University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK3DSCCHE202**				
Course Title	**CHEMICAL INSIGHTS: FROM SOIL TO PETROCHEMICALS**				
Type of Course	**DSC**				
Semester	3				
Academic Level	200 - 299				
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 2. First & second semester DSCs (chemistry) offered by UoK (preferable)				
Course Summary	This course covers soil and water chemistry, electrochemistry, petrochemicals, instrumental methods of analysis, and practical physical chemistry experiments. Students gain insights into the chemical processes governing soil and water behaviour, industrial applications of electrochemistry and petrochemicals, and hands-on experience in various analytical techniques.				

Detailed Syllabus:

Module	Unit	Content	Hrs
	CHEMICAL INSIGHTS: FROM SOIL TO PETROCHEMICALS		**75**
I	**SOIL AND WATER CHEMISTRY**		**18**
	1	Soil – Composition, mineral matter in soil process of soil formation, weathering – physical (mention), chemical (detail) + biological (mention) Saline and alkaline soil (brief explanation) Rocks – different types (Igneous, sedimentary and Metamorphic)	5
	2	Analysis of lime stone (qualitative treatment only)	1
	3	Chemistry of salt-affected soils and amendments, soil pH, ECe, ESP, SAR and important relation	3
	4	Soil management and amendments. Chemistry and electrochemistry of submerged soils	2
	5	Water Analysis Water quality parameters COD, BOD, main quality characteristics of water (alkalinity, hardness, total solids and oxidation)	3
	6	Water treatment including chemical (Precipitation, aeration, ozonisation, chlorination) and physical methods of sterilization.	4
II	**ELECTRO CHEMISTRY**		**9**

	7	Transport number – definition, determination by Hittorf's method and moving boundary method, application of conductance measurements	2
	8	Conductometric titrations involving strong acid – strong base, strong acid – weak base, weak acid – strong base and weak acid – weak base	2
	9	EMF – Galvanic cells, measurement of emf, cell and electrode potential, IUPAC sign convention, Reference electrodes, SHE and calomel electrode	1
	10	Standard electrode potential, Nernst equation, anion and cation reversible electrodes, redox electrode with examples, quinhydrone electrode, glass electrode	2
	11	Concentration cell without transference, Potentiometric titration Fuel cells – H_2 – O_2 and hydrocarbon – O_2 type	2
III	**PETRO CHEMICALS**		**9**
	12	Introduction to crude oil, exploratory methods, constitution of crude oil, natural gas – constituents	2
	13	Distillation of crude oil, separation of natural gas and different fractions Meaning of terms such as ignition point, flash point, octane number	2
	14	Types of hydrocarbon fuels and their characteristics	2
	15	Cracking – catalytic cracking, hydro cracking, isomerization, reforming, sulphur, hydrogen, petroleum, coke and nitrogen compounds from petroleum	3
IV	**INSTRUMENTAL METHODS OF ANALYSIS**		**9**
	16	Spectral methods – Atomic Absorption Spectroscopy (AAS) principle, measurement, advantages, disadvantages, and applications	2
	17	Flame Emission Spectroscopy (FES) principle, measurement (single beam method) applications	2
	18	Thermal methods: Thermogravimetric analysis (TG) principle and method, Factors affecting thermogravimetric analysis, Application	3
	19	Determination of Surface tension- capillary rise and stalagmometer method, Viscosity- Poiseuille's equation, Determination of viscosity- Ostwald's viscometer, Refractive index determination by Abbe refractometer	2
V	**PRACTICALS: PHYSICAL CHEMISTRY EXPERIMENTS**		**30**
	A minimum of 5 practical experiments out of which at least one each from sections I and II must be performed and reported.		
	20	**I. Conductometry**	8
	21	1. Determination of cell constant 2. Conductometric titration of NaOH using HCl	
	22	**II. Potentiometry**	8
		3. Potentiometric titration of Fe^{2+} versus $Cr_2O_7^{2-}$ 4. Potentiometric titration of KMnO4 versus KI	
	23	**III. Surface tension:** 5. Determination of Surface tension of any three liquids 6. Surface tension of binary mixtures and determination of concentration of an unknown mixture	8

