University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4DSCCHE200**				
Course Title	**INORGANIC CHEMISTRY II**				
Type of Course	**DSC**				
Semester	4				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	2 hours	-	4 hours	6
Pre-requisites	1. Higher secondary level chemistry 2. UK1DSCCHE100 (preferable)				
Course Summary	This course offers a comprehensive study of compounds of non-transition elements, covering various topics such as glass manufacturing, boron compounds, phosphorus oxides, halogen compounds, noble gases, inorganic polymers, and nuclear chemistry. Additionally, it includes practical experiments in inorganic qualitative analysis and preparations of inorganic compounds, providing students with hands-on experience in the laboratory.				

Detailed Syllabus:

Module	Unit	Content INORGANIC CHEMISTRY II	Hrs 90
I	**COMPOUNDS OF P BLOCK ELEMENTS - I**		**6**
	1	Unique properties of boron, preparation of boron from borax, industrially important boron compounds (structure and application only): Borax ($Na_2B_4O_7.10H_2O$), sodium perborate ($NaBO_3.H_2O$), orthoboric acid (H_3BO_3), Metaoboric acid (HBO_2), Boron trioxide (B_2O_3), Boron carbide (B_4C), Boron Halides, Boron hydride, Carboranes, Boron Nitrogen Heterocycles: Borazines, Boron nitride, Boron based materials for nuclear applications: BNCT (Boron-neurtron capture therapy)	2
	2	Silicon: The chemistry of silicates and aluminosilicates, structure and industrial applications of silicone polymers: silicone fluids, silicone rubbers, silicone resins, silicon carbide, zeolites and their applications: ZSM-5, Zeolite A or Linde-A, Zeolite Y or Faujasite	3
	3	Nitrogen based explosives and rockel fuels: Nitroglycerin, lead azide, TNT, NH_4NO_3, RDX.	1
II	**COMPOUNDS OF P BLOCK ELEMENTS - II**		**6**
	4	Oxides and oxyacids of phosphorous, phosphorous based inorganic	4

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		polymers. Oxides and oxyacids of halogens (structure only), Inter halogen compounds, pseudo halogens, chlorine-based disinfectants and antiseptics: Sodium hypochlorite, Calcium hypochlorite, p-chloro meta-xylenol, TCICA, chlorine dioxide (Structure and basic ideas only). Halogens containing Chemical warfares: tear gas, phosgene and diphosgene, mustard gas (structure only)	
	5	Noble gases-uses, Xenon compounds– structure and hybridization in Xenon flourides and oxyflourides	2
III	**NUCLEAR CHEMISTRY**		**12**
	6	Nuclear Stability and Decay Modes Nuclear stability: factors influencing nuclear stability, neutron-to-proton (n/p) ratio, Modes of decay: alpha (α), beta (β), and positron emission Packing fraction, mass defect, and binding energy	2
	7	Fundamentals of Radioactivity Introduction to natural radioactivity, Decay constant: definition and significance, Half-life and average life: definitions and calculations, Derivation of decay constant (brief overview, not detailed derivation)	2
	8	Disintegration Series and Modes of Decay Overview of disintegration series, Artificial transmutation and artificial radioactivity	2
	9	Units and Measurement of Radioactivity Units of radioactivity and Measurement using GM counter, Wilson cloud chamber, and scintillation counter	2
	10	Nuclear Reactions and Applications Nuclear fission and fusion: atom bomb and hydrogen bomb, Applications of radioactivity: ^{14}C dating, rock dating, neutron activation analysis, isotope tracers, dosimetry	2
	11	Application of radioactive isotopes in medicine: radio diagnosis and radiotherapy, Merits and demerits of nuclear technology: environmental impact, safety concerns, energy production.	2
IV	**PRINCIPLES OF QUALITATIVE ANALYSIS**		**6**
	12	Introduction to Qualitative Analysis: Definition and significance of qualitative analysis in chemistry. Basic principles of qualitative analysis: separation, detection, and identification of ions or compounds.	1
	13	Solubility Equilibria in Qualitative Analysis: Solubility product (K_{sp}) and its importance in qualitative analysis Predicting solubility of salts and formation of precipitates. Common ion effect and its impact on solubility equilibria. Selective precipitation and separation of ions based on solubility rules	2
	14	Identification of Cations in Qualitative Analysis: Systematic analysis of cations: principles, procedures and chemistry	1
	15	Identification of Anions in Qualitative Analysis: Systematic analysis of anions: principles, procedures and chemistry	1

