

# LESSON PLAN: Semester-2 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Anuva Samanta (AS), Dr Soumavo Ghosh (SG)

Paper Name & Code: Fundamentals of Chemistry – II (CHEM-H-CC2-2)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : I	<b>Kinetic Theory and Gaseous state:</b> Concept of pressure and temperature from kinetic theory of gas. Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case	Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011	4	Chalk and Talk	(AS)
	Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Wall collision and rate of effusion Calculation of number of molecules having energy $\geq \epsilon$ , Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases		4	Chalk and Talk	(AS)
	<b>Real gas and Virial equation:</b> Deviation of gases from ideal behavior; Compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behavior ; Existence of critical state, Critical constants in terms of van der Waals constants.	Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	4	Chalk and Talk	(AS)
	Law of corresponding states; Virial equation of state; van der Waals equation expressed in the Virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea.		3	Chalk and Talk	(AS)

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Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : II	<b>Chemical Bonding – I:</b> <b>i) Ionic bond:</b> General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elementary idea). Solubility energetics of dissolution process. <b>ii) Covalent bond:</b> Polarizing power and polarizability, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, The hydrogen molecule (Heitler – London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding ( $\sigma$ and $\pi$ bond approach).	i) Atkins, Overton, Rourke, Weller, Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010). ii) Lee, J. D. Concise Inorganic Chemistry, 5th Ed., Wiley India Pvt. Ltd., 2008	5	Chalk and Talk	(SG)
	<b>Theoretical principles of inorganic qualitative analysis:</b> Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principle involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.	Svehla & Sivasankar, Vogel's Qualitative Inorganic Analysis, 7th Ed., Pearson, 2012.	5	Chalk and Talk	(SG)
	Module : III	<b>Stereochemistry – II:</b>	Nasipuri, D.	4	Chalk and Talk

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Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Chirotopicity and its relationship with stereogenicity; concept of pseudoasymmetry for ABA type systems. Relative and absolute configuration: <i>R/S</i> descriptors; <i>erythro/threo</i> and <i>meso</i> nomenclature of compounds; <i>E/Z</i> descriptors for C=C, combination of <i>R/S</i> - and <i>E/Z</i> isomerisms.	Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd, 2020			
	<b>Optical activity of chiral compounds:</b> optical rotation, and specific rotation; racemic compounds, racemisation (through cationic, anionic intermediates); resolution of acids and bases <i>via</i> diastereomeric salt formation; optical purity and enantiomeric excess.	Finar, I. L. Organic Chemistry (Volume 1), 6th Edition, Pearson Education, 2002	4	Chalk and Talk	(PR)
	<b>General Treatment of Reaction Mechanism -I:</b> <b>Reactive intermediates:</b> Carbocations (carbenium and carbonium ions), non-classical carbocations, carbanions, carbon radicals: generation and stability, structure and electrophilic / nucleophilic behaviour of reactive intermediates (elementary idea). <b>Reaction thermodynamics:</b> Free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change <i>via</i> BDE, intermolecular & intramolecular reactions.	Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.	4	Chalk and Talk	(PR)
	<b>Reaction kinetics:</b> Rate constant and free energy of activation; free energy profiles for one-step, and two-step reactions; catalyzed	Sykes, P. A guidebook to	3	Chalk and Talk	(PR)

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Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	reactions, principle of microscopic reversibility; Hammonds postulate. <b>Substitution Reaction:</b> Free-radical substitution reaction: halogenation of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammonds postulate.	<b>Mechanism in Organic Chemistry, Pearson Education, 2003.</b>			
		<b>Total</b>	<b>45</b>		
<b>Practical</b>	<b>Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions (only water /acid soluble salts):</b> <b>Cation Radicals</b> Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup> , Al <sup>3+</sup> , Cr <sup>3+</sup> , Fe <sup>3+</sup> , Mn <sup>2+</sup> /Mn <sup>4+</sup> , Co <sup>2+</sup> /Co <sup>3+</sup> , Ni <sup>2+</sup> , Cu <sup>2+</sup> , Zn <sup>2+</sup> , Pb <sup>2+</sup> , NH <sub>4</sub> <sup>+</sup> , Sn <sup>2+</sup> /Sn <sup>4+</sup> <b>Anion Radicals</b> F <sup>-</sup> , Cl <sup>-</sup> , Br <sup>-</sup> , I <sup>-</sup> , S <sub>2</sub> O <sub>3</sub> <sup>2-</sup> , S <sup>2-</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , NO <sub>2</sub> <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , BO <sub>3</sub> <sup>3-</sup> , CrO <sub>4</sub> <sup>2-</sup> / Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> , SCN <sup>-</sup> , [Fe(CN) <sub>6</sub> ] <sup>3-</sup> , [Fe(CN) <sub>6</sub> ] <sup>4-</sup> , AsO <sub>4</sub> <sup>3-</sup> , BrO <sub>3</sub> <sup>-</sup> , IO <sub>3</sub> <sup>-</sup>	Svehla & Sivasankar, Vogel's Qualitative Inorganic Analysis, 7th Ed., Pearson, 2012.	28	Chalk and Talk and Hand on Demonstration	<b>(SG)</b>
	Practice		2		
		<b>Total</b>	<b>30</b>		

# LESSON PLAN: Semester-2 (Under CCF) 2025

**Department Name: Chemistry**

**Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Skill Enhancement Course (AI for Everyone) CHEM-H-SEC2-2**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module I: Introduction to Artificial Intelligence, Subfields and Technologies</b>	Definition and scope of AI	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH , 4th Edition , Pearson Education, 2022	2	On class demonstrations, study material supplied, modelling and interactive discussions	(AS)
	Historical overview and key milestones		2		
	Differentiating AI from human intelligence		2		
	Machine learning: Supervised, unsupervised, and reinforcement learning		3		
	Deep learning and neural networks		3		
	Natural language processing (NLP) and computer vision		3		
<b>Module II: Applications of AI and Ethical and Social Implications of AI</b>	AI in healthcare: Diagnosis, treatment, and medical imaging	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH , 4th Edition , Pearson Education, 2022	1	On class demonstrations, study material supplied, modelling and interactive discussions	(IS)
	AI in finance: Fraud detection, algorithmic trading, and risk assessment		2		
	AI in transportation: Autonomous vehicles and traffic optimization		1		
	AI in customer service and chatbots		1		
	AI in education: Personalized learning and intelligent tutoring systems		2		
	Bias and fairness in AI systems		2		
	Privacy and data protection concerns		2		

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Department Name: Chemistry

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Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Impact of AI on employment and the workforce		2	As above	(IS)
	AI and social inequality		2		
<b>Module III: Other Important Issues</b>	Ethical guidelines and responsible AI practices	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH , 4th Edition , Pearson Education, 2022	3	On class demonstrations, study material supplied, modelling and interactive discussions	(SG)
	AI and Innovation		4		
	Emerging trends and future directions in AI		4		
	AI and creativity: Generative models and artistic applications		4		
		Total	45		
<b>Project in Artificial Intelligence (A.I.)</b>	At the end of the semester-2, students are required to submit a report which can be based on any topic as given in the appendix 1 of University notification related to this course (CSR/35/2024 dated 24.06.2024).	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH , 4th Edition , Pearson Education, 2022	-	References material, interactive discussions and guidance	(AS, IS, SG)

