গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

NAAC accredited with 'B' Grade

TEACHING PLAN
DEPARTMENT OF CHEMISTRY
JULY 2022 - JUNE 2023

GARGAON COLLEGE
TEACHING PLAN

Course: B. Sc.

Session: Odd semester 2022

Subject: CHEMISTRY

Name of the Teacher: DR. ANNA GOGOI

Methods to be applied: Lecture, analytical and activity method, interaction and discussion.

Teaching Materials: Green Board, Chalk Pencil, Duster, Book, Journal, Laptop, Projector.

PaperCode/Title	Allotted Unit/ Topic	No. of Class required	Detail of the topics to be taught & class required	No. of tutorials
CHEMISTRY C-102	Unit I: Liquid State	6	• Qualitative treatment of the structure of the liquid state [1] • Radial distribution function [1] • physical properties of liquids: vapour pressure, Surface tension, viscosity [4] • Explanation of cleansing action of detergents [1]	3
	UNIT:IV Ionic equilibrium	20	• Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization [2] • ionization constant and ionic product of water [4] • pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment) [5] • Salt hydrolysis, Henderson equation [4] • Buffer solutions, solubility product [4]	3
CHEMISTRY C102-LAB	Physical Chemistry	10	• Surface tension measurements [4] • Determination of viscosity [4] • pH-metric titration [8]	5
CHEMISTRY -C-303	UNIT: II Chemical Kinetics	18	• Order and molecularity of a reaction, rate laws [2] • Zero, First and Second order reaction [4] • steady-state approximation [1] • complex reactions, Opposing reactions, parallel reactions, consecutive reactions, chain reactions [8]	5

			• Arrhenius equation, activation energy, Collision theory of reaction rates [3] • Lindemann mechanism, absolute reaction rates [3]	
CHEMISTRY -C-303-LAB	Physical Chemistry Practical	28	• Acid hydrolysis of methyl acetate with hydrochloric acid [4] • Saponification of ethyl acetate [4] • Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal [6]	3
CHEMISTRY GE-301	UNIT: 3 Conductance	6	• Conductivity, equivalent and molar conductivity [2] • Kohlrausch's law, Transference number, Hittorf method, Moving boundary methods [4] • Ionic mobility, solubility and solubility products of sparingly soluble salts, hydrolysis constant of a salt. Conductometric titrations [6]	2
CHEMISTRY GE-301 Lab	Section A: Physical Chemistry	10	• Cell constant [2] • conductometric titration [8]	2
CHEMISTRY -C-502	UNIT: II Molecular Spectroscopy	24	• Electromagnetic radiation, Born Oppenheimer approximation [3] • Rotation spectroscopy [5] • Vibrational spectroscopy [6] • Vibration-rotation spectroscopy [5] • Electronic spectroscopy [5] • NMR spectroscopy [4]	4
CHEMISTRY - C-502 Lab	Physical Chemistry Practical	28	• Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and λ determine the max values • Verify Lambert-Beer's law and determine the concentration of KMnO4 • Viva Voce [2]	5

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CHEMISTRY - C-202	UNIT: I Chemical Thermodynamics	36	• Intensive and extensive variables; state and path functions; isolated, closed and open systems [3] • zeroth law of thermodynamics [2] • First law: Concept of heat, q, work, w, internal energy, U [3] • enthalpy, H, heat capacities [3] • enthalpy, H, relation between heat capacities, calculations of q, w, U and H for free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions [6] • Heats of reactions: standard states; enthalpy of formation of molecules and ions [4] • bond energy, bond dissociation energy and resonance energy [3] • Adiabatic flame temperature, explosion temperature [3] • Second Law: Concept of entropy [4] • Calculation of entropy change for reversible and irreversible processes [4] • Third Law, Gibbs and Helmholtz energy, Free energy change and spontaneity [5]	4

			• Gibbs-Helmholtz equation; Maxwell relations [5]	
CHEMISTRY - C-202 Lab	Physical Chemistry Laboratory	12	• Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide[4] • Calculation of the enthalpy of ionization of ethanoic acid [4] • Study of the solubility of benzoic acid in water and determination of Δ H.[4]	4
CHEMISTRY-C- GE- 201	UNIT: 3 Ionic Equilibrium	12	• Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization [4] • ionization constant and ionic product of water [2] • Ionization of weak acids and bases [2] • pH scale, common ion effect, Salt hydrolysis [3] • Buffer solutions, Solubility and solubility product of sparingly soluble salts[4]	3
CHEMISTRY -C- GE-201 Lab	Section A: Physical Chemistry	15	• Determination of heat capacity [4] • Calculation of the enthalpy of ionization of ethanoic acid.[4] • Study of the solubility of benzoic acid in water[4]	3
CHEMISTRY - C-403	UNIT: 1 Conductance	20	• Arrhenius theory of electrolytic dissociation, Conductivity, equivalent and molar conductivity [4] • Kohlrausch law of independent migration of ions, Debye-Hückel-Onsager equation [3] • Wien effect, Debye-Falkenhagen effect, Walden's rules [2] • Ionic velocities, mobilities, transference number and its determination, Hittorf method, Moving Boundary method [6] • degree of dissociation of weak electrolytes, ionic product of water, hydrolysis constants of salts and conductometric titrations[6]	3
CHEMISTRY - C-403 -LAB	Physical Chemistry Practical	16	• Determination of cell constant [4] • conductometric titrations [12]	4

			• Viva Voce [3]	
CHEMISTRY -GE-401	UNIT: V Liquids	6	• surface tension and its determination [2] • Viscosity of a liquid and its determination [2] • Effect of temperature on surface tension and coefficient of viscosity of a liquid [2]	1
	UNIT: VII Chemical Kinetics	8	• The concept of reaction rates, Effect of temperature, pressure, catalyst and other factors on reaction rates [2] • Order and molecularity of a reaction, Zero order reaction, First order reaction, Second order reaction [4] • Half–life of a reaction, determination of order of a reaction [2] • activation energy and its calculation from Arrhenius equation [1] • Collision theory and Activated Complex theory [2]	2
CHEMISTRY -GE-401-LAB	Section B: Physical Chemistry Practical	12	• Determination of the surface tension [6] • Determination of viscosity of liquid [6] • Viva Voce [3]	2
CHEMISTRY-DSE-603	Project Work	48	• Project Work [48]	6

Signature of the teacher

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Course: B. Sc.
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Subject: **CHEMISTRY**
Name of the Teacher**: Dr. Arandao Narzary**
Methods to be applied: Lecture, practical demonstration, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Book, Journal, Laptop, Projector, Pointer

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CHEMISTRY C-302	Unit I: Chemistry of Halogenated Hydrocarbons Part:A Alkyl Halide and Aryl halide Part:B Organometallic compounds	14 2	● Nucleophilic substitution reaction[2] ● S_Ni mechanisms with stereochemical aspects and effect of solvent etc.[2] ● Nucleophilic substitution vs. elimination[2] ● Methods of preparation including Hunsdiecker Reaction[1] ● Preparation, including preparation from diazonium salts.[1] ● Nucleophilic aromatic substitution; SNAr[1] ● Benzyne mechanism[2] ● Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.[3] ● Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.[2]	4
	Unit III: Carbonyl Compounds: Part A:	12	● Structure, reactivity and preparation[1] ● Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α- substitution reactions, Clemmensen, Wolff-Kishner, MPV[8] ● $LiAlH_4$, $NaBH_4$, PDC , PCC , SeO_2, $Pb(OAc)_4$ & HIO_4 .(Synthetic applications only)[2] ● Addition reactions of unsaturated carbonyl compounds: Michael addition.	7

	Part B	2	Unsaturated Aldehydes (Acrolein, Crotonaldehyde, Cinnamaldehyde) Unsaturated Ketone (MVK)[1] ● Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate[2]	
CHEMISTRY C-302-LAB	Organic Chemistry practical	17	● Functional group tests for alcohols, carbonyl, and carboxylic acid group[8] ● Preparation by Acetylation[1] ● Preparation by Benzolyation [2] ● Preparation by Oxidation[1] ● Preparation by Nitration[1] ● Preparation by Hydrolysis[1] ● Preparation by Benzil-Benzilic acid rearrangement[1] ● Viva Voce [2]	2
CHEMISTRY-C-501	Unit I: Nucleic Acids	9	● Components of nucleic acids, Nucleosides and nucleotides[3] ● Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine[2] ● Structure of polynucleotides. Structure of DNA (Watson & Model) and RNA, Genetic Code Biological role of DNA and[2] ● RNA, Replication,Transcription and Translation [2]	4
	Unit II: Amino Acids, Peptides and Proteins	16	● Amino acids, Peptides and their classification.α-Amino Acids [4] ● Synthesis, properties and reactions [3] ● Study of peptides: determination of their primary structures-end group analysis [4] ● Methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups - Solid-phase synthesis [5]	5
	Unit IV: Lipids	8	● Introduction to oils and fats; common fatty acids present in oils and fats[3] ● Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity[5]	2
	Unit V: Disconnection approach in Organic Synthesis	10	● Elementary idea about disconnection, Synthon and Synthetic equivalent, Functionall group interconversion (FGI), Functional group addition (FGA)[3] ● Simple examples off retrosynthesis of C-C bond formation (Corey House, Grignard, aldol condensation)[2]	6

			• Retrosynthesis of monofunctionalised [3] • Bi-functionalized (1,1 and 1,2) compounds.[2]	
CHEMISTRY-C-501-LAB	Organic Chemistry practical	8	• Estimation of glycine by Sorenson's formalin method.[2] • Study of the titration curve of glycine[1] • Study of the action of salivary amylase on starch at optimum conditions[1] • Effect of temperature on the action of salivary amylase[1] • Saponification value of an oil or a fat.[1] • Viva [2]	2
CHEMISTRY-DSE-502-LAB	Green Chemistry practical	10	• Preparation of biodiesel from vegetable oil[2] • Preparation of acetanilide from aniline using acetic acid in presence of zinc dust[1] • Photoreduction of benzophenone to benzopinacol in the presence of sunlight[5] • Viva[2]	2
CHEMISTRY-GE-101	*Section B: Organic Chemistry* Unit IV: Stereochemistry	10	• Conformation with respect to ethane, butane and cyclohexane[2] • Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations[2] • Concept of chirality[1] • Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso Compounds. Threo and erythron[3] • Nomenclature: D and L; Cis-trans ;CIP Rules: R/S and E/Z[2]	3
	Unit V: Aliphatic Hydrocarbons Alkanes, Alkene	12	• Preparation and reactions of alkane[4] • Preparation and reactions of alkene[8]	4
CHEMISTRY-GE-101-LAB	Chemistry Practical	15	• Detection of characterized element (N, S, Cl, Br, I) in an organic compound[10] • Separation of mixtures by Chromatography: Measure the R_f value in each case[3] • Viva[2]	2
CHEMISTRY-GE-301	*Section B: Organic Chemistry*	10	• *Carbohydrates*: Classification, and General Properties[3]	3