		IV. Viscosity: 7. Determination of viscosity of any three liquids 8. Viscosity of binary mixtures and determination of concentration of an unknown mixture	
	24	**V. Refractive index experiments:** 9. Determination of refractive indices of any three liquids 10. Refractive indices of KCl solutions of different concentrations and determination of concentration of unknown KCl solution	6

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. J D Lee, *Concise Inorganic Chemistry*, ELBS.
4. Miller T. G. Jr., *Environmental Science*, Wadsworth publishing House, Meerut Odum.E.P.1971.
5. Odum, E.P. (1971) *Fundamentals of Ecology*. Third Edition, W.B. Saunders Co., Philadelphia
6. S. E. Manahan, *Environmental chemistry*, 1993, Boca Raton, Lewis publisher
7. *Environmental chemistry*, Sharma and Kaur, 2016, Krishna publishers
8. Puri, Sharma, Pathania *Principles of Physical Chemistry*
9. B. K. Sharma, *Instrumental methods of Chemical Analysis*
10. 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
11. B. K. Sharma, *Soil and Noise pollution*.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand and analyze the chemical and physical characteristics of soils and water, explain the processes involved in soil formation and weathering, classify different types of rocks and soils, interpret the chemistry of salt-affected and submerged soils, apply concepts of soil pH and salinity indicators, and evaluate water quality based on key parameters. The learner will also be able to suggest appropriate soil amendments and water treatment methods using chemical and physical techniques for sustainable environmental management.	An	PSO-1,2,3,4,5

CO-2	Understand and apply the principles of ionic conductance and electrochemical cells to interpret and analyze transport numbers, conductometric and potentiometric titrations, electrode potentials, and electrochemical energy conversion systems.	An	PSO-1,2,3,4,5
CO3	Understand the origin, composition, and processing of crude oil and natural gas; explain key petroleum refining techniques such as distillation, cracking, isomerization, and reforming; describe the characteristics of various hydrocarbon fuels; and interpret important fuel-related parameters such as ignition point, flash point, and octane number.	E	PSO-1,2,3,4,5
CO 4	Understand and explain the fundamental principles, measurement techniques, and applications of key analytical methods. Determine the physicochemical properties such as surface tension, viscosity and refractive index. Critically evaluate the advantages, limitations, and factors affecting the instrumental and thermal techniques and applying this knowledge to solve practical problems in chemical analysis and materials characterization.	C	PSO-1,2,3,5
CO 5	Develop proficiency in performing electrochemical, physicochemical, and optical property measurements of chemical systems; analyze experimental data to determine fundamental physical constants, concentrations, and properties of pure substances and mixtures; and interpret results in the context of solution behavior and intermolecular interactions.	C	PSO-1,2,3,4,5

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

Name of the Course: CHEMICAL INSIGHTS: FROM SOIL TO PETROCHEMICALS

Credits: 4:0:0 (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-1,2,3,4,5	An	F, C	L	-
2	CO-2	PO- 1,6 PSO-1,2,3,4,5	An	F, C	L	-
3	CO3	PO- 1,6 PSO-1,2,3,4,5	E	F, C	L	-

4	CO 4	PO- 1,2,3,6,7 PSO-1,2,3,5	C	F, C, P	L	-
5	CO 5	PO- 1,2,3,6,7 PSO-1,2,3,4,5	C	C, P, M	-	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	3	3	3	3	1	-	-	-	-	2	-	-
CO 2	3	3	3	3	3	1	-	-	-	-	2	-	-
CO 3	3	3	3	3	3	1	-	-	-	-	2	-	-
CO 4	3	3	2	-	2	1	2	2	-	-	2	2	-
CO 5	1	3	3	3	2	1	2	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	✓		✓	✓