chemistry*", W.H. Freeman and Company, 2012.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyze the structure and functioning of ecosystems by examining biotic and abiotic components, environmental segments, layers of the lithosphere and atmosphere, ecological succession, food chains, and ecological pyramids.	An	PSO-1,2,3
CO-2	Analyze the types, sources, and environmental consequences of air pollutants and contaminants, including their role in phenomena such as global warming, acid rain, smog formation, and ozone layer depletion.	An	PSO-1,2,3
CO-3	Critically evaluate water and soil quality parameters, identify major pollutants and their sources, and design effective waste water and solid waste treatment strategies using advanced techniques to promote sustainable environmental management.	E	PSO-1,2,3,4

CO-4	Critically analyze various natural and manmade disasters, evaluate disaster management strategies including mitigation, preparedness, response, and recovery, and creatively propose informed solutions by examining major environmental disasters.	C	PSO-1,2,3,4
CO-5	Gain a holistic understanding of pollution and develop skills to address it	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENVIRONMENTAL CHEMISTRY

Credits: 3:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	An	F, C, M	L	-
2	CO-2	PO-1,6 PSO-1,2,3	An	F, C	L	-
3	CO-3	PO-1,6 PSO-1,2,3,4	E	F, C	L	-
4	CO-4	PO-1,6 PSO-1,2,3,4	C	F, C	L	-
5	CO-5	PO-1,6 PSO-1,2,3	C	F, C	L, P	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	2	1	2	-	-	1	-	-	-	-	2	-	-
CO 2	1	2	3	-	-	1	-	-	-	-	2	-	-
CO 3	1	1	1	1	-	1	-	-	-	-	2	-	-

		CO 4	1	1	1	1	-	1	-	-	-	-	2	-	-
1	1	**CO 5**	1	12	13	- 2	- 2	1	- -	3 -	-	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓	✓	✓

University of Kerala

Discipline	CHEMISTRY
Course Code	**UK1MDCCHE101**
Course Title	**POLYMERS AND BIOPOLYMERS**
Type of Course	**MDC**

Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	1. Basic knowledge and interest in science				
Course Summary	This course provides a comprehensive understanding of the fundamental principles of polymer chemistry and a brief idea of biopolymers.				

Detailed Syllabus:

Module	Unit	Content POLYMERS AND BIOPOLYMERS	45 Hrs
I	**BASIC PRINCIPLES OF POLYMERS**		**6**
	1	General Introduction to Polymers: Macro Molecules, Oligomers, Polymers, Degree of Polymerisation, Functionality.	2
	2	Classification of Polymer: Origin, Structure, Synthesis, Molecular forces.	1
	3	Polymer Synthesis- Synthesis of Copolymers, Block-Polymers, Polyesters, Poly Olefins, Polyamides, Polycarbonates.	2
	4	Chemistry of Polymerization- Addition polymerization and Condensation polymerization.	1
II	**COMMERCIAL POLYMERS**		**6**
	5	Commercially important polymers and their applications: Poly ethylene, Polypropylene, Polystyrene, Polyesters, Polyvinyl Chloride (PVC).	2
	6	Polymethylmethacrylate, Bakelite, Natural Rubber, Nylon-6, Nylon-66, Melamine, Terylene.	3
	7	Numbering of Plastics (Plastic identification code)	1
III	**RUBBER CHEMISTRY AND TECHNOLOGY**		**9**
	8	Natural and Synthetic Rubber: Historical review, Physical and Chemical Properties of Natural Rubber.	2
	9	Manufacture, Physical Properties and Applications of Synthetic Rubbers such as SBR, Nitrile, Butyl Rubber.	2
	10	EPDM, Neoprene, Vulcanisation of Rubber	1
	11	Rubber Processing- Milling, Mixing, Extrusion, Calendering, Molding and Curing (Explanation only)	2
	12	Rubber Reinforcement Technologies: Brief introduction, Role of Fillers and Reinforcements – Carbon Black.	2
IV	**BIOPOLYMERS**		**15**
	13	Introduction of biopolymers, Its classification on the basis of Type, Origin, Monomeric Units.	2
	14	Sources of Biopolymers, Need for Biopolymers.	2