	Unit VII: Carbohydrates		• Glucose and Fructose (open chain and cyclic structure)[4] • Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose[2] • Mutarotation, ascending and descending in monosaccharides[1]	
	Unit VIII: Amino Acids, Peptides and Proteins	12	• *Introduction and Preparation of Amino Acids*: Strecker synthesis using Gabriel's phthalimide synthesis [4] • Zwitterion, Isoelectric point and Electrophoresis[2] • *Reactions of Amino acids*: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test[2] • Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins[4]	3
CHEMISTRY-GE-301-LAB	Chemistry Practical	10	• Systematic Qualitative Organic Analysis of Organic Compounds[10	2

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CHEMISTRY-C-201	UnitII: Stereochemistry	16	• Definition and classification of streoisomerism[1] • Representation of organic molecules in two & three dimensions, Fischer, Newmann and Sawhorse Projection formulae and their interconversions[2] • Geometrical isomerism: Restricted rotation about C=C bonds, Physical & Chemical properties of Geometrical isomers, Cis–trans and, syn-anti isomerism, E/Z notations with C.I.P rules.*Optical [3]*	4

			• *Isomerism:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres[4] • Distereoisomers, meso structures & Epimers, Racemic mixture and resolution[3] • Threo & Erythro forms, Relative and absolute configuration: D/L and R/S designations[3]	
	Unit III: Chemistry of Aliphatic Hydrocarbons A. Carbon-Carbon sigma bond B. Carbon-Carbon pi bonds:	4 19	• Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, CoreyHouse Reaction, Free radical substitutions: Halogenation - relative reactivity and selectivity[4] ‘ • Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb[2] • Reactions. Saytzeff and Hofmann eliminations. Pyrolysis of esters, Chugaev, Wittig and Heck Reaction [4] • *Reactions of alkenes:* Electrophilic additions, Markownikoff/ Anti Markownikoff addition, Regioselective and Streoselective addition reactions. oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction, syn and anti-hydroxylation, Simple effect ofStreoselectivity & Streospecificit [6] • 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene[3] • *Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes[4]	5
CHEMISTRY-C-201-LAB	Organic Chemistry Practical	9	• Purification of organic compounds by crystallization[2] • Determination of the melting points[1] • Effect of impurities on the melting point – mixed melting point of two unknown organic compounds[1] • Separation of a mixture of two amino acids by paper chromatography[1]	2

			• Separation of a mixture of two sugars by paper chromatography[1] • Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)[1] • Viva[2]	
CHEMISTRY-C-402	UnitII: Polynuclear Aromatic Hydrocarbons	14	• Preparation and structure elucidation & Reactions of Polynuclear hydrocarbons : naphthalene [4] • Preparation and structure elucidation & Reactions of Polynuclear hydrocarbons : Phenanthrene [4] • Preparation and structure elucidation & Reactions of Polynuclear hydrocarbons : anthracene [4] • Important derivatives of naphthalene and anthracene [2]	2
	Unit III: Heterocyclic Compound-I Heterocyclic Compound-II	12 12	• Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom[2] • Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene [8] • Derivatives of furan: Furfural and furoic acid [2] . • Synthesis and reaction of Pyridine, Pyrimidine, indole, Fischer indole quinoline and isoquinoline [12]	4
	Unit V: Terpenes	7	• Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol[7]	1
CHEMISTRY-C-402-LAB	Organic Chemistry Practical	14	• Qualitative analysis of unknown organic compounds [14]	2
CHEMISTRY-C-602	Unit I: Organic Spectroscopy *NMR Spectroscopy:*	15	• Basic principles of Proton Magnetic Resonance[[2] • Chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics[3] • Interpetation of NMR spectra of simple compounds[2] • Applications of IR, UV, NMR and Mass for identification of simple organicmolecules[8]	2

	Unit II: Carbohydrates	16	• Occurrence, classification and their biological importance [2] • Monosaccharides: Constitution and absolute configuration of glucose and fructose [4] • Epimers and anomers, mutarotation [2] • Determination of ring size of glucose and fructose[4] • Haworth projections and conformational structures; Assecnding and descending in monosaccharide[1] • Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation [3]	2
	Unit III: Dyes	8	• Classification, Colour and constitution; Mordant and Vat Dyes [2] • Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red [1] • Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet[1] • Phthalein Dyes – Phenolphthalein and Fluorescein[1] • Natural dyes –structure[1] • Elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples [2]	1
CHEMISTRY-C-602-LAB	Organic Chemistry Practical	19	• Qualitative analysis of unknown organic compounds containing monofunctional groups [14] • Extraction of caffeine from tea leaves [1] • Identification of simple organic compounds by IR spectroscopy and NMR Spectroscopy (Spectra to be provided) [2] • Viva [2]	3
CHEMISTRY-DSE-603	Dissertation (*Project Work*)	30	• Project Work [30]	2
CHEMISTRY-GE-201	Section *B: Organic Chemistry* Unit IV: Aromatic Hydrocarbons	8	• Preparation of aromatic hydrocarbon [2] • Reactions: Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's Side chain oxidation of alkyl benzenes [6]	2
	Unit V: Alkyl and Aryl Halides	8	• Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions [2] • Preparation of alkylhalide from alkenes and alcohols. Reactions: hydrolysis,	2

			nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.[2] ● *Aryl Halides*: *Preparation*: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.[2] ● Aromatic nucleophilic substitution and effect of nitro substituent. Benzyne Mechanism[1] ● Reactivity Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides[1]	
CHEMISTRY-GE-201-LAB	Chemistry Practical	5	● *Purification* of organic compounds by crystallization [2] ● Determination of melting and boiling points[1] ● Preparation by Benzoylation of amines/phenols[1] ● Preparation of Oxime and 2, 4-dinitrophenylhydrazone of aldehyde/ketone[1] ● Viva [2]	2

(Signature)

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Name of the Teacher**: Mr. Rituraj Tahu**
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CHEMISTRY C-302	Unit II: Alcohols, Phenols, Ethers and Epoxides	14	**Alcohols** ● preparation, properties and relative reactivity of 1°, 2°, 3° alcohols Bouvaelt-Blanc Reduction Preparation and properties of glycols Oxidation by OsO4, alkaline KMnO4, periodic acid and lead Tetraacetate Pinacol Pinacolone Rearrangement *Trihydric alcohols* : Glycerol /Preparation & Properties [8] **Phenols** ● Preparation and properties; Acidity and factors effecting it Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions Fries and Claisen rearrangements with mechanism [3] **Ether and Epoxides** ● Preparation and reactions with acids Reaction of epoxide with alcohols ammonia derivatives and LiAlH4 [3]	4
	Unit IV: Carboxylic Acids	12	● Preparation, physical properties and reactions of monocarboxylic acids	7

	and their Derivatives:		(Acidity and factors affecting it) Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids [4] ● succinic, phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids Preparation and reactions of acid chlorides, anhydrides, esters and amides [4] ● Comparative study of nucleophilic sustitution at acyl group - Mechanism of acidic and hydrolysis of esters Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement [4]	
CHEMISTRY C-302-LAB	Organic Chemistry practical	17	● Functional group tests for alcohols, carbonyl, and carboxylic acid group [8] ● Preparation by Acetylation [1] ● Preparation by Benzolyation [2] ● Preparation by Oxidation [1] ● Preparation by Nitration [1] ● Preparation by Hydrolysis [1] ● Preparation by Benzil-Benzilic acid rearrangement [1] ● Viva Voce [2]	2
CHEMISTRY-C-501	Unit III: Enzymes	8	● Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes [2] ● Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity) [3] ● enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition) [3]	4
	Unit VI: Pharmaceutical Compounds: Structure and Importance	16	● Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials	8

			• Antacids: Ranitidine; Antibacterial: Povidone—Iodine Solution, Synthesis and mode of action of Sulphanilamide and other Sulpha drugs (sulphapyridine sulphathiazole) • Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C.	
CHEMISTRY-C-501-LAB	Organic Chemistry practical	8	• Estimation of glycine by Sorenson's formalin method.[2] • Study of the titration curve of glycine [1] • Study of the action of salivary amylase on starch at optimum conditions [1] • Effect of temperature on the action of salivary amylase [1] • Saponification value of an oil or a fat.[1] • Viva [2]	2
CHEMISTRY-GE-101	Unit III: Fundamentals of Organic Chemistry	8	• Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis [2] • Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals [2] • Strength of organic acids and bases: Comparative study with emphasis on factors affecting *p*K values. Aromaticity: Benzenoids and Hückel's rule [2]	3
CHEMISTRY-GE-101-LAB	Chemistry Practical	15	• Detection of characterized element (N, S, Cl, Br, I) in an organic compound [10] • Separation of mixtures by Chromatography: Measure the R*f* value in each case [3] • Viva [2]	2

CHEMISTRY-GE-301	*Section B: Organic Chemistry* Unit V: Carboxylic acids and their derivatives	6	• *Carboxylic acids (aliphatic and aromatic)*: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction [2] • *Carboxylic acid derivatives (aliphatic): (upto 5 carbons)* Preparation: Acid chlorides, anhydrides, Esters and Amides from acids and their interconversion [2] • Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin Condensation [2]	3
	Unit VI: Amines and Diazonium Salts	6	• *Amines (Aliphatic and Aromatic)*: (Up to 5 carbons): Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation [4] • *Diazonium salts*: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes [2]	3
CHEMISTRY-GE-301-LAB	Chemistry Practical	10	• Systematic Qualitative Organic Analysis of Organic Compounds[10	2

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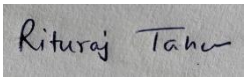
CHEMISTRY-C-201	Unit I: Basic Organic Chemistry	8	• ***Organic Compounds:*** Classification and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties [2] • ***Electronic effects:*** Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment [2] • Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes, Nitrenes [2] • Organic acids and bases; their relative strength, Hard and soft acids & bases. Energy profile diagrams of one step, two steps & three steps reactions, Activation energy, Kinetically Controlled & Thermodynamically	4

			Controlled reactions [2]	
	Unit IV: Cycloalkanes and Conformational analysis:	10	• Cycloalkanes: Preparation and their relative stability, Baeyer strain theory Conformation analysis of alkanes (Ethane and Butane): Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams [10]	5
	Unit V: Aromatic Hydrocarbons	12	• *Aromaticity:* Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples [5] • Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism [4] • Directing effects of the groups [3]	
CHEMISTRY-C-201-LAB	Organic Chemistry Practical	9	• Purification of organic compounds by crystallization [2] • Determination of the melting points [1] • Effect of impurities on the melting point – mixed melting point of two unknown organic compounds [1] • Separation of a mixture of two amino acids by paper chromatography [1] • Separation of a mixture of two sugars by paper chromatography [1] • Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC) [1] • Viva [2]	2
CHEMISTRY-C-402	Unit I: Nitrogen Containing Functional Groups	16	• **Amine**s: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid [10] • Diazonium Salts: Preparation and their synthetic applications.	2

