



Department of Chemistry and Chemical Sciences
CENTRAL UNIVERSITY OF JAMMU
 Rahya-Suchani (Bagla), District-Samba,
 Jammu-181143, (J&K) India

Five-year Integrated M.Sc. Chemistry
Teaching Plan (Feb 2021-May 2021)

Semester: IV
 Course: Inorganic Chemistry (ICCHM4C004T)
 Course Teacher: Dr. Sujata Kundan

Week	Lecture No./Day	Topic to be Taught	No. of Hours	Suggested Readings
1 st Week	1	UNIT – I Chemistry of transition elements-I: General characteristic properties of 3d-block elements	1	1, 2, 3,7
2 nd Week	2	Relative stability of their oxidation states with special reference to electronic configuration, Atomic radii and ionic radii,	1	1, 2, 3,7
	3	Oxidation state, Colour, Ionization enthalpy	1	1, 2, 3,7
	4	Ability to form complexes, Magnetic properties, Catalytic properties	1	1, 2, 3,7
	5	Formation of binary compounds- Oxides, Halides and sulphides	1	1, 2, 3,7
3 rd Week	6	Contd...	1	1, 2, 3,7
	7	Contd...	1	1, 2, 3,7
	8	Contd...	1	1, 2, 3,7
4 th Week	9	Coordination number, Geometry and complex formation	1	1, 2, 3,7
	10	UNIT – II Chemistry of transition elements-II: General characteristic properties of 4d- and 5d-block elements	1	1, 2, 3, 7
	11	Comparative treatment with 3d-analogues with special reference to electronic configuration, Atomic radii and ionic radii	1	1, 2, 3, 7
	12	Colour, Variable valency, Ability to form complexes	1	1, 2, 3, 7
5 th Week	13	Magnetic and catalytic properties	1	1, 2, 3, 7
	14	Difference between 3d-, 4d- and 5d-transition series	1	1, 2, 3, 7
	15	Contd...	1	1, 2, 3, 7
	16	Position of lanthanides and actinides in the periodic table	1	1, 2, 3, 7
6 th Week	17	Lanthanide contraction	1	1, 2, 3, 7
	18	Spectral and magnetic properties of lanthanides	1	1, 2, 3, 7
	19	Separation of lanthanides and actinides	1	1, 2, 3, 7
7 th Week	20	Revision and Class test for Unit-I	1	
	21	UNIT – III Acids and bases: Acid-base theories: Arrhenius Concept of Acid and Bases	1	7, 8, 9
	22	Bronsted-Lowry Concepts of Acid-Bases, Lewis Concept of Acid-bases	1	7, 8, 9



Department of Chemistry and Chemical Sciences
CENTRAL UNIVERSITY OF JAMMU
 Rahya-Suchani (Bagla), District-Samba,
 Jammu-181143, (J&K) India