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**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Interdisciplinary Course (Quantitative Analysis and Basic Laboratory Practices) CHEM-H-IDC2-2**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I</b>  <b>Introduction to Quantitative analysis and its interdisciplinary nature:</b>	Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method- accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD). Limitations of analytical methods.	Douglas A. Skoog, D.M. West , F. James Holler , Stanley R. Crouch,	4	Chalk and Talk	(SG)
	Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance.	Fundamentals of Analytical Chemistry , Cengage learning India Pvt Ltd. 10th Edition , 2022	3	Chalk and Talk	(SG)
	External standard calibration -regression equation (least squares method), correlation coefficient ( $R^2$ ). Presentation of experimental data and results from the point of view of significant figures.		3	Chalk and Talk	(SG)
<b>Module : II</b>  <b>Titrimetric analysis:</b>	<b>Principle</b> , classification, normality, molarity, molality, mole fraction, ppm, ppb etc. Standard solutions, preparation and dilution of reagents/ solutions using $N_1V_1 = N_2V_2$ , preparation of ppm level solutions from source materials (salts).	Daniel C. Harris , Quantitative Chemical Analysis , 10th Edition , W.H. Freeman , 2020	2	Chalk and Talk	(SB)
	<b>Acid-base titrimetry:</b> Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations.		2	Chalk and Talk	(SB)
	<b>Redox titrimetry:</b> Theory, balancing redox equations, titration curves.		2	Chalk and Talk	(SB)

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Paper Name & Code: Interdisciplinary Course (Quantitative Analysis and Basic Laboratory Practices) CHEM-H-IDC2-2

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	<b>Precipitation titrimetry:</b> Theory, titration curves, indicators for precipitation titrations.		2	Chalk and Talk	(SB)
	<b>Complexometric titrimetry:</b> Theory, titration methods employing EDTA (direct, back, displacement and indirect determinations). Indicators for EDTA titrations. Determination of hardness of water.		2	Chalk and Talk	(AS)
Module : III	<b>Water analysis:</b> Water availability, requirement of water. Quality of surface water and ground water. Impurities in water. Standards of water quality for potable, domestic, industrial and agricultural purpose (color, pH, alkalinity, hardness, TDS, sulphate, fluoride, chloride etc.)	Douglas A. Skoog, D.M. West, F. James Holler, Stanley R. Crouch, Fundamentals of Analytical Chemistry, Cengage learning India Pvt Ltd. 10th Edition, 2022	3	Chalk and Talk	(AS)
	<b>Water treatment technologies:</b> House hold water treatment, municipal water treatment and industrial treatment (primary and secondary treatment of industrial effluent). Softening of water. Disinfection of water. Definition and determinations of DO, BOD and COD, and their significance.		3	Chalk and Talk	(AS)
	<b>Basic laboratory practices:</b> Basic laboratory practices, calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying,		4	Chalk and Talk	(IS)



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Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.				
		Total	30		
<b>Tutorial:</b>	1. Safety Practices in the Chemistry Laboratory, knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glass wares.	Mendham, J., <i>A. I. Vogel's Quantitative Chemical Analysis</i> 6th Ed.,	3	Chalk and Talk and Demonstration	<b>(IS)</b>
	2. Calibration of glassware, pipette, burette and volumetric flask.		3	Chalk and Talk and Demonstration	<b>(SG)</b>
	3. Preparation of TLC plates and separation of amino acids	Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015	3	Chalk and Talk and Demonstration	<b>(SG)</b>
	4. Calibration of instruments like colorimeter, pH-meter, conductivity meter, spectrophotometer using reference standards or reference materials.		3	Chalk and Talk and Demonstration	<b>(AS)</b>
	5. Determination of alkali present in soaps/detergents.		3	Chalk and Talk and Demonstration	<b>(SB)</b>
		Total	15		

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**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-2) & Chemistry MDC- II (CHEM-MD-CC2-2)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I</b>	<b>Kinetic Theory and Gaseous state:</b> Concept of pressure and temperature from kinetic theory of gas. Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case	Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011	4	Chalk and Talk	(IS)
	Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Wall collision and rate of effusion Calculation of number of molecules having energy $\geq \epsilon$ , Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases		4	Chalk and Talk	(IS)
	<b>Real gas and Virial equation:</b> Deviation of gases from ideal behavior; Compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behavior ; Existence of critical state, Critical constants in terms of van der Waals constants.	Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	4	Chalk and Talk	(IS)
	Law of corresponding states; Virial equation of state; van der Waals equation expressed in the Virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea.		3	Chalk and Talk	(IS)

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**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-2) & Chemistry MDC- II (CHEM-MD-CC2-2)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : II</b>	<b>Chemical Bonding – I:</b> <b>i) Ionic bond:</b> General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elementary idea). Solubility energetics of dissolution process.	i) Atkins, Overton, Rourke, Weller, Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010). ii) Lee, J. D. Concise Inorganic Chemistry, 5th Ed., Wiley India Pvt. Ltd., 2008	5	Chalk and Talk	(SG)
	<b>ii) Covalent bond:</b> Polarizing power and polarizability, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, The hydrogen molecule (Heitler – London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding ( $\sigma$ and $\pi$ bond approach).		5	Chalk and Talk	(SG)
	<b>Theoretical principles of inorganic qualitative analysis:</b> Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principle involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.	Svehla & Sivasankar, Vogel's Qualitative Inorganic Analysis, 7th Ed., Pearson, 2012.	5	Chalk and Talk	(SG)

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Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : III</b>	<b>Stereochemistry – II:</b> Chirotopicity and its relationship with stereogenicity; concept of pseudoasymmetry for ABA type systems. Relative and absolute configuration: <i>R/S</i> descriptors; <i>erythro/threo</i> and <i>meso</i> nomenclature of compounds; <i>E/Z</i> descriptors for C=C, combination of <i>R/S</i> - and <i>E/Z</i> isomerisms.	Nasipuri, D. <b>Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd , 2020</b>	4	Chalk and Talk	(PR)
	<b>Optical activity of chiral compounds:</b> optical rotation, and specific rotation; racemic compounds, racemisation (through cationic, anionic intermediates); resolution of acids and bases <i>via</i> diastereomeric salt formation; optical purity and enantiomeric excess.	Finar, I. L. <b>Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002</b>	4	Chalk and Talk	(PR)
	<b>General Treatment of Reaction Mechanism -I:</b> <b>Reactive intermediates:</b> Carbocations (carbenium and carbonium ions), non-classical carbocations, carbanions, carbon radicals: generation and stability, structure and electrophilic / nucleophilic behaviour of reactive intermediates (elementary idea). <b>Reaction thermodynamics:</b> Free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change <i>via</i> BDE, intermolecular & intramolecular reactions.	Sykes, P. A <b>guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</b>	4	Chalk and Talk	(PR)
	<b>Reaction kinetics:</b> Rate constant and free energy of activation; free	Sykes, P. A	3	Chalk and Talk	(PR)