			Diazomethane & Diazoacetic Ester with synthetic application [6]	
	Unit IV: Alkaloids	6	• Natural occurrence, General structural features, Isolation and their physiological action [2] • Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine **[4]**	
CHEMISTRY-C-402-LAB	Organic Chemistry Practical	14	• Qualitative analysis of unknown organic compounds	2
CHEMISTRY-C-602	Unit I: Organic Spectroscopy	15	• ***UV Spectroscopy****:* Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α, β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers. • ***IR Spectroscopy****:* Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.	2
	Unit IV: Polymers	16	• Introduction and classification of polymers [6] • Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene) [10]	2
CHEMISTRY-C-602-LAB	Organic Chemistry Practical	19	• Qualitative analysis of unknown organic compounds containing monofunctional groups [14]	3

			• Extraction of caffeine from tea leaves [1] • Identification of simple organic compounds by IR spectroscopy and NMR Spectroscopy (Spectra to be provided) [2] • Viva [2]	
CHEMISTRY-DSE-603	Dissertation (*Project Work*)	30	• Project Work [30]	2
CHEMISTRY-GE-201	Section *B: Organic Chemistry* Unit VI: Alcohols, Phenols and Ethers (Up to 5 Carbons)	8	• *Alcohols*: Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Luca's test), esterification, oxidation (with PCC, *alk*. KMnO4, acidic dichromate, conc. HNO3). Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement [2] • *Phenols*: (Phenol case): Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Schotten – Baumann Reaction [2] • *Ethers (aliphatic and aromatic)* Cleavage of ethers with HI [2] • *Aldehydes and ketones (aliphatic and aromatic):* (Formaldehye, acetaldehyde, acetone and benzaldehyde): Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's Reaction, Wittig Reaction, Benzoin Condensation. Clemensen Reduction and Wolff Kishner Reduction. Meerwein-Pondorff Verley Reduction [2]	2
CHEMISTRY-GE-201-LAB	Chemistry Practical	5	• *Purification* of organic compounds by crystallization [2] • Determination of melting and boiling points [1] • Preparation by Benzoylation of amines/phenols [1] • Preparation of Oxime and 2, 4-dinitrophenylhydrazone of aldehyde/ketone [1] • Viva [2]	2



Signature of the Teachers

DEPARTMENT OF CHEMISTRY

Estd. 1969

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TEACHING PLAN

Dr. Pakiza Begum

Assistant Professor

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Gargaon College

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Assam, India

1. Assigned papers and units

Even semester

Semester		Paper Code	Paper Title	Unit Wise Division
II	H	N/A		
	GE	N/A		
IV	H	C-401	Inorganic Chemistry	Unit II: Transition Elements Unit III: Lanthanoids and Actinoids Unit IV: Bioinorganic Chemistry
		C-401-LAB	Inorganic Chemistry Practical	A. Gravimetric Analysis B. Inorganic Preparation C. Chromatography of metal ions
	GE	GE-401	Chemistry	Unit II: Coordination Chemistry Unit III: Crystal Field Theory
		GE-401-LAB	Chemistry Practical	A. Inorganic Chemistry practical
VI (H)		C-601	Inorganic Chemistry	Unit I: Theoretical Principles in Qualitative Analysis (H_2S Scheme) Unit II: Organometallic compounds Unit IV: Catalysis by Organometallic Compounds
		C-601-LAB	Inorganic Chemistry Practical	A. Qualitative Inorganic Analysis
		DSE-601	Inorganic Materials of Industrial Importance	Unit-I: Silicate Industries
		DSE-601-LAB	Inorganic Materials of Industrial Importance Practical	A. Any 2 (two) experiment to be set in examination a) Determination of free acidity in ammonium sulphate fertilizer. b) Determination of composition of dolomite (by complexometric titration). c) Analysis of Cement. d) Preparation of pigment (zinc oxide).
		DSE-603	Dissertation (Project Work)	A. Laboratory Experiment

			a) Literature Review: 5 marks b) Objectives: 5 marks c) Experimental work: 25 marks d) Results & Discussions: 25 marks e) Presentation and Viva: 20 marks f) IA: 20 marks

Odd semester

Semester		Paper Code	Paper Title	Unit Wise Division
I	H	C-101	Inorganic Chemistry	Unit I: Atomic Structure Unit II: Periodicity of Elements Unit IV: Oxidation-Reduction
		C-101-LAB	Inorganic Chemistry Practical	(A) Titrimetric Analysis (B) Acid-Base Titrations (C) Oxidation-Reduction Titrimetry
	GE	GE-101		Unit I: Atomic Structure
		GE-101-LAB		Section A: Inorganic Volumetric Analysis
III	H	C-301	Inorganic Chemistry	Unit I: General Principles of Metallurgy Unit II: Acids and Bases Unit IV: Noble Gases Unit V: Inorganic Polymers
		C-301-LAB	Inorganic Chemistry Practical	A. Iodo / Iodimetric Titrations B. Inorganic preparations
	GE	N/A		N/A

V (H)	DSE-501	Analytical Methods in Chemistry	Unit I: Qualitative and quantitative aspects of analysis Unit II: UV-Visible and IR Spectrometry
	DSE-501-PRACT	Analytical Methods in Chemistry Practical	A. Any two to be set in exam a. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values. b. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC c. Determination of dissolved oxygen in water. d. Determination of Biological oxygen demand (BOD).
	DSE-502	Green Chemistry	Unit I: Introduction to Green Chemistry Unit II: Principles of Green Chemistry and Designing a Chemical synthesis (points (i) and (ii))

2. Lesson Plan with Methodology being used adopted

FOR EVEN SEMESTER

4th SEMESTER (HONOURS)	
Paper Code/Title	**Title Paper:** Inorganic Chemistry **Paper Code:** CHEMISTRY-C-401
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Coordination Chemistry **No. of classes:** 26 **Marks:** 25 **Details of the topic:**

	IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes. Labile and inert complexes. Werner's theory, valance bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10Dq (Δ_o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10Dq (Δ_o, Δ_t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.
	Allotted Unit: III **Chapter Name:** Lanthanoids and Actinoids **No. of classes:** 6 **Marks:** 5 **Details of the topic:** Electronic configuration, oxidation states, colour, spectral and magnetic properties, Lanthanide contraction, separation of lanthanides (ion-exchange method only)
	Allotted Unit: IV **Chapter Name:** Bioinorganic Chemistry **No. of classes:** 10 **Marks:** 10 **Details of the topic:** Metal ion present in biological systems, classification of elements according to their action in biological system. Geo chemical effect on distribution of metals. Sodium/ K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin, storage and transfer of iron.
Teaching Tools	• Board and Marker • ICT tools like Projector, online platform like zoom, upload materials in Google Classroom.
Evaluation	• Assignment

Process	• Sessional Examination • Unit Test • Google Class Room Quiz • Seminar Presentation/Group Discussion/Micro Teaching
Paper Code/Title	**Paper Title:** Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-C-401-LAB
Allotted Unit/Topic	**Allotted Unit:** A **Chapter Name:** Gravimetric Analysis **Marks:** 11 **Details of the topic:** (i) Estimation of nickel(ii) using Dimethylglyoxime (ii) Estimation of copper as CuSCN (iii) Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$
	Allotted Unit: B **Chapter Name:** Inorganic preparations **Marks:** 7 **Details of the topic:** (i) Tetraamminecopper(II) sulphate (ii) Tetraamminecarbonatocobalt(III) ion (iii) Potassium tris(oxalate)ferrate(III)
	Allotted Unit: B **Chapter Name:** Chromatography of metal ions **Marks:** 4 **Details of the topic:** Principles involved in chromatographic separations. Paper chromatographic separation of following metals (i) Ni(II) and Co(II) (ii) Fe(III) and Al(III)

	Allotted Unit: D **Marks:** 5 **Details of the topic:** Viva-voce
Teaching Tools	• Learning through lab experiments • Industry and research institution visits
Evaluation Process	• In semester examinations • Viva-voce during practical
4th SEMESTER (GENERIC)	
Paper Code/Title	**Paper Title:** Section A: Inorganic Chemistry **Paper Code:** CHEMISTRY-GE-401
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Transition Series Elements (3d series) **No. of classes:** 12 **Marks: 10** **Details of the topic:** General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. *Lanthanoids and actinoids:* Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).
	Allotted Unit: III **Chapter Name:** Crystal Field Theory **No. of classes:** 10 **Marks:** 10 **Details of the topic:** *Crystal Field Theory* (CFT): Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d

	complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.
Teaching Tools	• Board and Marker • ICT tools like Projector, online platforms like zoom, upload materials in Google Classroom.
Evaluation Process	• Assignment • Sessional Examination • Unit Test • Group Discussion
Paper Code/Title	**Paper Title:** Section A: Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-GE-401-LAB
Allotted Unit/Topic	**Allotted Unit:** Section A **Chapter Name:** Inorganic Chemistry Salt Analysis **Marks:** 11 **Details of the topic:** Semi-micro qualitative analysis using H2S of mixtures- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following: **Cations:** Pb^{2+}, Ag^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^+. **Anions:** CO_3^{2-}, NO^{2-}, NO^{3-}, SO_4^{2-}, Cl^-, Br^-, I^-, BO_3^{3-}, PO_4^{3-}. *Spot tests should be done whenever possible*
Teaching Tools	• Learning through lab experiments
Evaluation Process	• In semester examinations • Viva-voce during practical
6th SEMESTER (HONOURS)	
Paper Code/Title	**Title Paper:** Inorganic Chemistry **Paper Code:** CHEMISTRY-C-601

Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Theoretical Principles in Qualitative Analysis (H2S Scheme) **No. of classes:** 10 **Marks:** 10 **Details of the topic:** Basic principles involved in analysis of cations and anions and solubility products, common ion effect. 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.
	Allotted Unit: II **Chapter Name:** Organometallic compounds **No. of classes:** 22 **Marks:** 20 **Details of the topic:** Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. **Metal carbonyls**: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behavior of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. **Zeise's salt:** preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. **Metal Alkyls:** Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicenter bonding in these compounds. Role of triethylaluminium in polymerization of ethane (Ziegler-Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium. **Ferrocene:** Preparation and reactions (acetylation, alkylation, metalation, Mannich

	condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.
	Allotted Unit: IV **Chapter Name:** Catalysis by Organometallic Compounds **No. of classes:** 10 **Marks:** 10 **Details of the topic:** Study of the following industrial processes and their mechanism (i) Alkene hydrogenation (Wilkinson's Catalyst) (ii) Hydroformylation (Co salts) (iii) Wacker Process (iv) Synthetic Gasoline (Fisher Tropsch reaction) (v) Synthesis gas by metal carbonyl complexes
Paper Code/Title	**Title Paper:** Inorganic Materials of Industrial Importance **Paper Code:** CHEMISTRY-DSE-601
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Silicate Industries **No. of classes:** 16 **Marks:** 15 **Details of the topic:** *Glass*: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armored glass, safety glass, borosilicate glass, fluorosilicate, colored glass, photosensitive glass. *Ceramics*: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fiber. *Cements*: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Paper Code/Title	**Title Paper:** Inorganic Materials of Industrial Importance **Paper Code:** CHEMISTRY-DSE-601
Teaching Tools	• Board and Marker • ICT tools like Projector, online platforms like zoom, upload materials in Google Classroom.
Evaluation Process	• Assignment • Sessional Examination • Unit Test • Google ClassRoom Quiz • Seminar Presentation/Group Discussion/Micro Teaching
Paper Code/Title	**Title Paper:** Dissertation (Project Work) **Paper Code:** CHEMISTRY-DSE-603
Allotted Unit/Topic	**Marks:** 100 **Details of the unit:** In this paper students have to carry out project work (Laboratory experiments or Comprehensive Review work on a specified topic) either at their respective colleges or any other R&D laboratory and UGC recognized University under guidance of a faculty member. The student may start their project work during the semester break between fifth and sixth semester. The area of work is to be decided by the advisor. On completion of the project work students have to submit the work in the form of a dissertation followed by oral presentation in the presence of faculty member and an external expert. [Mark Distribution for evaluation of the Project Work A. Laboratory Experiment Sl. No. Topic Marks (i) Literature Review 5 (ii) Objectives 5

	(iii) Experimental work 25 (iv) Results & Discussion 25 (v) Presentation and Viva 20 (vi) IA 20 B. Comprehensive Review Sl. No. Topic Marks (i) Objective 5 (ii) Review 35 (iii) References 10 (iv) Future prospects 25 (v) Presentation and Viva 20 (vi) IA 20 Note: Students are encouraged to carry out laboratory experiment individually (However in case of infrastructural issues a maximum of 4 students can perform experiments together). Comprehensive review must be carried out individually. Students are encouraged to submit Anti Plagiarism certificate for the report/review.
Paper Code/Title	**Title Paper:** Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-C-601-LAB
Allotted Unit/Topic	**Allotted Unit:** A **Chapter Name:** Qualitative Inorganic Analysis **Marks:** 22 **Details of the unit:** Qualitative analysis of mixtures containing 2 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: NO_2^-, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+} Mixtures should preferably contain one interfering anion, or insoluble component e.g.,

	$BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3 or combination of anions e.g., CO_3^{2-} and SO_3^{2-}, NO^{2-} and NO^{3-}, Cl^- and Br^-, Cl^- and I^-, B^- rand I^-, NO^{3-} and Br^-, NO^{3-} and I^-. *Spot tests should be done whenever possible.*
	Allotted Unit: B **Marks:** 5 **Details of the topic:** Viva-voce
Paper Code/Title	**Title Paper:** Inorganic Materials of Industrial Importance Practical **Paper Code:** CHEMISTRY-DSE-601-LAB
Allotted Unit/Topic	**Allotted Unit:** A **Marks:** 22 **Details of the unit:** (i) Determination of free acidity in ammonium sulfate fertilizer. (ii) Estimation of Calcium in Calcium ammonium nitrate fertilizer. (iii) Estimation of phosphoric acid in superphosphate fertilizer. (iv) Electroless metallic coatings on ceramic and plastic material. (v) Determination of composition of dolomite (by complexometric titration). (vi) Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples. (vii) Analysis of Cement. (viii) Preparation of pigment (zinc oxide).
	Allotted Unit: B **Marks:** 5 **Details of the topic:** Viva-voce
Teaching Tools	• Learning through laboratory experiments • Industry and research institution visits
Evaluation Process	• In semester examinations • Viva-voce during practical

FOR ODD SEMESTER

1st SEMESTER (HONOURS)	
Paper Code/Title	**Paper Title:** Inorganic Chemistry **Code**: CHEMISTRY-C-101
Allotted Unit/Topic	**Allotted Unit: I** **Chapter Name:** Atomic Structure **No. of classes: 14** **Marks: 13** **Details of the topic:** Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f- orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations. Variation of orbital energy with atomic number.
	Allotted Unit: II **Chapter Name:** Periodicity of Elements **No. of classes:** 16 **Marks:** 15 **Details of the topic:** Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral)

	(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.
	Allotted Unit: IV **Chapter Name:** Oxidation-Reduction **No. of classes:** 4 **Marks:** 4 **Details of the topic:** Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.
Teaching Tools	• Board and Marker • ICT tools like Projector, online platforms like zoom, upload materials in Google Classroom.
Evaluation Process	• Assignment • Sessional Examination • Unit Test • Google ClassRoom Quiz • Seminar Presentation/Group Discussion/Micro Teaching
Paper Code/Title	**Paper Title:** Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-C-101-LAB
Allotted Unit/Topic	**Allotted Unit:** A **Chapter Name:** Titrimetric Analysis **Marks:** 5 **Details of the topic:**

	(i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality of titrants
	Allotted Unit: B **Chapter Name:** Acid-Base Titrations **Marks:** 6 **Details of the topic:** (i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture
	Allotted Unit: C **Chapter Name:** Oxidation-Reduction Titrimetry **Marks:** 11 **Details of the topic:** (i) Estimation of Fe (II) or oxalic acid using standardized $KMnO_4$ solution. (ii) Estimation of Fe (II) with $K_2Cr_2O_7$ using diphenylamine as internal indicator
	Allotted Unit: D **Chapter Name:** Viva-voce **Marks:** 5
Teaching Tools	• Learning through lab experiments • Industry and research institution visits
Evaluation Process	• In semester examinations • Viva-voce during practical
1st SEMESTER (GENERIC)	
Paper Code/Title	**Paper Title:** Section A: Inorganic Chemistry **Paper Code:** CHEMISTRY-GE-101
Allotted Unit/Topic	**Allotted Unit: I** **Chapter Name:** Atomic Structure **No. of classes: 14**

	Marks: 13 **Details of the topic:** Review of: Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.
Teaching Tools	• Board and Marker • ICT tools like Projector, online platforms like zoom, upload materials in Google Classroom.
Evaluation Process	• Assignment • Sessional Examination • Unit Test • Google ClassRoom Quiz • Group Discussion
Paper Code/Title	**Paper Title:** Section A: Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-GE-101-LAB

Allotted Unit/Topic	**Allotted Unit:** Section A **Chapter Name:** Inorganic Volumetric Analysis **Marks:** 11 **Details of the topic:** (i) Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using an internal indicator. (ii) Estimation of oxalic acid by titrating it with $KMnO_4$. (iii) Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$. (iv) Estimation of Fe (II) ions by titrating it with $KMnO_4$. (v) Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
	Allotted Unit: C **Marks:** 5 **Details of the topic:** Viva-voce
Teaching Tools	• Learning through lab experiments
Evaluation Process	• In semester examinations • Viva-voce during practical
3rd SEMESTER (HONOURS)	
Paper Code/Title	**Title Paper:** Inorganic Chemistry **Paper Code:** CHEMISTRY-C-101
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** General Principles of Metallurgy **No. of classes:** 6 **Marks:** 5 **Details of the topic:** Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

	Allotted Unit: II **Chapter Name:** Acids and Bases **No. of classes:** 8 **Marks:** 7 **Details of the topic:** Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.
	Allotted Unit: III **Chapter Name:** Noble Gases **No. of classes:** 8 **Marks:** 7 **Details of the topic:** Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).
	Allotted Unit: IV **Chapter Name:** Acids and Bases **No. of classes:** 8 **Marks:** 7 **Details of the topic:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.
Teaching Tools	• Board and Marker • ICT tools like Projector, online platforms like zoom, upload materials in Google Classroom.
Evaluation Process	• Assignment • Sessional Examination

	• Unit Test • Google ClassRoom Quiz • Seminar Presentation/Group Discussion/Micro Teaching
Paper Code/Title	**Paper Title:** Inorganic Chemistry Practical **Paper Code:** CHEMISTRY-C-301-LAB
Allotted Unit/Topic	**Allotted Unit:** A **Chapter Name:** Iodo/Iodimetric Titrations **Marks:** 13 **Details of the topic:** (vi) Estimation of Cu (II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically) (vii) Estimation of available chlorine in bleaching powder iodometrically
	Allotted Unit: B **Chapter Name:** Inorganic preparations **Marks:** 9 **Details of the topic:** (iv) Cuprous Chloride, Cu_2Cl_2 (v) Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$ (vi) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.
	Allotted Unit: C **Marks:** 5 **Details of the topic:** Viva-voce
Teaching Tools	• Learning through lab experiments • Industry and research institution visits
Evaluation Process	• In semester examinations • Viva-voce during practical
3rd semester (Generic)	

Paper Code/Title	**NA**
5th SEMESTER (HONOURS)	
Paper Code/Title	**Title Paper:** Analytical Methods in Chemistry **Paper Code:** CHEMISTRY-DSE-501
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Qualitative and quantitative aspects of analysis **No. of classes:** 5 **Marks:** 4 **Details of the topic:** Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.
	Allotted Unit: II **Chapter Name:** UV-Visible and IR Spectrometry **No. of classes: 2**5 **Marks:** 25 **Details of the topic:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry*: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry*: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, effect and importance of isotope substitution.

	Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.
Paper Code/Title	**Title Paper:** Analytical Methods in Chemistry **Paper Code:** CHEMISTRY-DSE-501
Allotted Unit/Topic	**Allotted Unit:** I **Chapter Name:** Introduction to Green Chemistry **No. of classes:** 4 **Marks:** 4 **Details of the topic:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations? Obstacles in the persuit of the goals of Green Chemistry.
	Allotted Unit: I **Chapter Name:** Introduction to Green Chemistry (only a part) **No. of classes:** 4 **Marks:** 4 **Details of the topic:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (i) Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, Calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. (ii) Prevention/ minimization of hazardous/ toxic products reducing toxicity
Teaching Tools	• Board and Marker • ICT tools like Projector, online platform like zoom, upload materials in Google Classroom.

Evaluation Process	• Assignment • Sessional Examination • Unit Test • Google Class Room Quiz • Seminar Presentation/Group Discussion/Micro Teaching
Paper Code/Title	**Title Paper:** Analytical Methods in Chemistry Practical **Paper Code:** CHEMISTRY-DSE-501-PRACT.
Allotted Unit/Topic	**Allotted Unit:** A **Chapter Name:** Analytical Chemistry Practical **Marks:** 22 **Details of the topic:** (i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, Cr^{3+}, Ag^{+}, Hg_2^{2+}, and Pb^{2+} (ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values. (iii) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values. (iv) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC (v) Determine the pH of the given aerated drinks fruit juices, shampoos and soaps. (vi) Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques. (vii) Analysis of soil: determination of pH of soil, total soluble salt, estimation of calcium, magnesium, phosphate, nitrate (viii) Separation of metal ions from their binary mixture. (ix) Separation of amino acids from organic acids by ion exchange chromatography. (x) Determination of dissolved oxygen in water. (xi) Determination of chemical oxygen demand (COD). (xii) Determination of Biological oxygen demand (BOD).