	23	Lux-Flood Concept of Acid-Bases Usanovich Concept of Acid-Bases	1	7, 8, 9
8 th Week	24	Hard and soft acids and bases (HSAB), Classification of acids and bases as hard and soft	1	7, 8, 9
	25	Contd...	1	7, 8, 9
	26	Pearson's HSAB concept	1	7, 8, 9
	27	Acid-base strength in relation to hardness and softness, Symbiosis	1	7, 8, 9
9 th Week	28	Theoretical basis of hardness and softness	1	7, 8, 9
	29	Relationship between electronegativity and hardness/softness	1	7, 8, 9
10 th Week	30	Revision and Class Test for Unit- II	1	
11 th Week	31	UNIT – IV Chemistry of non-aqueous solvents: Physical properties of a solvent	1	3, 4, 7, 8, 9
	32	Solvent system and its classification	1	3, 4, 7, 8, 9
	33	Reactions in non-aqueous solvents with reference to liquid NH ₃ , H ₂ SO ₄ , liquid HF, liquid SO ₂ . PCl ₅	1	3, 4, 7, 8, 9
	34	Contd...	1	3, 4, 7, 8, 9
12 th Week	35	Contd..	1	3, 4, 7, 8, 9
	36	Contd...	1	3, 4, 7, 8, 9
	37	Contd...	1	3, 4, 7, 8, 9
13 th Week	38	Chemistry of molten salts as non-aqueous solvents: Solvent properties, solution of metals, complex formation	1	3, 4, 7, 8, 9
	39	Contd...	1	3, 4, 7, 8, 9
	40	Contd...	1	3, 4, 7, 8, 9
14 th Week	41	Low temperature molten salts, Super acids	1	3, 4, 7, 8, 9
	42	Supercritical fluids: Properties of supercritical fluids and their uses as solvents	1	3, 4, 7, 8, 9
	43	Contd...	1	3, 4, 7, 8, 9
	44	Revision and Class test for Unit-III	1	
15 th Week	45	UNIT – V Nuclear chemistry and radioactivity-I: Fundamental particles of nucleus	1	8, 10, 11, 12, 13
	46	Basics of different nuclear models (shell model, liquid drop model, fermi gas model, collective model)	1	8, 10, 11, 12, 13
	47	Contd...	1	8, 10, 11, 12, 13
	48	Contd...	1	8, 10, 11, 12, 13
16 th Week	49	Revision and Class Test for Unit-IV	1	8, 10, 11, 12, 13
	50	Isotone, Isobar and Nuclear isomer	1	8, 10, 11, 12, 13
	51	Nuclear reactions, Types of nuclear reactions	1	8, 10, 11, 12, 13
	52	Chemical effects of nuclear transformations, Nuclear fission and nuclear fusion	1	8, 10, 11, 12, 13
17 th Week	53	Contd...	1	8, 10, 11, 12, 13
	54	Fission products and fission yields	1	8, 10, 11, 12, 13



Department of Chemistry and Chemical Sciences
CENTRAL UNIVERSITY OF JAMMU
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	55	Isotope Nuclear reactors: Classification of reactors	1	8, 10, 11, 12, 13
	56	Reactor power, Nuclear waste management	1	8, 10, 11, 12, 13
18 th Week	57	Contd...	1	8, 10, 11, 12, 13
	58	Discussion on Unit-I, II, III, IV	1	
	59	Revision and Class test of Unit-V	1	

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1. F. A. Cotton and G. Wilkinson, *Basic Inorganic Chemistry*, 3th Ed., John Wiley, 1972.
2. J. E. Huhey, Harpes and Row, *Inorganic Chemistry-Principles of structure and reactivity*, 4th Ed., 2006.
3. P. Atkins, T. Overton, J. Rourke, et.al., *Shriver and Atkins' Inorganic Chemistry*, 5th Ed., Oxford University Press, 2009.
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Department of Chemistry and Chemical Sciences
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Integrated B.Sc. (Hons.)-M.Sc. Chemistry
Teaching Plan (January 2021-June 2021)

Semester: IV
 Course: Organic Chemistry-II (ICCHM4C005T)
 Course Teacher: Dr. V. Sridharan