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Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	energy profiles for one-step, and two-step reactions; catalyzed reactions, principle of microscopic reversibility; Hammonds postulate. <b>Substitution Reaction:</b> Free-radical substitution reaction: halogenation of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammonds postulate.	<b>guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</b>			
		<b>Total</b>	<b>45</b>		
<b>Practical</b>	<b>Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions (only water /acid soluble salts):</b> <b>Cation Radicals</b> Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup> , Al <sup>3+</sup> , Cr <sup>3+</sup> , Fe <sup>3+</sup> , Mn <sup>2+</sup> /Mn <sup>4+</sup> , Co <sup>2+</sup> /Co <sup>3+</sup> , Ni <sup>2+</sup> , Cu <sup>2+</sup> , Zn <sup>2+</sup> , Pb <sup>2+</sup> , NH <sub>4</sub> <sup>+</sup> , Sn <sup>2+</sup> /Sn <sup>4+</sup> <b>Anion Radicals</b> F <sup>-</sup> , Cl <sup>-</sup> , Br <sup>-</sup> , I <sup>-</sup> , S <sub>2</sub> O <sub>3</sub> <sup>2-</sup> , S <sup>2-</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , NO <sub>2</sub> <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , BO <sub>3</sub> <sup>3-</sup> , CrO <sub>4</sub> <sup>2-</sup> / Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> , SCN <sup>-</sup> , [Fe(CN) <sub>6</sub> ] <sup>3-</sup> , [Fe(CN) <sub>6</sub> ] <sup>4-</sup> , AsO <sub>4</sub> <sup>3-</sup> , BrO <sub>3</sub> <sup>-</sup> , IO <sub>3</sub> <sup>-</sup>		4	Chalk and Talk and Hand on Demonstration	<b>(AS, IS)</b>
			10		
			14		
	Practice		2		
		<b>Total</b>	<b>30</b>		

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Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Ishita Saha (IS),

Paper Name & Code: Skill Enhancement Course (Chemistry In Daily Life) CHEM-MD-SEC-Th

Planned			After Implementation		
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : I	Dairy Products	Edward Cox Henry, The Chemical analysis of Foods , Hardcover, Hassell Street Press , 2021	5	Chalk and Talk	(SB)
	Food additives, adulterants, and contaminants		5	Chalk and Talk	(SB)
	Artificial food colorants		5	Chalk and Talk	(SB)
Module : II	Vitamins	B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)	5	Chalk and Talk	(PR)
	Oils and fats		5	Chalk and Talk	(PR)
	Soaps & Detergents		5	Chalk and Talk	(PR)
Module : III	Chemical and Renewable Energy Sources	Fred Billmeyer : Textbook of polymer science; Wiley 3rd edition.	5	Chalk and Talk	(IS)
	Polymers		10	Chalk and Talk	(IS)
		<b>Total</b>	<b>45</b>		
Tutorial	1. Estimation of Vitamin C		4	Chalk and Talk	(SB)
	2. Determination of Iodine number of oil.		3	Chalk and Talk	(IS)
	3. Determination of saponification number of oil.		4	Chalk and Talk	(PR)
	4. Determination of methyl alcohol in alcoholic beverages.		4	Chalk and Talk	(IS)
		<b>Total</b>	<b>15</b>		

# LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Inorganic Chemistry – I (CHEM-H-CC5-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I (Chemical bonding –II)</b>	<b>Molecular orbital concept of bonding:</b> The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach): sigma and pi bonds and delta interaction, multiple bonding. Orbital designations: gerade, ungerade, HOMO, LUMO. Orbital mixing,. MO diagrams of H <sub>2</sub> , Li <sub>2</sub> , Be <sub>2</sub> , B <sub>2</sub> , C <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> , F <sub>2</sub> , and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO <sup>+</sup> , CN <sup>-</sup> , HF, BeH <sub>2</sub> , CO <sub>2</sub> and H <sub>2</sub> O. Bond properties: bond orders, bond lengths.	1. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3 <sup>rd</sup> Edition, Pearson India, 2008 2. A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition, Pearson India ,2002	18	Chalk and Talk	SB
	<b>Metallic Bond</b> Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.		5	Chalk and Talk	SB
	<b>Weak Chemical Forces</b> Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.		5	Chalk and Talk	SG
<b>Module : II (Acids and bases)</b>	<b>Acid-Base concept</b> Arrhenius concept, theory of solvent system (in H <sub>2</sub> O, NH <sub>3</sub> , SO <sub>2</sub> and HF), Bronsted-Lowry's concept, Lux Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Relative strength of acids, Pauling's rules. HSAB principle.	1. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3 <sup>rd</sup> Edition, Pearson India, 2008 2. A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition, Pearson India ,2002	6	Chalk and Talk	SG
	<b>Acid-base equilibria in aqueous solution:</b> Proton transfer equilibria in water, pH, buffer. Acid-base neutralization curves; indicator, choice of indicators.		6	Chalk and Talk	SG
<b>Module : III (Radioactivity)</b>	<b>Nuclear stability:</b> Nuclear stability and nuclear binding energy. <b>Nuclear Reactions:</b> Artificial radioactivity, fission, fusion and spallation. <b>Radiocarbon dating</b>	A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition, Pearson India ,2002	5	Chalk and Talk	SG
		<b>Total</b>	<b>45</b>		

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)

Paper Name & Code: Inorganic Chemistry – I (CHEM-H-CC5-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Practical	<b>Complexometric Titration</b> 1. Ca(II) and Mg(II) in a mixture 2. Hardness of water 3. Fe(III) and Al(III) in a mixture 4. Cu(II) and Zn(II) in a mixture 5. Cu(II) and Ni(II) in a mixture	1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Practical Workbook Chemistry (Honours), UGBOS, Chemistry, University of Calcutta, 2015	28	Chalk and Talk and Hand on Demonstration	(SG)
	Practice		2		
		Total	30		



# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Priyabrata Roy (PR)

Paper Name & Code: Organic Chemistry – II (CHEM-H-CC6-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : I Stereochemistry – IV	<b>Conformation-II</b> Concept of dihedral angle, torsion angle; energy barrier of rotation, concept of torsional and steric strains; relative stability of conformers on the basis of steric effect, dipole-dipole interaction and H-bonding; butane gauche interaction; conformational analysis of ethane, propane, <i>n</i> -butane, and 2-methylbutane; 1,2-dihaloalkanes and ethylene glycol.	Nasipuri, D. Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd, 2020	4	Chalk and Talk	
	<b>Concept of prostereoisomerism</b> Prostereogenic centre; concept of (pro)nchirality: topicity of ligands and faces (elementary idea); pro-R/pro-S, pro-E/pro-Z and Re/Si descriptors; pro- <i>r</i> and pro- <i>s</i> descriptors of ligands on propseudoasymmetric centre.		4	Chalk and Talk	
	<b>Chirality arising out of stereoaxis</b> Stereoisomerism of substituted cumulenes with even and odd number of double bonds; chiral axis in allenes, and biphenyls; related configurational descriptors ( <i>Ra/Sa</i> ); atropisomerism; racemisation of chiral biphenyls		4	Chalk and Talk	