	Allotted Unit: B **Marks:** 5 **Details of the topic:** Viva-voce
Teaching Tools	• Learning through lab experiments • Industry and research institution visits
Evaluation Process	• In semester examinations • Viva-voce during practical

SIGNATURE

TEACHING PLAN & LESSON PLAN

GARGAON COLLEGE, SIMALUGURI-785686, SIVASAGAR, ASSAM

SESSION- 2022-2023

EVEN SEMESTER

I. GENERAL INFORMATION

NAME OF THE TEACHER: Dr. Saheen Shehnaz Begum

DEPARTMENT: Chemistry

DESIGNATION: Assistant Professor

OBJECTIVES OF THE TEACHING PLAN:

- To develop a strong knowledge on chemical thermodynamics, their mathematical expression & application.
- To develop the basic knowledge on electrochemistry, various laws governing electro chemical process and their application.
- To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective

II. ASSIGNED PAPERS AND UNIT

SEMESTER	PAPER CODE	PAPER TITLE	UNITS
II H	C-202	Chemical Thermodynamics and its Applications	Unit 2: Systems of Variable composition Unit 3: Chemical Equilibrium Unit 4: Solutions and Colligative properties
II H Lab	C-202-LAB	Physical Chemistry	Thermochemistry
II GE	CHEMISTRY-GE-201	Chemical Energetics, Equilibria and Functional Organic Chemistry	Unit 1: Chemical energetics Unit 2: Chemical equilibrium
II GE Lab	CHEMISTRY-GE-201-LAB	Physical Chemistry and Organic Chemistry	Thermochemistry and Ionic equilibria
IV H	C-403	Electrochemistry	Unit 2: Electrochemistry

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			Unit 3: Electrical and Magnetic Properties of Atoms and Molecules
IV H Lab	C-403-LAB	Physical Chemistry	A. Conductometry B. Potentiometry
IV GE	CHEMISTRY-GE-401	Transition metals, Coordination Chemistry, States of Matter and Chemical Kinetics	Unit 4: Kinetic Theory of Gases Unit 6: Solids
IV GE Lab	CHEMISTRY-GE-401 - LAB	Inorganic Chemistry and Physical Chemistry	Surface Tension and Viscosity
VI	DSE-601	Inorganic Materials of Industrial Importance	Unit 4: Batteries
	DSE-603	Dissertation	Dissertation (Project Work)
	DSE-601- Lab	Inorganic Materials of Industrial Importance	

III. PAPER WISE/UNIT WISE LESSON PLAN

PAPER CODE: C-202 and C-202-LAB

TITLE OF THE PAPER: Chemical Thermodynamics and its Applications and Associated Practical

Unit 2: Systems of Variable composition

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Partial molar quantities	To build foundational concept	The application of mathematical tools to calculate thermodynamic properties.

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EVEN SEMESTER

2	Dependence of thermodynamic parameters on composition	Introduce dependence of thermodynamic parameters on composition	To make the students comprehend thermodynamic parameters
3	Chemical potential	Introduce and understand Chemical Potential	To teach about chemical potential
4	Mixtures and chemical potential of ideal mixtures	Concept of ideal mixtures and variation of chemical potential	Students will be able to grasp the concept of ideal mixtures and variation using chemical potential
5	Change in thermodynamic functions in mixing of ideal gases	Relation between ΔG_{mix}, ΔS_{mix}, ΔH_{mix} with μ	To teach the thermodynamic relation between thermodynamic functions in mixing ideal gas
6	Gibbs-Duhem equation	Importance of μ and dn	Numericals and proper understanding of relation between Gibbs-Duhem equation.
7.	Numerical based on all topics and general discussion		
8.	Doubt clearing session		

Unit 3: Chemical Equilibrium

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Concept and Criteria and types of thermodynamic equilibrium	To build foundational concept in equilibria by demonstrating types of equilibria	Students would be able to identify the given equilibria and their types.
2	Degree of advancement of reaction and chemical equilibria in ideal gases	To teach ξ - extent of reaction or degree of advancement and its application	To inculcate the concept of advancement of reaction
3	Thermodynamic derivation of relation between G of reaction and Q, reaction quotient.	Introduce Q and how it is different from K_{eq} and its relation with G	To

4	Fugacity	To teach concept of fugacity	Students will be able to grasp the concept of ideal mixtures and variation using chemical potential
5	Exoergic and endoergic reactions and their coupling	To teach about exoergic and endoergic reactions	To teach the thermodynamic relation between thermodynamic functions in mixing ideal gas
6	Equilibrium constants, K_{eq} and their quantitative dependence on T, P and C	Derive the dependence of K_{eq} with T, P and C	Students will be able to relate K_{eq} with T, P and C
7.	Thermodynamic derivation of relations between equilibrium constants *Kp* , *Kc* and *K*	Introduce types of equilibrium constant and their derivation	Students will be able to distinguish *Kp* , *Kc* and *K*
8.	Le Chatelier principle (quantitative treatment)	Application of Le Chatelier principle to different types of systems	Students will be able to apply Le Chatelier principle
9.	Equilibrium between ideal gases and a pure condensed phase.	Conditions for equilibria between ideal gas and pure condensed phase	Learn about equilibria of ideal gas and pure condensed phase
10.	Numericals and General Discussion	Problem solving capability enhancement	To adapt them to numerical aptitude

Unit 4: Solutions and Colligative properties

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Solutions – components and types; Dilute solutions	To build foundational concept of solutions mostly focused on dilute solutions	Students would be able to identify the given equilibria and their types.
2	Raoult's and Henry's Laws and their applications and Raoult's and Henry's Laws and their applications	To rediscuss Raoult's and Henry's Laws and solve problems based on it.	To inculcate the concept of advancement of reaction

3	Lowering of vapour pressure	To define vapour pressure	To ascertain that student, grasp the concept of vapour pressure
4	Colligative property	Definition and Application	Students can define and identify colligative properties
5	Thermodynamic derivation using chemical potential to derive relations between four colligative properties	To carry out derivation of relations between four colligative properties and chemical properties	To make the students more adaptable to thermodynamic derivations
6	Relative lowering of vapour pressure	Each property has to been explained in each class and associated problem solving	Students would be able to solve both numerical and application-based question of each colligative property
7	Elevation of boiling point		
8.	Depression of freezing point		
9.	Osmotic pressure and amount of solute		
10.	Normal, dissociated and associated solutes in solution	Dissociation and association of solute affecting the solution	Applications in calculating molar masses in calculating Normal, dissociated and associated solutes in solution
11.	Applications in calculating molar masses	Calculation of molar mass considering association and dissociation	
12.	Numericals and general discussion	Problem solving capability enhancement	Adaptability in question solving

PAPER CODE: C-202 Lab

TITLE OF THE PAPER: Physical Chemistry Laboratory

UNIT: Practical

EXPECTED DATE OF COMPLETION OF THE UNIT: 10th April, 2022

CLASSES	TOPIC	OBJECTIVES	OUTCOME

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GARGAON COLLEGE, SIMALUGURI-785686, SIVASAGAR, ASSAM

SESSION- 2022-2023

EVEN SEMESTER

1	Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.	enthalpy of neutralization	Practical idea on enthalpy of neutralization
2	Calculation of the enthalpy of ionization of ethanoic acid.	enthalpy of ionization	Practical idea on enthalpy of ionization
3	Study of the solubility of benzoic acid in water and determination of Δ H.	solubility	solubility of benzoic acid

PAPER CODE: CHEMISTRY-GE-201

TITLE OF THE PAPER: *Chemical Energetics, Equilibria and Functional Organic Chemistry*

UNIT: 1: Chemical Energetics

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Review of thermodynamics	To build foundational concept of thermodynamics	The application of mathematical tools to calculate thermodynamic properties.
2	Review of Laws of Thermodynamics.		
3	Principles and definitions of thermochemistry.	Basis of properties like Extensive, intensive, state function, path function	To make the students comprehend thermodynamic properties
4	Concept of standard state and	Introduce the idea of standard state	Definition and properties of standard state
5	Concept standard enthalpies of formations	Introduction to Gibbs free energy, enthalpy, entropy	To make students understand the basis of change in enthalpies in chemical system
6	Integral enthalpies of solution and dilution	Concept of integral enthalpies and its change with dilution.	Students will be able to grasp the concept integral enthalpies and Differential enthalpies and its change with dilution.
7	Differential enthalpies of solution and dilution	Concept of differential enthalpies and its change with dilution.	

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EVEN SEMESTER

8	Calculation of bond energy from thermochemical data.	To teach the students about the analysis of thermochemical data and its calculation for determination of bond energy, bond dissociation energy and resonance energy	Students would be able to calculate values of BE, BDE and RE from thermochemical data
9	Calculation of bond dissociation energy from thermochemical data.		
10	Calculation of resonance energy from thermochemical data.		
11	Kirchhoff's equation – derivation and application Numerical based on all topics	Variation of enthalpy of a reaction with temperature	Students would be taught to solve numerical so that they can identify and apply Kirchhoff's equation

UNIT: 1: Chemical Equilibrium

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Free energy change in a chemical reaction	To build foundational concept of chemical reaction and free energy change	Students would be able to understand free energy change in chemical reaction and make derivation. They would also be able to distinguish between ΔG and ΔG^o
2	Thermodynamic derivation of the law of chemical equilibrium.	Law of chemical equilibrium and its derivation	
3	Distinction between ΔG and ΔG^o	Elaborate distinction of change is Gibbs free energy and change in standard Gibbs free energy.	
4	Le Chatelier's principle	To be able to predict the effect of a change in conditions on chemical equilibria.	Students would be able to determine if a dynamic equilibrium shifts to a particular direction by changing the conditions.
5	Ideal gases	Introduction to ideal gas; assumptions of ideal gas.	To make students understand the basis how ideal gas molecules interact.

6	Relationships between *Kp*, *Kc* and *Kx* for reactions involving ideal gases.	Equilibrium constant based on partial pressure, concentration and mole fraction	Students would be able to solve questions based on *Kp*, *Kc* and *Kx* for reactions involving ideal gases
7	Differential enthalpies of solution and dilution	Concept of differential enthalpies and its change with dilution.	