	15	Introduction to Cellulose, Cotton, Wool, Silk	2
	17	Structure and functions of bio-polymers (basic idea only): Proteins, Nucleic acid, Polysaccharides, starch, shellac and cellulose.	4
	18	Biopolymers from Renewable Resources, Biocompatibility Requirements.	2
	19	Synthetic Biopolymers: Polylactic acid and its co-polymers, Aliphatic Polyesters, Polyethylene Oxides and its Copolymers.	3
V	**OPEN ENDED MODULE:**		**9**
	20	Seminar presentations, group discussions, debates, quizzes etc on a. Identification of polymer in a variety of common objects made from different types of polymers b. A specific biopolymer (e.g., cellulose, starch, chitin) and its application in various industries c. Recycling or upcycling of polymer waste d. Extraction of biopolymers from natural sources e. Biodegradation behavior of biopolymers in different environmental conditions (Or any other similar topics suggested by the teacher)	9

References

1. F.W. Billimeyer, "*Textbook of Polymer Science*", Wiley, India 2007.
2. V.R. Gowarikar, "*Polymer Science*", New Age International Publishers Ltd 2010.
3. P.J. Flory, "*Principles of Polymer Chemistry*", Asian Books Private Ltd 2006.
4. P. Ghosh, "*Polymer Science and Technology of Plastic and Rubber*", Tata McGraw Hill 2010.
5. M.P. Stevens, "*Polymer Chemistry*", Oxford University Press, Inc, 1990.
6. R. M Johnson, L Y Mwaikambo and N Tucker, "*Biopolymers*", Rapra Technology 2003.
7. S. Kalia and L. Avérous, "*Biopolymers: Biomedical and Environmental Applications*".

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Analyze the structure, classification, synthesis methods, and polymerization mechanisms of various polymers, including copolymers and key polymer classes, to understand their macromolecular properties and functionalities.	An	PSO-1,2,3

CO-2	Analyze the structure, properties, and diverse industrial applications of key commercial polymers—including polyethylene, polypropylene, polystyrene, polyesters, PVC, polymethylmethacrylate, Bakelite, natural rubber, nylons, melamine, and terylene—while interpreting plastic identification codes for effective material classification and sustainable usage.	An	PSO-1,2,3,4
CO-3	Critically evaluate the historical development, chemical and physical properties, manufacturing processes, and industrial applications of natural and synthetic rubbers, including vulcanization and reinforcement technologies, demonstrating a comprehensive understanding of rubber processing techniques and material enhancements.	E	PSO-1,2,3
CO-4	Critically analyze the classification, structure, sources, and functional properties of natural and synthetic biopolymers, and creatively apply this knowledge to innovate sustainable materials with biocompatibility for diverse industrial and biomedical applications.	C	PSO-1,2, 3
CO-5	Critically analyze, evaluate, and creatively present the identification, industrial applications, sustainable recycling methods, extraction techniques, and environmental biodegradation behaviors of various polymers and biopolymers, demonstrating advanced understanding and innovative problem-solving skills in polymer science.	C	PSO-1,2,3,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: POLYMERS AND BIOPOLYMERS

Credits: 3:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,6 PSO-1,2,3	An	F, C	L	-
2	CO-2	PO-1,6 PSO-1,2,3,4	An	F, C	L	-

3	CO-3	PO-1,6 PSO-1,2,3	E	F, C	L	-
4	CO-4	PO-1,6 PSO-1,2	C	F, C, P	L	-
5	CO-5	PO-1,2,3,4,5,6,8 PSO-1,2,3,4,5	C	F, C, P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO 1	2	1	1	-	-	1	-	-	-	-	2	-	-
CO 2	2	1	2	-	-	1	-	-	-	-	2	-	-
CO 3	2	2	2	-	-	1	-	-	-	-	2	-	-
CO 4	2	1	1	-	-	1	-	-	-	-	2	-	-
CO 5	2	1	2	2	2	1	1	2	2	2	2	-	2

Correlation Levels:

Level	**Correlation**
-	Nil
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Assessment Rubrics:

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CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓			✓
CO 5	✓	✓	✓	✓