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Priyabrata Roy (PR)

Paper Name & Code: Organic Chemistry – II (CHEM-H-CC6-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : II Chemistry of carbonyl Compounds	<b>Nucleophilic Addition to C=O</b>  Structure and reactivity of carbonyl compounds; mechanism (with evidence), reactivity, equilibrium and kinetic control; formation of hydrates, cyanohydrins and bisulphite adduct; nucleophilic addition-elimination reactions with alcohols, thiols and nitrogen-based nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenko reactions, reactions with ylides: Wittig and Corey-Chaykovsky reaction; Rupe rearrangement, oxidations and reductions: Clemmensen, Wolff-Kishner, LiAlH <sub>4</sub> , NaBH <sub>4</sub> , MPVO redox equilibrium, acyloin condensation; oxidation of alcohols with PDC and PCC; periodic acid and lead tetraacetate oxidation of 1,2-diols.	1. Finar, I. L. Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002  2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.  3. Morrison, R. N. & Boyd, R. N. and Bhattacharjee, Organic Chemistry, 7th Edition(Pearson Education), 2010	10	Chalk and Talk	
	<b>Exploitation of acidity of <math>\alpha</math>-H of C=O</b> Formation of enols and enolates; kinetic and thermodynamic enolates; reactions (mechanism with evidence): halogenation of		1. Finar, I. L. Organic Chemistry	10	Chalk and Talk

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Priyabrata Roy (PR)

Paper Name & Code: Organic Chemistry – II (CHEM-H-CC6-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	carbonyl compounds under acidic and basic conditions, Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO <sub>2</sub> (Riley) oxidation; condensations (mechanism with evidence): Aldol, Tollens', Knoevenagel, Claisen-Schmidt, Claisen ester including Dieckmann; Mannich reaction, Perkin reaction; alkylation of active methylene compounds; synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines and silyl enol ethers) in connection with alkylation, acylation and aldol type reaction	(Volume 1), 6th Edition, Pearson Education, 2002  2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.			
	<b>Nucleophilic addition to <math>\alpha, \beta</math>-unsaturated carbonyl system</b> General principle and mechanism (with evidence); direct and conjugate addition, addition of enolates (Michael reaction), Robinson annulations reaction. <b>Substitution at sp<sup>2</sup> carbon (C=O system)</b> Mechanism (with evidence): BAC2, AAC2, AAC1, AAL1 (inconnection to acid and ester); acid derivatives: amides, anhydrides & acyl halides (formation and hydrolysis including comparison).	3. Morrison, R. N. & Boyd, R. N. and Bhattacharjee, Organic Chemistry, 7th Edition (Pearson Education), 2010	8	Chalk and Talk	

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Priyabrata Roy (PR)

Paper Name & Code: Organic Chemistry – II (CHEM-H-CC6-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : III	<b>Organometallics</b> Grignard reagents ,Organolithiums; Gilman cuprates: preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directed <i>ortho</i> metalation of arenes using organolithiums, conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behaviour of Grignard reagents; comparison of reactivity among Grignard, organolithiums and organocopper reagents; Reformatsky reaction; concept of umpolung.	1. Finar, I. L. Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002	5	Chalk and Talk	
		2. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.			
		3. Morrison, R. N. & Boyd, R. N. and Bhattacharjee, Organic Chemistry, 7th Edition(Pearson Education), 2010			
		<b>Total</b>	<b>45</b>		

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Priyabrata Roy (PR)

Paper Name & Code: Organic Chemistry – II (CHEM-H-CC6-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Practical	<b>Qualitative analysis of single solid organic compound:</b> 1. Detection of special elements (N, S, Cl) by Lassaigne's test 2. Solubility and classification (solvents: H <sub>2</sub> O, 5% HCl, 5% NaOH and 5% NaHCO <sub>3</sub> ) 3. Detection of the following functional groups by systematic chemical tests: aromatic amino (Ar-NH <sub>2</sub> ), aromatic nitro (-NO <sub>2</sub> ), amido (-CONH <sub>2</sub> , including imide), phenolic -OH, carboxylic acid (-COOH), carbonyl (distinction between -CHO and >C=O); only one test for each functional group is to be reported.  Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups in known and unknown (at least six) organic compounds.	1. Practical Workbook Chemistry (Honours), UGBOS, Chemistry, University of Calcutta, 2015  2. Furniss, Hannaford, Smith, Tatcholl, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Pearson India, 2003	28	Chalk and Talk and Hand on Demonstration	
	Practice		2		
		<b>Total</b>	<b>30</b>		

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Physical Chemistry – II PAPER : CHEM-H-CC7-4-Th Module : I	Transport processes and Liquid State: Diffusion and Viscosity: Diffusion Fick's law, Flux, force, phenomenological coefficients & their inter-relationship (general form),	1. Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011 2. Castellan, G. W. Physical Chemistry, Narosa, 2004 3. Atkins, P. W. & Paula, J. de, Atkins' Physical	1	Chalk and talk	IS

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	different examples of transport properties	Chemistry, 11th Edition, Oxford University Press, 2018	1		
Module : I	Viscosity General features of fluid flow (streamline flow and turbulent flow); Newton's equation,	1. Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011 2. Castellan, G.	1	Chalk and talk	IS

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	viscosity coefficient; Poiseuille's equation ( with derivation); principle of determination of viscosity coefficient of liquids by falling sphere method and using Ostwald's viscometer.	W. Physical Chemistry, Narosa , 2004 3. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	1		



## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Temperature variation of viscosity of liquids and comparison with that of gases. Relation between viscosity coefficient of a gas and mean free path.		1		

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Module : II	Solid State: (12 Lectures) Bravais Lattice and Laws of Crystallography Types of solid, Bragg's law of diffraction; Laws of crystallography (Haüy's law and Steno's law);	1. Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011 2. Castellan, G. W. Physical Chemistry, Narosa, 2004 3. Atkins, P. W.	3	Chalk and talk	AS

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Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Permissible symmetry axes in crystals; Lattice, space lattice, unit cell, crystal planes, Bravais lattice. Packing of uniform hard sphere, close packed arrangements (fcc and hcp); Tetrahedral and octahedral voids. Void space in cubic systems	& Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	3		

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Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Crystal plane Distance between consecutive planes [cubic and orthorhombic lattices];	1. Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011	1	Chalk and talk	AS
	Indexing of planes, Miller indices; calculation of dhkl;	2. Castellan, G. W. Physical Chemistry, Narosa, 2004	2		
	Relation between molar mass and unit cell dimension for cubic system; Bragg's law (derivation).	3. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press,	2		

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Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Determination of crystal structure: Powder method; Structure of NaCl and KCl crystals.	2018	1		
Module : III Application of Thermodynamics – II:	Colligative properties Vapour pressure of solution;	1.Denbigh, K. The Principles of Chemical Equilibrium, Cambridge University Press	2	Chalk and talk	IS
	Thermodynamic derivations (using chemical potential)	2.Zemansky, M. W. & Dittman, R.H , Heat and	2		