PAPER CODE: GE-201 Lab

TITLE OF THE PAPER: Chemistry Practical

UNIT: Section A: Physical Chemistry

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.	enthalpy of neutralization	Practical idea on enthalpy of neutralization
2	Calculation of the enthalpy of ionization of ethanoic acid.	enthalpy of ionization	Practical idea on enthalpy of ionization
3	Study of the solubility of benzoic acid in water	solubility	solubility of benzoic acid

PAPER CODE: IV H

TITLE OF THE PAPER: **Physical Chemistry**

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EVEN SEMESTER

UNIT: **II: Electrochemistry**

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Quantitative aspects of Faraday's laws of electrolysis	Revision of previously known concept so as to build foundational concept of electrolysis	To check the foundation on which further concept can be built.
2	Rules of oxidation/reduction of ions based on half-cell potentials	Rules of redox reactions and half cell potentials	To teach about the half-cell potentials and oxidation-reduction rules
3	Applications of electrolysis in metallurgy and industry	To introduce the applicability of elctrolysis	Electrolysis as part of industrial application.
4	Chemical cells, reversible and irreversible cells with examples	Concept and exemplification of types of cells	Students can identify different types of cells
5	Electromotive force of a cell and its measurement	Definition of EMF of a cell and how to measure it	Students can calculate EMF of a cell
6	Standard electrode (reduction) potential	Explanation of Standard reduction potential	Students learn about what is SE and its applications in different types of half-cells.
7.	SE and its application to different kinds of half-cells	To teach about the various applications of SE in different types of cells	
8.	Nernst equation and its application	To teach the concept and derivation of Nernst equation and its application	Students know and can solve problems based on Nernst equation
9.	Application of EMF measurements in determining free energy	Free energy relation with EMF	Students can derive application of EMF for determining free energy
10.	Application of EMF measurements in determining enthalpy and entropy of a cell reaction	Relation of EMF with enthalpy and entropy of a cell reaction	Students know the relation between enthalpy and cell reaction with EMF and their applications.

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EVEN SEMESTER

11.	Application of EMF measurements in determining equilibrium constants	Relation between EMF and K and Q of cell reaction	Students can derive the relation between K or Q with EMF
12.	Application of EMF measurements in determining pH values using hydrogen electrodes	Relation between EMF and pH values using H-electrode	Students can determine the relation between pH of H-electrode and EMF
13.	Application of EMF measurements in determining pH values using quinone-hydroquinone electrodes	Relation between EMF and pH values using H-electrode	Students can determine EMF and pH of hydroquinone electrode
14.	Application of EMF measurements in determining pH values using glass electrodes	Relation between EMF and pH values using glass electrode	Students can determine EMF and pH of glass electrode
15.	Application of EMF measurements in determining pH values using SbO/Sb_2O_3 electrodes	Relation between EMF and pH values using using SbO/Sb_2O_3 electrodes	Students can determine EMF and pH using SbO/Sb_2O_3 electrodes
16.	Concentration cells and types	Foundation class on concentration cells and their types	Students can define concentration cells and differentiate between the types
17.	Concentration cells with and without transference	Concept of concentration cells with transference and without transference	Students can diagrammatically represent the conc cells with transference and without transference
18.	Liquid junction potential	Foundational class to build the concept and role of LJP	Concept built on LJP
19.	Determination of activity coefficients	Role and method of determination of activity coefficients	Students can calculate the value of activity coefficients
20.	Transference numbers and its determination	Foundational concept on transference number and their determination	Students can grasp the concept of transference numbers and realize the method of its determination
21.	Potentiometric titrations	Elaboration on the technique and use of potentiometric titrations	Students can correlate theory with experiments on potentiometric titrations

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EVEN SEMESTER

22.	Potentiometric titrations: acid-base, Redox reaction, Precipitation reaction	Qualitative discussion of different types of potentiometric titrations such as complete discussion on acid-base, redox and precipitation reaction	Students can differentiate and define different types of potentiometric titrations
23.	Numerical on different aspects of Electrochemistry	Class focused on numericals	Students are encouraged to solve different types of numericals from easy to tough of this chapter
24.	General Doubt clearing session	All doubts clearing session	Adaptability in question solving

PAPER CODE: C-403

TITLE OF THE PAPER: Physical Chemistry Practical

UNIT: Practical

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Determination of cell constant	Use of conductivity bridge	Practical idea on cell constant
2	conductometric titration: Strong acid vs. strong base	conductometric titration	Practical idea on conductometric titration
3	conductometric titrations: Weak acid vs. strong base	conductometric titration	Practical idea on conductometric titration
4	potentiometric titrations: Strong acid vs. strong base ii	potentiometric titrations	Practical idea on potentiometric titration

TEACHING PLAN & LESSON PLAN

GARGAON COLLEGE, SIMALUGURI-785686, SIVASAGAR, ASSAM

SESSION- 2022-2023

EVEN SEMESTER

PAPER CODE: GE-401

TITLE OF THE PAPER: Transition metals, Coordination Chemistry, States of Matter and Chemical Kinetics

UNIT: IV Kinetic Theory of Gases

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Kinetic Theory of Gases: Postulates of Kinetic Theory of Gases	Foundational topic elaborated into the postulates	Students learn about the theory that determines the kinetics of gases
2	Derivation of the kinetic gas equation	To mathematically formulate the kinetic gas equation	Derivation is taught to the students
3	Deviation of real gases from ideal behaviour and causes of deviation	Causes of deviation from ideal behaviour is explained	Students can correlate the causes and know why the real gases deviate from ideal gases
4	Compressibility factor.	To teach about the compressibility factor	Students know about the ratio of PV for ideal and real gas
5	van der Waals equation of state for real gases	Relevance and form of van der Waals equation for real gases	Students know about the mathematical form of van der Waals equation
6	Boyle temperature	To teach Boyle temperature	Students learn about Boyle temperature
7	Critical phenomena, critical constants and their calculation from van der Waals equation	To teach critical phenomena	Students learn
8	Andrews isotherms of CO_2	To teach Andrews isotherm diagrammatically	Students can draw the Andrews isotherm of CO_2
9	Maxwell Boltzmann distribution laws of molecular velocities and molecular energies	Distribution of molecular velocities and energies is explained by Maxwell-Boltzmann distribution	Students can draw the relation mathematically

10	Temperature dependence of these distributions	Temperature dependence is taught so as to explain the role of temperature can be explained. Shown diagrammatically.	Students can figure out most probable velocity from the temperature dependence curves
11	Most probable, average and root mean square velocities	Difference between the types of velocities and their mathematical forms	Students can define and differentiate between the types of velocities.
12	Collision number and mean free path of molecules	To teach about the parameters of collision of gas molecules	Students learn about the collision parameters
13	Viscosity of gases, effect of temperature/pressure on coefficient of viscosity	Relation between viscosity of gases and T and P on coeff of viscosity	Students learn about the viscosity of gases and coeff of viscosity relation to T and P

UNIT: VI Solids

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Solids and Forms of solids.	To build the foundation on states of matter and particularly solids	Students know what solids are and how they are different from gas and liquid.
2	Symmetry elements	Introduction to symmetry elements	Plane of symmetry, point of symmetry, identity elements are learnt
3	Unit cells and crystal systems	Concept of Unit cell and crystal systems	Students learn about the unit cell and how these are drawn.
4	Bravais lattice types	Types of Bravais lattice	Students learn about Bravais lattice
5	identification of lattice planes	Taught how to identify the lattice planes	Students learn about lattice plane identification
6	Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices	Laws are explained and taught	Students learn about laws governing solids

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EVEN SEMESTER

7	Miller indices	Class on Miller indices for solids	Students learn about miller indices
8	Bragg's law	Class on Bragg's law	Students learn about Law X-ray diffraction
9	Structures of NaCl (qualitative treatment only)	Qualitative treatment of structure of NaCl	Students learn about structure of NaCl
10	Defects in crystals	Crystal defects and reasons and implications taught	Students learn about crystal defects and its implications
11	Glasses and liquid crystals	Taught glasses and liquid crystals	Students learn about glasses and liquid crystals

PAPER CODE: GE-401 Lab

TITLE OF THE PAPER: Section B: Physical Chemistry Practical

UNIT: Practical

EXPECTED DATE OF COMPLETION OF THE UNIT: 10th April, 2022

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Determination of the surface tension of a liquid or a dilute solution using a stalagmometer	Determination of the surface tension	Knowledge how to prepare solutions use of stalagmometer
2	Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer	Determination of viscosity of liquid	Knowledge how to prepare solutions use of viscometer

PAPER CODE: DSE-601

TITLE OF THE PAPER: Inorganic Materials of Industrial Importance

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SESSION- 2022-2023

EVEN SEMESTER

UNIT: IV: Batteries

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Introduction to batteries and their usage in day-to-day life	Introductory class	Students can elaborate on usage of batteries and their usage in day-to-day life
2	Primary and secondary batteries	Difference between primary and secondary batteries	Students can elaborate on Primary and secondary batteries with examples
3	Battery components and their role	Class on components of batteries and their role	Students can elaborate on components of battery and their role
4	Characteristics of Battery.	Class on characteristics of battery	Students can elaborate on characteristic of battery
5	Working of Pb acid batteries:	Working mechanism of Pb acid batteries	Students can diagrammatically explain the mechanism of Pb acid batteries
6	Working of Li Battery	Application and working of Li battery	Students can diagrammatically explain the mechanism of Li battery
7	Working of solid-state electrolyte battery	Application and working of solid-state electrolyte battery taught	Students can diagrammatically explain the mechanism of solid-state electrolyte battery
8	Working and application of Fuel cells	Application and working of Fuel cells taught	Students can diagrammatically explain the mechanism of Fuel cells
9	Working of Solar cell and polymer cell	Application and working of solar cell and polymer cells taught in details	Students can diagrammatically explain the mechanism of solar cell and polymer cells

PAPER CODE: DSE-603

TITLE OF THE PAPER: Dissertation

TEACHING PLAN & LESSON PLAN

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EVEN SEMESTER

UNIT: Project Work

EXPECTED DATE OF COMPLETION OF THE UNIT: 10th April, 2022

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	In this paper students have to carry out project work (Laboratory experiments or Comprehensive Review work on a specified topic)	To develop the written and verbal communication. To present information in a clear an effective manner, to write report in a scientific style and to solve scientific problems	Communication effectively, verbally and written for the purpose of conveying chemical information to both professional scientist and to the public

ODD SEM

II. ASSIGNED PAPERS AND UNIT

SEMESTER	PAPER CODE	PAPER TITLE	UNITS
1st (H)	C-102	Physical Chemistry	Unit II (Liquid State)
1st (H)	C-102	Physical Chemistry	Unit IV (Ionic Equilibrium)
1st (H)	C-102 Lab	Physical Chemistry Laboratory	Practical
3rd (H)	C-303	Physical Chemistry	Unit II (Chemical Kinetics)
3rd (H)	C-303 Lab	Physical Chemistry Laboratory	Practical
3rd (GE)	GE-301	Physical Chemistry	Unit-3 (Conductance)
3rd (GE)	GE-301 Lab	Physical Chemistry Laboratory	Practical
5th (H)	C-502	Physical Chemistry	Unit-II (Spectroscopy)
5th (H)	C-502 Lab	Physical Chemistry Laboratory	Practical