Week	Lecture No./Day	Topic to be Taught	No of Hours	Suggested Readings
1 st Week	I	Alcohols: Monohydric alcohols: Methods of formation, Reduction of aldehydes, ketones, carboxylic acids and esters	1	1, 2, 3, 4
	II	Contd.	1	1, 2, 3, 4
	III	Hydrogen bonding, Acidic nature	1	1, 2, 3, 4
	IV	Reactions of monohydric alcohols: Substitution, Dehydration	1	1, 2, 3, 4
2 nd Week	I	Oxidation and Esterification	1	1, 2, 3, 4
	II	Methods to distinguish primary, secondary and tertiary alcohols	1	1, 2
	III	Dihydric alcohols: Methods of formation	1	1, 2
	IV	Chemical reactions of vicinal glycols, Oxidative cleavage by periodic acid and lead tetraacetate	1	1, 2, 7, 8
3 rd Week	I	Contd.	1	1, 2, 7, 8
	II	Pinacol-pinacolone rearrangement	1	1, 2, 7, 8
	III	Trihydric alcohols: Methods of formation	1	1, 2, 3, 4
	IV	Chemical reactions of glycerol	1	1, 2, 3, 4
4 th Week	I	Phenols: Preparation of phenols	1	1, 2, 3, 4
	II	Acidity and factors effecting it, Relative acidity of phenol, alcohol and carboxylic acid, Resonance stabilization of phenoxide ion	1	1, 3, 4
	III	Contd.	1	1, 3, 4
	IV	Reactions of phenols, Electrophilic aromatic substitution	1	1, 2, 7, 8
5 th Week	I	Contd.	1	1, 2, 7, 8
	II	Fries rearrangement	1	1, 2, 7, 8
	III	Claisen rearrangement	1	1, 2, 7, 8
	IV	Kolbe's-Schmidt reaction	1	1, 2, 7, 8
6 th Week	I	Gattermann synthesis	1	1, 2, 7, 8
	II	Hauben-Hoesch and Lederer-Manasse reactions	1	1, 2, 7, 8
	III	Reimer-Tiemann reaction	1	1, 2, 7, 8
	IV	Schotten-Baumann Reaction	1	1, 2, 7, 8
7 th Week	I	Ethers: Nomenclature, Methods of formation	1	1, 2, 3, 4
	II	Physical properties, Chemical reactions	1	1, 2, 3, 4
	III	Cyclic ethers, Introduction to crown ethers, Structure and applications	1	1, 2, 3, 4
	IV	Contd.	1	1, 2, 3, 4



Department of Chemistry and Chemical Sciences
CENTRAL UNIVERSITY OF JAMMU
Rahya-Suchani (Bagla), District-Samba,
Jammu-181143, (J&K) India

8 th Week	I	Epoxides: Nomenclature and synthesis of epoxides	1	1, 2, 3, 4
	II	Acid and base-catalyzed ring opening of epoxides, Regiochemistry of epoxide ring opening	1	1, 2, 3, 4
	III	Contd.	1	1, 2, 3, 4
	IV	Reactions of epoxides with alcohols, amines, Grignard and organolithium reagents	1	1, 2, 3, 4
9 th Week	I	Contd.	1	1, 2, 3, 4
	II	Alkyl halides: Methods of formation, Mechanisms of nucleophilic substitution reactions of alkyl halides (S_N1 , S_N2 , S_Ni)	1	1, 5, 6, 7, 8
	III	Contd.	1	1, 5, 6, 7, 8
	IV	Contd.	1	1, 5, 6, 7, 8
10 th Week	I	Substitution at the allylic and vinylic positions	1	1, 7
	II	Mechanisms of elimination reactions of alkyl halides ($E1$ and $E2$), Stereochemical aspects of substitution and elimination reactions	1	1, 7
	III	Contd.	1	1, 7
	IV	Contd.	1	1, 7
11 th Week	I	Competition between substitution and elimination	1	1, 7
	II	Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides	1	1, 7
	III	Aryl halides: Preparation of aryl halides	1	1, 7
	IV	Aromatic nucleophilic substitution, Addition-elimination and the elimination-addition mechanisms	1	1, 7
12 th Week	I	Contd.	1	1, 7
	II	Carboxylic acids: Nomenclature, structure and bonding, Preparation of monocarboxylic acids	1	1, 2, 3, 4
	III	Physical properties, Acidity of carboxylic acids, Effect of substituents on acid strength	1	1, 2, 3, 4
	IV	Reactions of carboxylic acids, HVZ reaction, Synthesis of acid chlorides, esters and amides	1	1, 2, 3, 4
13 th Week	I	Contd.	1	1, 2, 3, 4
	II	Reduction of carboxylic acids, Mechanism of decarboxylation	1	1, 2, 3, 4
	III	Methods of formation and chemical reactions hydroxy acids: Malic, Tartaric and Citric acids	1	1, 2, 3, 4
	IV	Contd.	1	1, 2, 3, 4
14 th Week	I	Dicarboxylic acids, Methods of formation and effect of heat and dehydrating agents	1	1, 2, 3, 4
	II	Unsaturated acids: Cinnamic, Maleic and Fumaric acids	1	1, 2, 3, 4
	III	Carboxylic acid derivatives: Preparation and reactions of acid chlorides, anhydrides, esters, amides and acid anhydrides	1	1, 2, 3, 4