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	16	Applications of Qualitative Analysis: Real-world applications of qualitative analysis in various industries and fields. Case studies highlighting the importance of qualitative analysis in forensic science, environmental monitoring, and pharmaceuticals. Future trends and advancements in qualitative analysis techniques.	1
V	**PRACTICALS: INORGANIC QUALITATIVE ANALYSIS**		**60**
	I	**Qualitative Inorganic Analysis (Micro Analysis)**	**42**
	17	Studies of the reactions of the following basic radicals with a view to their identification and confirmation: Lead, Copper, Bismuth, Cadmium, Tin, Antimony, Ferrous, Ferric ions, Aluminium, Chromium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Magnesium, Potassium and Ammonium ions/radicals	10
	18	Studies of the reactions of the following acid radicals with a view to their identification and confirmation: Carbonate, Sulphide, Nitrite, Nitrate, Fluoride, Chloride, Bromide, Iodide, Borate, Acetate, Oxalate, Chromate, Phosphate and Sulphate anions.	10
	19	Systematic qualitative analysis by microscale methods of salt mixtures containing two acidic and two basic radicals from the above list (more than one interfering radical should be avoided). **(Minimum 8 mixtures are to be analysed)**	22
	II	**Inorganic Preparations (Open ended – Minimum 4 preparations)** Preparations of 1. Potash alum 2. Hexamine cobalt Chloride 3. Tetramine copper Sulphate 4. Mohr's salt 5. Microcosmic salt 6. Sodium cobalt nitrate 7. Sodium nitroprusside 8. vii) Manganese phthalocyanin 9. Potassium trioxalatochromate 10. Potassium trioxalatoferrate	**18**

References:

1. B.R. Puri L.R. Sharma, K.C. Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers, New Delhi, 2010.

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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 V. V.Ramanujam, "*Semi micro–Qualitative Analysis*"
11. E. S. Gilreath "*Qualitative Analysis using semi micro method*" Mc Graw Hill.
12. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edn., Brooks/Cole, Thomson Learning, Inc., USA, 2004.
13. James E. House, Inorganic Chemistry, academic press, 2008.
14. W.U. Malik, G.D.Tuli, R.D. Madan, selected Topics in Inorganic Chemistry, S. Chand and Co., New Delhi, 2010.
15. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Edn., Wiley India Pvt. Ltd., New Delhi,2009.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	To apply the structural knowledge of boron, silicon and nitrogen compounds, interpret their properties and select appropriate applications in real-world chemical processes and materials development.	Ap	PSO-1,2,5
CO-2	To analyse and interpret the structural features, bonding patterns and functional roles of phosphorus and halogen oxides/oxyacids, interhalogens, pseudohalogens, chlorine-based disinfectants, halogenated chemical warfare agents, and xenon compounds, correlating their molecular structures with reactivity, stability and applications.	An	PSO-1,2,5
CO-3	To evaluate nuclear stability, radioactive decay	E	PSO-1,2

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	processes, detection methods, nuclear reactions, and the applications and societal implications of nuclear technology in science, medicine, and environmental contexts.		
CO-4	To design and develop systematic qualitative analysis schemes, identify unknown inorganic ions and predict selective precipitation behaviour using solubility equilibria principles for real-world applications.	C	PSO-1,2,3,5
CO-5	To design and implement systematic microscale qualitative schemes to accurately identify and confirm basic and acidic radicals in complex inorganic salt mixtures.	C	PSO-1,2,3,5

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

Name of the Course: INORGANIC CHEMISTRY II

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

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

Mapping of COs with PSOs and POs:

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

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