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EVEN SEMESTER

III. PAPER WISE/UNIT WISE LESSON PLAN

PAPER CODE: C-102

TITLE OF THE PAPER: Physical Chemistry

UNIT: 1: Gaseous State

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Introductory Class	To put an overview in the subject, Chemistry	To make the subject interesting
2	States of Matter	To emphasize on different states of matter & their mechanical treatment	Physical properties of solids and how it is different from liquids and gas
3	Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation	To teach the postulates that define the gaseous state and their relevance	Students can derive the kinetic gas equation and know the significance and relations between the functions
4	Collision frequency; collision diameter; mean free path and viscosity of gases	Diagrammatically represent collision freq, diameter and mean free path	Students can define and differentiate between them
5	Temperature and pressure dependence	Mathematical relation to show the dependence	Students should be able to determine the relation and the T and P dependence
6	Relation between mean free path and coefficient of viscosity	Theory, concept and derivation of relation between coeff of viscosity and mean free path of a gas	Students are able to understand the relation
7	Variation of viscosity with temperature and pressure.	Temperature and pressure effect on viscosity	Relation between viscosity and temperature and pressure
8	Average, root mean square and most probable velocities	Class on types of velocities	Students can differentiate between the types of velocities
9	Maxwell distribution of molecular velocities		Maxwell distribution is learnt

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10	Maxwell distribution of molecular energies, average kinetic energy	Explanation on distribution of molecular velocities and molecular energies, average kinetic energy	
11	Law of equipartition of energy and degrees of freedom	Class on law of equipartition and DOF	Students can define law of equipartition of energy
12	Molecular basis of heat capacities	Heat capacities	Students understand the Molecular basis of heat capacities
13	Behaviour of real gases: Deviations from ideal gas behaviour	Explanation on behavior and deviation of ideal gas behaviour	Students explain the deviation of ideal gas behaviour
14	Compressibility factor, *Z*, and its variation with pressure for different gases	Elaboration on z and variation with P for different gases	Compressibility factor graphically is made understood.
15	Causes of deviation from ideal behavior	Explanation for deviation of ideal behaviour	Students can correlate the causes of deviation
16	van der Waals equation of state, its derivation and application in explaining real gas behaviour	Class on van der Waals equation and its application	Real gas behaviour, van der Waals equation and derivation can be done by students
17	van der Waals equation expressed in virial form and calculation of Boyle temperature.	Explanation on Boyle Temperature – definition and derivation	Virial form and Boyle Temp can be derived by the students
18	Other equations of state (Berthelot, Dietrici); virial equation of state	Class on other equations of states	Berthelot and Dietrici equation
19	Isotherms of real gases and their comparison with van der Waals isotherms	Elaboration on isotherms of real gases and variation from van der Waals isotherm	Isotherms of both real and van der Waals gases
20	Continuity of states	Explanation on continuity of states	Concept of continuity of states is taught
21	Critical state, relation between critical constants and van der Waals constants	Class on critical states, critical T, P and V and their relations with vdW constants	Students can do numerical and the relation between T_c, P_c and V_c

22	Law of corresponding states	Explanation of law of corresponding states	Law is learnt

UNIT: III Solid State

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Nature of the solid state	To build the foundation on states of matter and particularly solids	Students know what solids are and how they are different from gas and liquid.
2	Law of constancy of interfacial angles, law of rational indices	Laws are taught for better understanding of the solid state and crystallography	Students can define the laws and use them when required
3	Miller indices	Class on Miller indices for solids	Students learn about miller indices
4	Elementary ideas of symmetry, symmetry elements and symmetry operations	Introduction to symmetry elements	Plane of symmetry, point of symmetry, identity elements are learnt
5	Qualitative idea of point and space groups	Taught how to identify the lattice planes	Students learn about lattice plane identification
6	Seven crystal systems and fourteen Bravais lattices	Concept of the 7-crystal system and 14 Bravais lattices	Students can diagrammatically show the 14 Bravais lattices
7	X-ray diffraction and Bragg's law	Class on Bragg's law	Students learn about Law X-ray diffraction
8	An account of rotating crystal method and powder pattern method	Explanation of the rotating crystal method and powder pattern method	Students can draw and elaborate the same
9	Analysis of powder diffraction patterns of NaCl, CsCl and KCl	Qualitative treatment of structure of NaCl	Students learn about structure of NaCl
10	Defects in crystals	Crystal defects and reasons and implications taught	Students learn about crystal defects and its implications

11	Glasses and liquid crystals	Taught glasses and liquid crystals	Students learn about glasses and liquid crystals

PAPER CODE: C-102 Lab

TITLE OF THE PAPER: Physical Chemistry

UNIT: Practical

EXPECTED DATE OF COMPLETION OF THE UNIT: 31th October, 2021

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Surface tension measurements	Determine the surface tension of various liquids by drop number method	Practical knowledge on surface tension of liquid
2	Determination of viscosity	Viscosity of various liquids	Practical knowledge on viscosity of liquid
3	pH metry	pH-metric titration of strong acid vs strong base	Practical knowledge on pH meter and pH metric titration
4	pH metry	pH-metric titration of weak acid vs strong base	Practical knowledge on pH meter and pH metric titration

PAPER CODE: C-303

TITLE OF THE PAPER: Physical Chemistry

UNIT: I Phase Equilibria

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CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Concept of phases, components and degrees of freedom	Foundation course	Students have the concept of phases, components and DOF
2	Derivation of Gibbs Phase Rule for non-reactive and reactive systems	Mathematical derivation	Can derive the Phase rule
3	Clausius-Clapeyron equation	Concept of the theory	Students know about the CC equation
4	CC equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria	Applications of the theory to different systems	Students learn about the CC equation applied to S-L, L-V and S-V equilibria
5	Phase diagram for one component systems with applications	Explanation of 1 Component system with application	Students can draw phase diag of different 1 C systems
6	Phase diagrams for systems of solid-liquid equilibria involving eutectic systems	Explanation, application and example of eutectic systems	Students know about the eutectic phase diagram
7	Systems with congruent and incongruent melting points	Explanation of systems with congruent and incongruent melting points	Congruent and incongruent melting point is clear
8	Solid solutions	To teach about solutions of solids	Students learn about solid solutions
9	Three component systems, water-chloroform-acetic acid system and triangular plots	3 C systems and triangular plots of the specified are explained	Students can draw the triangular plot of 3C systems
10	Gibbs-Duhem-Margules equation and its derivation	Explanation of Gibbs-Duhem-Margules equation and derivation	Students can derive it
11	Applications of GDM to fractional distillation of binary miscible liquids in ideal and non-ideal equilibria	GDM equation applied to fractional distillation of binary liquids of both ideal and non-ideal equilibria	Students learn about the application of GDM to binary liquids of ideal and non-ideal equilibria
12	Azeotropes	Class on the definition and formation of azeotropes	Students can explain about azeotropes and their types
13	Lever rule and partial miscibility of liquids	To teach about the lever rule and the partial miscibility of liquids	Students learn about the form of lever rule and partial miscibility of liquids

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14	CST; miscible pairs	Explanation on Critical Solution temperature and miscible pairs of liquids	Students learn about the CST with examples and miscible pairs of liquid
15	Steam distillation	Explanation on Steam Distillation	Students can draw and explain the steam distillation
16.	Nernst distribution law: its derivation and applications	Class on Nernst distribution law with derivation and applications	They can derive and apply the Nernst distribution law
17.	Doubt clearing and problem solving session	Class on numericals and doubt clearing	Students are given to solve numerical pertaining to various aspects of the chapter

UNIT: III: Catalysis

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Types of catalyst	Foundational class on catalysis	Types of catalysts are made known
2	Specificity and selectivity	Concept of specificity and selectivity	Students know the difference of specificity and selectivity
3	Mechanisms of catalyzed reactions solid surfaces	Solid surface catalysis explained with mechanism	Students can diagrammatically explain the mechanism of surface catalysis
4	Effect of particle size	Concept of particle size in catalysis elaborated	Students learn about the effect of particle size in catalysis
5	Efficiency of nanoparticles as catalysts	Nano-particles efficiency discussed	Students learn about the importance of nanoparticles
6	Enzyme catalysis	Explanation of the facets of enzyme catalysis	Students can explain the catalysis in enzyme systems

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7	Michaelis-Menten mechanism	Michaelis-Menten equation and constant explained with turn-over number and graph	Students can graphically explain the enzyme action and explain MM mechanism
8	Acid-base catalysis	Explanation on both acid catalysed and base catalysed reactions	Students learn about the acid-base catalysis

PAPER CODE: C-303 Lab

TITLE OF THE PAPER: Physical Chemistry Practical

UNIT: Practical

EXPECTED DATE OF COMPLETION OF THE UNIT: 15th October, 2021

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Study the kinetics of the following reactions: Acid hydrolysis of methyl acetate with hydrochloric acid.	Acid hydrolysis	Knowledge on hydrolysis
2	Study the kinetics of the following reaction: Saponification of ethyl acetate	Base hydrolysis	Knowledge on saponification of ethyl acetate
3	Adsorption: Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.	Adsorption	Knowledge on adsorption

PAPER CODE: GE-301

TITLE OF THE PAPER: Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II

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UNIT: 1 Solutions

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Solutions and Ideal solutions	Foundational class	Concept is built
2	Raoult's law and deviations from it	Solutions and derivation of Raoults law with application	Learn about it in details
3	Non-ideal solutions	Explanation of non-ideal solutions	Solutions of non-ideal nature is explained in details
4	Vapour pressure-composition and temperature composition curves of ideal Solutions	Vapour pressure and composition curve and temperature composition and composition curve of ideal solutions	Student are taught the concept of the graph in ideal solutions
5	Vapour pressure-composition and temperature composition curves of non-ideal Solutions	Vapour pressure and composition curve and temperature composition and composition curve of non- ideal solutions	Students are taught the concept of the graph in non-ideal solitions
6	Distillation of solutions and Azeotropes	Explanation on the process of solutions and azeotropes	Students are taught how distillations in solutions and taught about azeotropes
7	Partial miscibility of liquids: CST	Explanation on Critical solution temperature and partial miscibility of liquids	CST and partial miscibility concept taught
8	Effect of impurity on partial miscibility of liquids.	Effect of impurity discussed	Students learn about the effect impurity has on the miscibility of liquids
9	Immiscibility of liquids- Principle of steam distillation	Immiscibility of liquids explained and the principle of steam distillation elaborated	Students made to understand about the concept of immiscibility of liquids and how steam distillation is carried out
10	Nernst distribution law and its applications	Nernst distribution law explained with applications	Students are given the core concept and application part elaborated
11	Solvent extraction	Principle, application and need of solvent extraction taught	Students learn about it in details for different systems