Department of Chemistry and Chemical Sciences
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	IV	Contd.	1	1, 2, 3, 4
15 th Week	I	Comparative study of nucleophilic substitution at acyl group, Mechanism of acidic and alkaline hydrolysis of esters	1	1, 2, 3, 4
	II	Claisen and Dieckmann condensations	1	1, 7
	III	Reformatsky reaction, Hofmann bromamide degradation, Curtius rearrangement	1	1, 7
	IV	Contd.	1	1, 7
16 th Week	I	Revision of Units I and II	1	
	II	Revision of Units III and IV	1	
	III	Revision of Unit V, Discussion of model question papers	1	
	IV	Discussion of model question papers	1	

REFERENCES

1. R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, *Organic Chemistry*, 7th Ed., 2010.
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Five-year Integrated M.Sc. Chemistry
Teaching Plan (February 2021-June 2021)

Semester: IV
 Course: Physical Chemistry - II (ICCHM4C006T)
 Course Teacher: Dr. Mukesh Kumar Verma

Week	Lecture No./Day	Topic to be Taught	No of Hours	Suggested Readings
1 st Week	I	Chemical equilibrium: Dynamic nature of Chemical equilibrium,	1	1-5
	II	Attainment and characteristics of chemical equilibrium,	1	1-5
	III	Law of mass action and its thermodynamic derivation,	1	1-5
	IV	Relation between K_p , K_c and K_x ,	1	1-5
2 nd Week	I	Thermodynamic relations for chemical affinity,	1	1-5
	II	Homogeneous equilibria, Temperature dependence of equilibrium constant and integrated form of van't Hoff equation,	1	1-5
	III	Contd.	1	1-5
	IV	Pressure dependence of equilibrium constant (K_p , K_c and K_x),	1	1-5
3 rd Week	I	Heterogeneous equilibria, Le Chatelier's principle	1	1-5
	II	Thermodynamic treatment of Le Chatelier's principle.	1	1-5
	III	Phase equilibrium: Statement and meaning of the terms – phase, component and degree of freedom,	1	1-5
	IV	Conditions for equilibrium between phases,	1	1-5
4 th Week	I	Thermodynamic derivation of Gibbs Phase Rule,	1	1-5
	II	Phase equilibria of one component system: water, carbon dioxide and sulphur systems,	1	1-5
	III	Contd.	1	1-5
	IV	Phase equilibria of two component systems: simple eutectic systems like Pb-Ag system,	1	1-5
5 th Week	I	Compound formation with congruent m.pt. Mg-Zn and $FeCl_3-H_2O$ system,	1	1-5
	II	Compound formation with incongruent m.pt.,	1	1-5
	III	Liquid-liquid mixtures: ideal liquid mixtures,	1	1-5
	IV	Raoult's and Henry's Law,	1	1-5
6 th Week	I	Non ideal systems, Azeotropes, HCl-Water and ethanol-water systems,	1	1-5
	II	Contd.	1	1-5
	III	Partially miscible liquids: phenol-water system.	1	1-5
	IV	Nernst distribution law: Partition coefficient, Thermodynamic derivation,	1	1-5