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Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Applications in calculating molar masses of normal, dissociated and associated solutes in solution;	Thermodynamics, Special Indian Edition , 8th Edition, Tata-McGraw-Hil ,2017	3		
	Abnormal colligative properties.	3. Klotz, Irving M , Rosenberg, Robert M, Chemical Thermodynamics ,Wiley India , 2013	1		
	Phase Equilibrium: Definitions of phase, component	1.Levine, I. N. Physical Chemistry, 6th	1	Chalk and talk	IS

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	and degrees of freedom;	Edition McGraw-Hill India, 2011			
	Phase rule and its derivations;	2. Castellan, G. W. Physical Chemistry, Narosa , 2004	1		
	Definition of phase diagram; Phase diagram for water, CO <sub>2</sub> , Sulphur. Binary solutions:	3. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	3		
	Three component systems		3		

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
ELECTROCHEMISTRY-II:	Electromotive Force: Rules of oxidation/reduction of ions based on half-cell potentials; Electromotive force of a cell and its measurement	1. Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018 2. An Introduction To Electrochemistry by	2	Chalk and talk	AS
	Chemical cells, reversible and irreversible cells with examples	Glasstone, Samuel	1		



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Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone and glass electrodes		3		
	Concentration cells with and without transference, liquid		1		

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	junction potential				
	Potentiometric Titration.		1		
PAPER : CHEM-H-CC7-4-P	1. Surface tension measurements using Stalagmometer: 2. Viscosity	. Practical Workbook Chemistry (Honours), UGBOS, Chemistry,	10 10	Chalk and talk	IS

## LESSON PLAN: Semester 4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr Ishita Saha (IS)

Paper Name & Code: Physical Chemistry – II (CHEM-H-CC7-4)

Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	measurement using Ostwald's viscometer: 3. Conductometric Experiments :	University of Calcutta, 2015	10		

# LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Inorganic Chemistry – II (CHEM-H-CC8-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I (Coordination chemistry)</b>	<b>Basics of coordination chemistry</b> Werner's theory, ligands, IUPAC nomenclature, Isomerism (constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes)	1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Okhil K. Medhi , Principles of Structure and Reactivity, 5 <sup>th</sup> Edition ,Pearson India, 2022 2. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3rd Edition, Pearson India, 2008	5	Chalk and Talk	SB
	<b>Valence bond theory and crystal field theory</b> VB description and its limitations. Elementary Crystal Field Theory: splitting of $d^n$ configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn- Teller distortion. Octahedral site stabilization energy (OSSE). Metal-ligand bonding (MO concept, elementary idea), sigma- and pi-bonding in octahedral complexes (qualitative pictorial approach) and their effects on the oxidation states of transitional metals (examples).		10	Chalk and Talk	SB
	<b>Electronic spectra of complexes and magnetic properties</b> d-d transitions; L-S coupling; qualitative Orgel diagrams for $3d^1$ to $3d^9$ ions. Racah parameter. Selection rules for electronic spectral transitions; spectrochemical series of ligands; charge transfer spectra (elementary idea). Orbital and spin magnetic moments, spin only moments of $d^n$ ions and their correlation with effective magnetic moments, including orbital contribution; quenching of magnetic moment: super exchange and antiferromagnetic interactions (elementary idea with examples only);		11	Chalk and Talk	SG
<b>Module : II (Supramolecular chemistry)</b>	Hydrogen bonding. Non-covalent interactions – examples of Ion-Dipole Interactions, Dipole-Dipole interactions, Dipole-Induced Dipole and Ion-Induced Dipole interactions, van der Waals or Dispersion Interactions, Halogen bonding, Cation-interactions, Anion-pi interactions, pi - pi interactions, Aromatic-Aromatic Interactions: Edge-to face vs pi-pi Stacking Interactions, N-H- pi interactions, Sulfur-aromatic interactions.	J-M Lehn , Supramolecular Chemistry	8	Chalk and Talk	SB
<b>Module : III</b>	<b>Basic principle of redox reactions</b> Ion-electron method of balancing equation of redox reaction. Elementary idea on	A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3rd Edition,	5	Chalk and Talk	SG

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**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Inorganic Chemistry – II (CHEM-H-CC8-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>(Redox reactions)</b>	standard redox potentials with sign conventions. Nernst equation (without derivation). Influence of complex formation, precipitation and change of pH on redox potentials; formal potential.	Pearson India ,2002			
	<b>Redox titrations</b> Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions (typical examples).	A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3rd Edition, Pearson India ,2002	6	Chalk and Talk	SG
		Total	45		
<b>Practical</b>	<b>Estimation of mixtures of metal ions:</b> 1. Estimation of Fe <sup>3+</sup> and Cu <sup>2+</sup> in a mixture. 2. Estimation of Fe <sup>3+</sup> and Cr <sup>3+</sup> in a mixture. 3. Estimation of Fe <sup>3+</sup> and Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> in a mixture. 4. Estimation of Fe <sup>3+</sup> and Mn <sup>2+</sup> in a mixture. 5. Estimation of Cr <sup>3+</sup> and Mn <sup>2+</sup> in a mixture.	1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Practical Workbook Chemistry (Honours), UGBOS, Chemistry, University of Calcutta, 2015	28	Chalk and Talk and Hand on Demonstration	(SB)
		Practice	2		
		Total	30		

## LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)

**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-4) & Chemistry MDC- II (CHEM-MD-CC2-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I</b>	<b>Kinetic Theory and Gaseous state:</b> Concept of pressure and temperature from kinetic theory of gas. Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case	Levine, I. N. Physical Chemistry, 6th Edition McGraw-Hill India, 2011	4	Chalk and Talk	(IS)
	Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Wall collision and rate of effusion Calculation of number of molecules having energy $\geq \epsilon$ , Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases		4	Chalk and Talk	(IS)
	<b>Real gas and Virial equation:</b> Deviation of gases from ideal behavior; Compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behavior ; Existence of critical state, Critical constants in terms of van der Waals constants.	Atkins, P. W. & Paula, J. de, Atkins' Physical Chemistry, 11th Edition, Oxford University Press, 2018	4	Chalk and Talk	(IS)
	Law of corresponding states; Virial equation of state; van der Waals equation expressed in the Virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea.		3	Chalk and Talk	(IS)

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**Department Name: Chemistry**

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)

**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-4) & Chemistry MDC- II (CHEM-MD-CC2-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : II</b>	<b>Chemical Bonding – I:</b> <b>i) Ionic bond:</b> General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elementary idea). Solubility energetics of dissolution process. <b>ii) Covalent bond:</b> Polarizing power and polarizability, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, The hydrogen molecule (Heitler – London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding ( $\sigma$ and $\pi$ bond approach).	i) Atkins, Overton, Rourke, Weller, Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010). ii) Lee, J. D. Concise Inorganic Chemistry, 5th Ed., Wiley India Pvt. Ltd., 2008	5	Chalk and Talk	(SG)
	<b>Theoretical principles of inorganic qualitative analysis:</b> Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principle involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.	Svehla & Sivasankar, Vogel's Qualitative Inorganic Analysis, 7th Ed., Pearson, 2012.	5	Chalk and Talk	(SG)

# LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)

**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-4) & Chemistry MDC- II (CHEM-MD-CC2-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : III</b>	<b>Stereochemistry – II:</b> Chirotopicity and its relationship with stereogenicity; concept of pseudoasymmetry for ABA type systems. Relative and absolute configuration: <i>R/S</i> descriptors; <i>erythro/threo</i> and <i>meso</i> nomenclature of compounds; <i>E/Z</i> descriptors for C=C, combination of <i>R/S</i> - and <i>E/Z</i> isomerisms.	Nasipuri, D. <b>Stereochemistry of Organic Compounds, 4th Edition, New Age International Pvt Ltd , 2020</b>	4	Chalk and Talk	<b>(PR)</b>
	<b>Optical activity of chiral compounds:</b> optical rotation, and specific rotation; racemic compounds, racemisation (through cationic, anionic intermediates); resolution of acids and bases <i>via</i> diastereomeric salt formation; optical purity and enantiomeric excess.	Finar, I. L. <b>Organic Chemistry (Volume 1), 6th Edition , Pearson Education , 2002</b>	4	Chalk and Talk	<b>(PR)</b>
	<b>General Treatment of Reaction Mechanism -I:</b> <b>Reactive intermediates:</b> Carbocations (carbenium and carbonium ions), non-classical carbocations, carbanions, carbon radicals: generation and stability, structure and electrophilic / nucleophilic behaviour of reactive intermediates (elementary idea). <b>Reaction thermodynamics:</b> Free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change <i>via</i> BDE, intermolecular & intramolecular reactions.	Sykes, P. A <b>guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</b>	4	Chalk and Talk	<b>(PR)</b>
	<b>Reaction kinetics:</b> Rate constant and free energy of activation; free	Sykes, P. A	3	Chalk and Talk	<b>(PR)</b>



## LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Priyabrata Roy (PR), Dr Anuva Samanta (AS), Dr Ishita Saha (IS), Dr Soumavo Ghosh (SG)

**Paper Name & Code: Chemistry Minor - II (CHEM-H-CC2-4) & Chemistry MDC- II (CHEM-MD-CC2-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	energy profiles for one-step, and two-step reactions; catalyzed reactions, principle of microscopic reversibility; Hammonds postulate. <b>Substitution Reaction:</b> Free-radical substitution reaction: halogenation of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammonds postulate.	<b>guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003.</b>			
		<b>Total</b>	<b>45</b>		
<b>Practical</b>	<b>Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions (only water /acid soluble salts):</b> <b>Cation Radicals</b> Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>2+</sup> , Sr <sup>2+</sup> , Ba <sup>2+</sup> , Al <sup>3+</sup> , Cr <sup>3+</sup> , Fe <sup>3+</sup> , Mn <sup>2+</sup> /Mn <sup>4+</sup> , Co <sup>2+</sup> /Co <sup>3+</sup> , Ni <sup>2+</sup> , Cu <sup>2+</sup> , Zn <sup>2+</sup> , Pb <sup>2+</sup> , NH <sub>4</sub> <sup>+</sup> , Sn <sup>2+</sup> /Sn <sup>4+</sup> <b>Anion Radicals</b> F <sup>-</sup> , Cl <sup>-</sup> , Br <sup>-</sup> , I <sup>-</sup> , S <sub>2</sub> O <sub>3</sub> <sup>2-</sup> , S <sup>2-</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , NO <sub>2</sub> <sup>-</sup> , PO <sub>4</sub> <sup>3-</sup> , BO <sub>3</sub> <sup>3-</sup> , CrO <sub>4</sub> <sup>2-</sup> / Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> , SCN <sup>-</sup> , [Fe(CN) <sub>6</sub> ] <sup>3-</sup> , [Fe(CN) <sub>6</sub> ] <sup>4-</sup> , AsO <sub>4</sub> <sup>3-</sup> , BrO <sub>3</sub> <sup>-</sup> , IO <sub>3</sub> <sup>-</sup>		4	Chalk and Talk and Hand on Demonstration	<b>(AS, IS)</b>
			14		
	Practice		2		
		<b>Total</b>	<b>30</b>		

# LESSON PLAN: Semester-4 (Under CCF) 2025

**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: Chemistry MDC-IV (CHEM-MD-CC4-4)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module : I (Chemical bonding –II)</b>	<b>Molecular orbital concept of bonding:</b> The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach): sigma and pi bonds and delta interaction, multiple bonding. Orbital designations: gerade, ungerade, HOMO, LUMO. Orbital mixing,. MO diagrams of H <sub>2</sub> , Li <sub>2</sub> , Be <sub>2</sub> , B <sub>2</sub> , C <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> , F <sub>2</sub> , and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO <sup>+</sup> , CN <sup>-</sup> , HF, BeH <sub>2</sub> , CO <sub>2</sub> and H <sub>2</sub> O. Bond properties: bond orders, bond lengths.	1. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3 <sup>rd</sup> Edition, Pearson India, 2008 2. A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition, Pearson India ,2002	18	Chalk and Talk	SB
	<b>Metallic Bond</b> Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.		5	Chalk and Talk	SB
	<b>Weak Chemical Forces</b> Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.		5	Chalk and Talk	SG
<b>Module : II (Acids and bases)</b>	<b>Acid-Base concept</b> Arrhenius concept, theory of solvent system (in H <sub>2</sub> O, NH <sub>3</sub> , SO <sub>2</sub> and HF), Bronsted-Lowry's concept, Lux Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Relative strength of acids, Pauling's rules. HSAB principle.	1. G. L. Miessler, D. A. Tarr, Inorganic Chemistry , 3 <sup>rd</sup> Edition, Pearson India, 2008 2. A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition, Pearson India ,2002	4	Chalk and Talk	SG
	<b>Thermodynamic acidity parameters</b> Drago-Wayland equation. Superacids, Gas phase acidity and proton affinity		4	Chalk and Talk	SG
	<b>Acid-base equilibria in aqueous solution:</b> Proton transfer equilibria in water, pH, buffer. Acid-base neutralization curves; indicator, choice of indicators.		4	Chalk and Talk	SG
<b>Module : III</b>	<b>Nuclear stability:</b> Nuclear stability and nuclear binding energy. <b>Nuclear</b>	A. G. Sharpe, C. E. Housecroft, Inorganic Chemistry 3 <sup>rd</sup> Edition,	5	Chalk and	SG

# LESSON PLAN: Semester-4 (Under CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)

Paper Name & Code: Chemistry MDC-IV (CHEM-MD-CC4-4)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
(Radioactivity)	Reactions: Artificial radioactivity, fission, fusion and spallation. Radiocarbon dating	Pearson India ,2002		Talk	
		<b>Total</b>	<b>45</b>		
Practical	<b>Complexometric Titration</b> 1. Ca(II) and Mg(II) in a mixture 2. Hardness of water 3. Fe(III) and Al(III) in a mixture 4. Cu(II) and Zn(II) in a mixture 5. Cu(II) and Ni(II) in a mixture	1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009. 2. Practical Workbook Chemistry (Honours), UGBOS, Chemistry, University of Calcutta, 2015	28	Chalk and Talk and Hand on Demonstration	(SG)
	Practice		2		
		<b>Total</b>	<b>30</b>		

# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Module: I Thermodynamics -II</b>	<b>Second Law:</b> Need for a Second law; statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Carnot engine and refrigerator; Kelvin – Planck and Clausius statements and equivalence of the two statements with entropic formulation; Carnot's theorem; Values of $\delta Q/T$ and Clausius inequality; Physical concept of Entropy; Entropy is a measure of the microscopic disorder of the system. Entropy change of systems and surroundings for various processes and transformations; Entropy and unavailable work; Temperature – Entropy diagram. Useful work and The Gibbs and Helmholtz function. Changes at constant T, P. Application to electric work. Criteria for spontaneity and equilibrium. Gibbs-Helmholtz equation, The Gibbs Function and useful work in Biological systems. Gibbs free energy and spontaneous phase transition. Maxwell's relations; Joule-Thomson experiment and its consequences; inversion temperature; Joule-Thomson	Castellan, G. W. <i>Physical Chemistry</i> , Narosa	15	On class demonstrations using chalk and board, interactive discussions	IS

# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	coefficient for a van der Waals gas; General heat capacity relations				
	<b>Systems of Variable Compositions:</b> State functions for system of variable compositions. Criteria of equilibrium and spontaneity in systems of variable composition. Partial molar quantities, dependence of thermodynamic parameters on composition; Chemical potential as an escaping tendency. Gibbs-Duhem equation, Entropy and Gibbs function for mixing of ideal gases, the chemical potential of ideal mixtures. The Fugacity function of a pure real gas. Calculation of the fugacity of a van der Waals gas using compressibility factor. Definitions of Activities and activity coefficients. Choice of standard states.	Kapoor K.L, A Text Book Of Physical Chemistry, McGraw Hill India	5	On class demonstrations using chalk and board, interactive discussions	IS
Module: II <b>Applications of Thermodynamics – I</b>	<b>Chemical Equilibrium:</b> Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm (deduction from chemical potential); Variation of free energy with	Denbigh, K. <i>The Principles of Chemical Equilibrium</i> , Cambridge	6	On class demonstrations using chalk and board, interactive discussions	IS

# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	degree of advancement; Equilibrium constant and standard Gibbs free energy change; Van't Hoff's reaction isobar and isochore from different standard states; Le Chatelier's principle and its derivation, variation of equilibrium constant under different conditions. Nernst's distribution law; Application- (eg. dimerization of benzene in benzoic acid). Solvent Extraction.				
<b>Module: III</b> <b>ELECTROCHEMISTRY-I</b> <b>(i) Conductance</b>	Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Debye – Huckel theory of Ion atmosphere	Castellan, G. W. <i>Physical Chemistry</i> , Narosa  Glasstone, S. & Lewis, <i>G.N. Elements of Physical Chemistry</i>	9	On class demonstrations, study material supplied, modelling and interactive discussions	AS

# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	(qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Debye-Huckel limiting law-brief qualitative description. Estimation of activity coefficient for electrolytes using Debye-Huckel limiting law. Ostwald's dilution law; Ionic mobility; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations. Transport number, Principles of Hittorf's and Moving-boundary method; Wien effect, Debye-Falkenhagen effect, Walden's rule				
<b>(ii) Ionic equilibrium</b>	Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and triprotic acids (exact treatment). Salt hydrolysis - calculation of hydrolysis	Atkins, P. W. & Paula, J. de <i>Atkins' Physical Chemistry</i> , 10th Edition, Oxford University Press	8	On class demonstrations, study material supplied, modelling and interactive discussions	AS

# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	constant, degree of hydrolysis and pH for different salts (exact Treatment). Determination of hydrolysis constant conductometrically. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibrium in polyelectrolyte systems; hydrolysis and hydrolysis constants				
CHEM-MD-CC5-4-P	<b>Experiment 1:</b> Determination of rate constant of the reaction between H <sub>2</sub> O <sub>2</sub> and acidified KI solution using Clock reaction. <b>Experiment 2:</b> Determination of the rate constant for the decomposition of H <sub>2</sub> O <sub>2</sub> using FeCl <sub>3</sub> as catalyst. <b>Experiment 3:</b> Determination of the rate constant for the first order acid catalyzed hydrolysis of an ester.	<i>Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015</i>	30	On class explanation, experimental practice in laboratory	AS+IS



# LESSON PLAN: Semester-4 (CCF) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: CHEM-MD-CC5-4-Th

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	<b>Experiment 4:</b> To study the kinetics of the inversion of cane sugar using a polarimeter				
		<b>TOTAL</b>	<b>45(TH)+30 (PR)=75</b>		

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)

Paper Name & Code: INORGANIC CHEMISTRY-5 (CEMA-CC-6-13)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Theoretical Principles in Qualitative Analysis	Basic principles involved in analysis of cations and anions and solubility products, common ion effect.	Svehla, G., Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.	5	Chalk and Talk	(SG)
	Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.		5	Chalk and Talk	(SB)
Bioinorganic Chemistry	Elements of life: essential and beneficial elements, major, trace and ultra-trace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially $\text{Na}^+$ , $\text{K}^+$ , $\text{Mg}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Fe}^{3+/2+}$ , $\text{Cu}^{2+/+}$ and $\text{Zn}^{2+}$ ).	Bioinorganic Chemistry, G. N. Mukherjee and A. Das	5	Chalk and Talk	(SB)
	Metal ion transport across biological membrane $\text{Na}^+$ / $\text{K}^+$ -ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin.		10	Chalk and Talk	(SB)
	Hydrolytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A.		5	Chalk and Talk	(SB)
	Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases (examples only).		5	Chalk and Talk	(SB)
Organometallic	Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. 18-electron and 16-	1. Cotton, F.A., Wilkinson, G.,	5	Chalk and Talk	(SG)

## LESSON PLAN: Semester-6 (Under CBCS) 2025

**Department Name: Chemistry**

**Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)**

**Paper Name & Code: INORGANIC CHEMISTRY-5 (CEMA-CC-6-13)**

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>Chemistry</b>	electron rules (pictorial MO approach). Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides.	Murrillo, C. A., Bochmann, M., advanced Inorganic Chemistry 6th Ed. 1999., Wiley.  2. Huheey, J.E.; Keiter, E.A., & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity  3. Atkin, P. Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010).			
	General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls. pi-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding.		4	Chalk and Talk	(SG)
	Zeise's salt: Preparation, structure, evidences of synergic effect. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions.		6	Chalk and Talk	(SG)
	<b>Catalysis by Organometallic Compounds:</b> Study of the following industrial processes 1. Alkene hydrogenation (Wilkinson's Catalyst) 2. Hydroformylation 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) 5. Ziegler-Natta catalysis for olefin polymerization.		10	Chalk and Talk	(SG)
		Total	60		

## LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Sharmila Bhattacharya (SB), Dr Soumavo Ghosh (SG)

Paper Name & Code: INORGANIC CHEMISTRY-5 (CEMA-CC-6-13)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Practical	<b>Qualitative semimicro analysis of mixtures containing not more than three radicals.</b> Emphasis was given to the understanding of the chemistry of different reactions: Cation Radicals, Anion Radicals, Insoluble Materials.	Svehla, G., Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.	21	Face-to-face demonstrations, hand on experiment and interactive discussions	(SB)
	<b>Qualitative semimicro analysis of unknown mixtures containing not more than three radicals:</b> Minimum six unknown mixtures.		21		
	Practice		3		
		Total	45		

