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 scales – Paulings and Mullikan's approaches, factors influencing polarity 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 organo arsenic 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, chlorofluro 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 (8 Experiments from Section A are compulsory)** 7. Preparation of standard solutions. 8. Neutralization Titrations g. Strong acid – Strong base h. Strong acid – weak base i. Weak acid – strong base. 9. Redox Titrations - Permanganometry e. Estimation of oxalic acid. f. 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	Discuss the rules for filling electrons in atomic orbitals	U	PSO-1
CO-2	Discuss theories of chemical bonding and their limitations	U	PSO-1,2
CO3	Predict geometry of molecules from the type of hybridisation.	Ap	PSO-1,2,3
CO 4	Discuss the applications of organometallics.	U	PSO-1,2,3

CO 5	Critically select suitable indicators for acid base and redox titrations	E	PSO-1,2,3
CO 6	Apply the basic principles in quantitative analysis	Ap	PSO-1,2,3,4
CO 7	Discuss the factors affecting environmental pollution	U	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	U	F, C	L	-
2	CO-2	PO-1,6 PSO-1,2	U	F, C	L	-
3	CO3	PO-1,3,6 PSO-1,2,3	Ap	F, C, P	L	-
4	CO 4	PO-1,6 PSO-1,2,3	U	F, C	L	-
5	CO 5	PO-1,2,3,6 PSO-1,2,3	E	F, C, P	-	P
6	CO 6	PO-1,2,6 PSO-1,2,3,4	Ap	F, C, P	-	P
7	CO 7	PO-1,6 PSO-1,2,3,4,5	U	F, C, M	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	-	-	-	-	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	3	-	-	1	1	1	-	-	2	-	-
CO 6	2	2	3	3	-	1	1	-	-	-	2	-	-
CO 7	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	✓			✓
CO 6	✓		✓	✓