Department of Chemistry and Chemical Sciences

CENTRAL UNIVERSITY OF JAMMU

Rahya-Suchani (Bagla), District-Samba,

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7 th Week	I	Association and dissociation of solute in one solvent.	1	1-5
	II	Electrochemistry II: E.M.F. and potential,	1	1-5
	III	Nernst equation, Derivation of cell E.M.F. and single electrode potential.	1	1-5
	IV	Reference electrode: Standard hydrogen electrode, Ag/AgCl and Calomel electrode,	1	1-5
8 th Week	I	Contd.	1	1-5
	II	Electrolytic and Galvanic cells: Reversible and irreversible cells,	1	1-5
	III	Contd.	1	1-5
	IV	Calculation of thermodynamic quantities of cell reactions (ΔG , ΔH and K).	1	1-5
9 th Week	I	Contd.	1	1-5
	II	Formal potential and its application:	1	1-5
	III	Effect of pH, Concentration cell with and without transport,	1	1-5
	IV	Contd.	1	1-5
10 th Week	I	Liquid junction potential,	1	1-5
	II	Application of EMF measurement: Solubility product and activity coefficient,	1	1-5
	III	Potentiometric titrations (redox and acid-base),	1	1-5
	IV	Determination of pH using hydrogen and quinhydrone electrodes by potentiometric methods.	1	1-5
11 th Week	I	Contd.	1	1-5
	II	Catalysis: Characteristic of catalytic reactions,	1	1-5
	III	Homogeneous catalysis,	1	1-5
	IV	Acid-base catalysis and its kinetics,	1	1-5
12 th Week	I	Enzyme catalysis and its mechanism, Effect of temperature on enzyme catalysis,	1	1-5
	II	Heterogeneous catalysis,	1	1-5
	III	Surface reactions, Kinetics of surface reactions,	1	1-5
	IV	Unimolecular surface reactions,	1	1-5
13 th Week	I	Bimolecular surface reactions,	1	1-5
	II	Effect of temperature on heterogeneous reactions: Unimolecular and bimolecular.	1	1-5
	III	Contd.	1	1-5
	IV	Solid state chemistry: Crystal structures, Close packing,	1	5-8
14 th Week	I	Body centered and primitive structures,	1	5-8
	II	Symmetry in crystals, Crystallographic point groups,	1	5-8
	III	Space groups,	1	5-8
	IV	Lattices, One, Two- and Three-dimensional unit cells,	1	5-8



Department of Chemistry and Chemical Sciences

CENTRAL UNIVERSITY OF JAMMU

Rahya-Suchani (Bagla), District-Samba,

Jammu-181143, (J&K) India

15 th Week	I	Translational symmetry elements,	1	5-8
	II	Miller & Weiss indices,	1	5-8
	III	Interplanar spacing, Packing diagrams,	1	5-8
	IV	Atomic packing fraction,	1	5-8
16 th Week	I	Braggs' law,	1	5-8
	II	Structures of important ionic solids: Ionic Radii,	1	5-8
	III	Ionic solids with formula MX (CsCl, NaCl, zinc blende and wurtzite structures),	1	5-8
	IV	Contd.	1	5-8
17 th Week	I	MX_2 (fluorite and anti-fluorite structures),	1	5-8
	II	Crystal defects.	1	5-8
	III	Revision of Units I, II, III	1	
	IV	Revision of Units IV & V	1	

REFERENCES

1. P. W. Atkins, *The Elements of Physical Chemistry*, Oxford, 10th Ed., 2016.
2. R. P. Rastogi and R. R. Mishra, *Chemical Thermodynamics*, Vikas Publishing House Pvt. Ltd., 6th Ed., 2009.
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4. S. Glasstone, *An Introduction to Electrochemistry*, Affiliated East-West Press Pvt. Ltd., New Delhi, 2006.
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Five-year Integrated M.Sc. Chemistry
Teaching Plan (Feb 2021-June 2021)

Semester: IV
Course: Basic Analytical Chemistry (ICCHM4F001T)
Course Teacher: Dr. Shivender Singh Saini