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: PHYSICAL CHEMISTRY-5 (CEMA-CC-6-14-TH)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
1. Molecular Spectroscopy	Interaction of electromagnetic radiation with molecules and various types of spectra; <b>Rotation spectroscopy:</b> Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution <b>Vibrational spectroscopy:</b> Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, Diatomic vibrating rotator, P, Q, R branches	Banwell, C. N. Fundamentals of Molecular Spectroscopy, Tata-McGraw-Hill  Barrow, G. M. Molecular Spectroscopy, McGraw-Hills	10	On class demonstrations using chalk and board, interactive discussions	IS
	<b>Electronic Spectroscopy:</b> Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra; Frank Condon factor. Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonskii diagram;		8		IS

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: PHYSICAL CHEMISTRY-5 (CEMA-CC-6-14-TH)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
	<b>Raman spectroscopy:</b> Classical Treatment. Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion		7		IS
2. <b>Photochemistry and Theory of reaction rate:</b>	Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients; Laws of photochemistry, Stark-Einstein law of photochemical equivalence quantum yield, actinometry, examples of low and high quantum yields Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition, H <sub>2</sub> -Br <sub>2</sub> reaction, dimerisation of anthracene; photosensitised reactions, quenching; Role of photochemical reactions in biochemical processes, chemiluminescence Collision theory of reaction rate (detailed treatment). Lindemann theory of unimolecular reaction; Outline of Transition State theory (classical treatment). Primary Kinetic Salt Effect.	Banwell, C. N. Fundamentals of Molecular Spectroscopy, Tata-McGraw-Hill  McHale, J. L. Molecular Spectroscopy, Pearson Education	15	On class demonstrations, study materials given, continuous assessment and interactive discussions	AS

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: PHYSICAL CHEMISTRY-5 (CEMA-CC-6-14-TH)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
<b>3. Surface phenomenon</b>	Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over other surface; Vapour pressure over curved surface; Temperature dependence of surface tension Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zeta potential; Micelle formation	Atkins, P. W. & Paula, J. de <i>Atkins' Physical Chemistry</i> , 10th Edition, Oxford University Press	15	On class demonstrations using chalk and board, study materials supplied, interactive discussions, class test	AS
<b>4. Dipole moment and polarizability</b>	Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole moments	Maron, S. & Prutton, <i>Physical Chemistry</i>	5	On class demonstrations using chalk and board, interactive discussions	IS

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr Anuva Samanta (AS), Dr. Ishita Saha (IS)

Paper Name & Code: PHYSICAL CHEMISTRY-5 (CEMA-CC-6-14-TH)

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
5. CEMA-CC-6-14-P	<b>Experiment 1:</b> Determination of surface tension of a liquid using Stalagmometer <b>Experiment 2:</b> Determination of the indicator constant of an acid base indicator spectrophotometrically <b>Experiment 3:</b> Verification of Beer and Lambert's Law for KMnO <sub>4</sub> and K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> solution <b>Experiment 4:</b> Study of kinetics of K <sub>2</sub> S <sub>2</sub> O <sub>8</sub> +KI reaction, spectrophotometrically <b>Experiment 5:</b> Determination of pH of unknown buffer, spectrophotometrically <b>Experiment 6:</b> Determination of CMC of a micelle from Surface Tension Measurement	Palit, S.R., De, S. K. <i>Practical Physical Chemistry Science Book Agency</i>	45	On class explanation showing visual lab videos, experimental observation in laboratory	AS
		TOTAL	60(TH)+ 45(PR)= 105		



# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE A3)

Planned					
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Introduction to Green Chemistry	What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University 5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST	04	Offline method 1. Traditional method through the use of the chalk and board 2. Project-Based Learning 3. Consulting different reference books and photocopy of prepared notes 4. E book	

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Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE A3)

Principles of Green Chemistry and Designing a Chemical synthesis	Twelve principles of Green Chemistry with their explanations and examples	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).  2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001)  3. Kirchhoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013  4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University  5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST	16		
Examples of Green Synthesis/ Reactions and some real world	Green Synthesis	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India)	20		

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Department Name: Chemistry

Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE A3)

cases	Microwave assisted Ultrasound assisted Green counterpart of common organic reactions Rearrangement reactions	Pvt. Ltd. (Pearson Education). 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University 5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST			
Future Trends in Green Chemistry	Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry;	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	12		

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Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE A3)

	Proliferation of solventless reactions.Green chemistry in sustainable development	2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. Green Chemistry: Principles and Practice, Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., Teaching Green Chemistry few thoughts, Jadavpur University 5. Monograph on Green Chemistry Laboratory Experiments, GreenChemistry Task Force Committee, DST			
Alkaloids	Nicotine, Hygrine, Quinine, Morphine, Cocaine and ReserpineCocaine and Reserpine	Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	5		

## LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE A3)

Terpenes	Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral.	Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	3		
Practicals	Green Synthesis	Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST	45	Offline method 1. Traditional method through the use of the chalk and board 2. Demonstration	
		Total	105		

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE B1)

Planned					
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks / Comments
Introduction to Green Chemistry	What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University 5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST	04	Offline method 1. Traditional method through the use of the chalk and board 2. Project-Based Learning 3. Consulting different reference books and photocopy of prepared notes 4. E book	

# LESSON PLAN: Semester-6 (Under CBCS) 2025

Department Name: Chemistry

Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE B1)

Principles of Green Chemistry and Designing a Chemical synthesis	Twelve principles of Green Chemistry with their explanations and examples	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).  2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001)  3. Kirchhoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013  4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University  5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST	16		
Examples of Green Synthesis/ Reactions and some real world	Green Synthesis	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India)	20		

# LESSON PLAN: Semester-6 (Under CBCS) 2025

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Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE B1)

cases	Microwave assisted Ultrasound assisted Green counterpart of common organic reactions Rearrangement reactions	Pvt. Ltd. (Pearson Education). 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. <i>Green Chemistry: Principles and Practice</i> , Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., <i>Teaching Green Chemistry few thoughts</i> , Jadavpur University 5. <i>Monograph on Green Chemistry Laboratory Experiments</i> , Green Chemistry Task Force Committee, DST			
Future Trends in Green Chemistry	Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry;	1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	12		



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Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE B1)

	Proliferation of solventless reactions.Green chemistry in sustainable development	2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) 3. Kirchoff M. M. Green Chemistry: Principles and Practice, Summer School on Green Chemistry and Sustainable Energy, 2013 4. Bhar S., Teaching Green Chemistry few thoughts, Jadavpur University 5. Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST			
Alkaloids	Nicotine, Hygrine, Quinine, Morphine, Cocaine and Reserpine Cocaine and Reserpine	Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	5		

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Name of Faculty: Dr. Priyabrata Roy

Paper Name & Code: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS (DSE B1)

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Practicals	Green Synthesis	Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST	45	Offline method 1. Traditional method through the use of the chalk and board 2. Demonstration	
		Total	105		