Week	Lecture No./Day	Topic to be Taught	No of Hours	Suggested Readings
1 st Week	I	Analytical methods: Types of analytical methods	1	1-2
	II	Importance of analytical methods in qualitative and quantitative analysis	1	1-2
	III	Chemical and instrumental methods	1	1-2
	IV	Advantages and limitations of chemical and instrumental methods	1	1-2
2 nd Week	I	Laboratory hygiene and safety: Storage and handling of corrosive, Flammable, explosive,	1	1-2
	II	Storage and handling of Toxic, carcinogenic and poisonous chemicals	1	1-2
	III	Simple first aid procedures for accidents involving acids, alkalies	1	1-2
	IV	Simple first aid procedures for accidents involving acids, alkalies, bromine	1	1-2
3 rd Week	I	Simple first aid procedures for accidents involving burns and cut by glass, ,	1	1-2
	II	Threshold vapour concentration	1	1-2
	III	Safe limits	1	1-2
	IV	Waste disposal and fee me disposal.	1	1-2
4 th Week	I	Errors in chemical analysis: Accuracy and precision of measurements	1	3,4,5
	II	Determinate and indeterminate errors in chemical analysis with examples	1	3,4,5
	III	Systematic and random errors in chemical analysis with examples	1	3,4,5
	IV	Absolute and relative errors with examples	1	3,4,5
5 th Week	I	Source, Effect and Detection of systematic errors,	1	3,4,5
	II	Distribution of random errors, Normal error curve ,	1	3,4,5
	III	Standard deviations,	1	3,4,5
	IV	Standard deviation of calculated results: Sum or difference Product or quotient,	1	3,4,5
6 th Week	I	Standard deviation of calculated results: Product or quotient	1	3,4,5



CENTRAL UNIVERSITY OF JAMMU
Rahya-Suchani (Bagla), District-Samba, Jammu-
181143, (J&K) India

	II	Significant figures	1	3,4,5
	III	Rounding and expressing results of chemical computations	1	3,4,5
	IV	Contd.	1	3,4,5
7th Week	I	Solvent extraction: Solvent purification methods	1	2,6
	II	Distribution law,	1	2,6
	III	Single extraction, Multiple extraction	1	2,6
	IV	Craig concept of counter-current distribution,	1	2,6
8th Week	I	Important solvent systems: Chelate extraction,	1	2,6
	II	Contd. Synergic extraction, Extraction by solvation,	1	2,6
	III	Contd. Ion-pair extraction	1	2,6
	IV	Radio-analytical methods: Elementary theory,.	1	2,6
9th Week	I	Contd. Isotope dilution methods	1	2,6
	II	Contd. Applications	1	2,6
	III	Neutron activation methods	1	2,6
	IV	Contd. Applications	1	2,6

10 th Week	I	Chromatographic techniques: Chromatographic separations, General Introduction	1	7
	II	General description and classification of chromatographic methods	1	7
	III	Contd.	1	7
	IV	Thin layer, Paper and Column chromatographic techniques and their simple applications	1	7
11 th Week	I	Contd.	1	7
	II	Types of adsorbents, R _f -values and their significance,	1	7
	III	Contd.	1	7
	IV	Elution in column chromatography, Migration rates of solutes,	1	7
12 th Week	I	Band broadening and column efficiency	1	7
	II	Column resolution, Ion exchange resins	1	7
	III	Contd. and their exchange capacities,	1	7
	IV	Principle and simple applications of ion exchange separation.	1	7

13 th Week	I	Thermo analytical methods: Principles and applications of Thermogravimetry Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), Thermometric titrations	1	2,6
	II	Contd.	1	2,6
	III	Principles and applications of Differential Thermal Analysis (DTA)	1	2,6
	IV	Contd.	1	2,6
14 th week	I	Principles and applications of Differential Scanning Calorimetry (DSC)	1	2,6
	II	Contd.	1	2,6
	III	Thermometric titrations	1	2,6
	IV	Contd.	1	2,6
15 th week	I	Revision of Unit I	1	1-2
	II	Revision of Unit II	1	3,4,5
	III	Revision of unit III	1	2,6
	IV	Contd.	1	2,6
16 th week	I	Revision of Unit IV and V	1	2,6,7
	II	Contd.	1	2,6,7
	III	Model question papers	1	
	IV	Contd.	1	

REFERENCES

1. J. Mendham, R. C. Denney, J. D. Barnes and M. J. K. Thomas, *Vogel's Quantitative Chemical Analysis*, 6th Ed., Pearson, 2009.
2. H. H. Willard, L. L. Merritt Jr., J. A. Dean and F. A. Settle Jr., *Instrumental Methods of Analysis*, 7th Ed., Wardsworth Publishing Company, 1988.
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7. O. Mikes, *Mikes Laboratory Hand Book of Chromatographic and Allied Methods (Elles Harwood Series on Analytical Chemistry)*, John Wiley & Sons, 1979.