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UNIT: II Phase Equilibrium

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Introduction to Phase Equilibria and criteria of phase equilibrium	Foundation class	Introduced to the concept of phase equilibria and criteria for it
2	Phases, components and degrees of freedom of a system	Concept of the theory	Students have the concept of phases, components and DOF
3	Gibbs Phase Rule and its thermodynamic deviation	Applications of the theory to different systems	Can derive the Phase rule
4	Phase diagrams of one-component system of i) water and ii)sulphur)	Explanation of 1 Component system with application	Students can draw phase diag of different 1 C systems
5	Two component systems involving eutectics	Explanation, application and example of eutectic systems	Students know about the eutectic phase diagram
6	Phase system with congruent and incongruent melting points specifically lead –silver, $FeCl_3$-H_2O and Na-K systems	Congruent and incongruent m.p. pertaining to specific system elaborated	Students are taught about the congruent and incongruent m.p for systems as given in syllabus

UNIT: IV Electrochemistry

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Reversible and irreversible cells	Foundational class to teach about reversibility and irreversibility	Students learn about Reversible and irreversible cells
2	Concept of EMF of a cell	Concept of EMF of the cell	Students learn about EMF
3	Measurement of EMF of a cell	Taught about how EMF of the cell is measured	Students learn about measurement of EMF technique
4	Nernst equation and its importance	Importance and explanation of Nernst equation	Students learn about Nernst equation and its application
5	Types of electrodes	Class on the types of electrodes	Types of electrodes is learnt by them

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6	Standard electrode potential.	Class on concept and determination of Standard electrode potential	Students learn about concept and determination of Standard electrode potential
7	Electrochemical series	Class on electrochemical series	Concept and elaboration of electrochemical series
8	Thermodynamics of a reversible cell.	Taught about the thermodynamics of reversible cell.	Students learn about thermodynamics of reversible cell
9	Calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data	EMF data correlation with thermodynamic properties	Students learn about EMF correlation with thermodynamic properties
10	Calculation of equilibrium constant from EMF data	Relation on K_{eq} with EMF data taught	Students learn about relation on K_{eq} with EMF
11	Concentration cells with transference and without transference	Explanation of concentration cells with transference with and without transference	Students learn about of concentration cells with transference with and without transference
12	Liquid junction potential and salt bridge	LJP and salt bridge concept and explanation	Students learn about LJP and salt bridge
13	pH determination using hydrogen electrode and quinhydrone electrode	Class on how pH is determined using H and quinhydrone electrode	Students learn about H and quinhydrone electrode in pH determination

PAPER CODE: GE-301 Lab

TITLE OF THE PAPER: Chemistry Practical

UNIT: Section A: Physical Chemistry

EXPECTED DATE OF COMPLETION OF THE UNIT: 15th October, 2021

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Determination of cell constant	Cell constant	Use of conductivity bridge

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SESSION- 2022-2023

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2	Determination of conductometric titrations: Strong acid vs. strong base	conductometric titration	Use of conductivity bridge
3	Determination of conductometric titrations: Weak acid vs. strong base	conductometric titration	Use of conductivity bridge

PAPER CODE: C-502

TITLE OF THE PAPER: Physical Chemistry

UNIT: I Quantum Chemistry

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Background of quantum mechanics and its necessity	Foundational class on the importance of quantum nature	Each topic is tough, so every student is taken care of individually to learn and grasp every concept. It was observed that in some cases student would fully understand and do a few topics and for others they
2	Postulates of quantum mechanics	Postulates of quantum mechanics is taught	
3	Quantum mechanical operators	Concept of operators and how they function	
4	Schrödinger equation and its application to 1. free particle and 2. “particle-in-a-box”(rigorous treatment)	Need 3-4 classes to provide proper understanding and appreciation of the topic	
5	quantization of energy levels and zero-point energy	ZPE and energy quantization in quantum mechanics	
6	Heisenberg Uncertainty principle	Heisenberg uncertainty principle explained in both forms in details	
7	Wavefunctions – concept and foundation	Definition and form of wavefunction	
8	Probability distribution functions	Concept of probability distribution function	
9	Nodal properties	Properties and types of nodes	
10	Extension to two- and three-dimensional boxes	2-D, 3-D boxes and their nodal properties	
11	Technique of separation of variables	Concept of separation of variable	

12	Concept of degeneracy	Degeneracy concept and rules and form	struggled. Ample time is given for the completion of this chapter
13	Qualitative treatment of simple harmonic oscillator model of vibrational motion	SHO qualitative treatment	
14	Setting up of Schrödinger equation and discussion of solution and wavefunctions	Solutions and wavefunctions of Schrödinger equation	
15	Vibrational energy of diatomic molecules and zero-point energy.	Vib energy of diatomic molecules and ZPE explained in correlation	
16	Commutation rules and Angular momentum	Commutation rules are taught and operator of ang momentum is derived	
17	quantization of square of total angular momentum and z-component	Angular momentum in quantum systems elaborated	
18	Rigid rotator model of rotation of diatomic molecule	Rigid rotor explained in quantum form in much detail	
19	Schrödinger equation, transformation to spherical polar coordinates	Transformation of coordinates is taught	
20	Spherical harmonics Discussion of solution	Simple harmonics and solutions to such systems	
21	Qualitative treatment of hydrogen atom and hydrogen-like ions	setting up of Schrödinger equation in spherical polar coordinates for H and H-like ions	
22	Radial part and quantization of energy (only final energy expression).	Final energy expression with radial part and quantization of energy taught	
23	Average and most probable distances of electron from nucleus	Class on Average and most probable distances of electron from nucleus	
24	Setting up of Schrödinger equation for many-electron atoms (He, Li)	setting up of Schrödinger equation is taught for other systems	
25	Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom)	Need for approximation methods is emphasized and the variation theorem and its application to already taught system is explained.	

UNIT: III Photochemistry

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SESSION- 2022-2023

EVEN SEMESTER

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Characteristics of electromagnetic radiation	Foundational class on EM radiation	Concept is built
2	Lambert-Beer's law and its limitations	Law of Beer and Lambert, application and limitations	Application, use and limitation with the definition of Beer-Lambert law
3	Physical significance of absorption coefficients	Absorption coefficients and physical significance	Students learn about coefficient of absorption and its physical significance
4	Laws of photochemistry	Important laws of photochemistry	Two more laws on photochemistry are made known
5	Quantum yield	Class on Quantum yield and its calculation of different types	Students learn about quantum yield and its calculation
6	Actinometry	Class on the concept of actinometry	Actinometry concept and mechanism
7	Examples of low and high quantum yields	Concept of high and low quantum yields	Students can explain the reason of high and low quantum yields
8	Photochemical equilibrium and the differential rate of photochemical reactions	Class on photochemical equilibrium and rates of photochemical reactions	Students learn about the photochemical equilibrium and rate of such reactions
9	Photosensitised reactions	Explanation on photosensitized reaction and their mechanism	Students learn about photosensitized reaction
10	Quenching	Concept of quenching	Students learn and can explain about quenching
11	Role of photochemical reactions in biochemical processes	Biochemical processes involving photochemical reactions	Students learn about the photochemistry involved in biochemical process
12	Photostationary states	Concept of photostationary states	Students can explain about photostationary states
13	Chemiluminescence	Elaboration on light generated in chemical reaction	Students learn about chemiluminescence and its mechanism
14	General discussion and doubt clearing	Doubt clearing session	Opportunity to learn by solving problems

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EVEN SEMESTER

PAPER CODE: C-502 Lab

TITLE OF THE PAPER: Physical Chemistry Practical

UNIT: Practical

EXPECTED DATE OF COMPLETION OF THE UNIT: 15th October, 2021

CLASSES	TOPIC	OBJECTIVES	OUTCOME
1	Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and λdetermine the max values.	absorbance spectra	Practical knowledge on spectroscopy
2	Verify Lambert-Beer's law and determine the concentration of KMnO4 in a solution of unknown concentration	Lambert-Beer's law	Practical knowledge on spectroscopy

IV. PEDAGOGY

TEACHING METHODOLOGY	TEACHING LEARNING RESOURCES	EVALUATION METHODS
In the beginning, to teach a unit of the syllabus, we try to give an overview of the content of the unit. Then One by one each topic is taught along with clearing all the drought of the students. End of each topic, if required, problems (mathematical problems) also are solved for the students.	Teaching learning resources used for teaching is mostly White Board and Marker pen. Apart from these some modes of structure of molecules are used for teaching. Online teaching with google classroom, zoom, insert learning, online quizzes are also handed out. Youtube links are also shared depending upon the clarity of the students and the relevance of the topic taught. Interactive teaching plays a major role	Traditional method of evaluation is used in combination with points given to the assignments in online mode.

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V. STUDY MATERIALS

SEMESTER	SOURCES OF STUDY MATERIALS INCLUDING ONLINE MATERIALS	GOOGLE CLASS ROOM LINKS OR CODE
2nd (H) 2nd (GE) 4th (H) 4th (GE) 6th (H)	Text books, Reference books, Research papers and online materials are used as study materials. Sometimes we prepare notes for students compiling the study materials from different books. For all semesters the study materials are provided in both online and offline mode.	https://classroom.google.com/u/1/c/NTE4MjgxMTU1NzQ1 https://classroom.google.com/u/1/c/NTQ0MzY3ODE0MTkw https://classroom.google.com/u/1/c/NDg0OTIwNjE5ODUw https://classroom.google.com/u/1/c/NDYzMzM0NjcyNTQx https://classroom.google.com/c/MzQ3MzA1MzU0MzQ3

Sahera Shahnaz Begum

SIGNATURE

GARGAON COLLEGE
TEACHING PLAN

Course: B. Sc.

Session: Odd semester 2022

Subject: CHEMISTRY

Name of the Teacher: Dr. PLABAN JYOTI SARMA

Methods to be applied: Lecture, analytical and activity method, interaction and discussion.

Teaching Materials: Green Board, Chalk Pencil, Duster, Book, Journal, Laptop, Projector.

PaperCode/Title	Allotted Unit/ Topic	No. of Class required	Detail of the topics to be taught & class required	No. of tutorials
CHEMISTRY C-101	Unit I: Atomic Structure	14	• Wave Mechanics [9] • Pauli Exclusion principles, Hund's rule, Aufbau's principles [3] • Variation of orbital energy with atomic number [2]	3
	Unit II: Periodicity of Elements	9	• Effective Nuclear Charge, Slater's rule [3] • Atomic Radii, ionic radii, Covalant radii [3] • Ionization energy, electron affinity, electronegativity [3]	3
CHEMISTRY C101-LAB	Inorganic Chemistry practical	28	• Titrimetric Analysis [8] • Acid-Base Titrations [9] • Oxidation-Reduction Titrimetry [9] • Viva Voce [2]	5
CHEMISTRY -C-301	Unit III: Chemistry of s and p Block Elements	30	• Inert pair effect, Relative stability of different oxidation states, diagonal relationship anomalous behaviour of first member of each group. [12] • Allotropy and catenation. Complex, formation tendency of *s* and *p* block elements [5] • Chemistry of Boron, Carbon, Nitrogen, Oxygen, helogens, Phosporus, Sulpher. [13]	5
	Unit V: Inorganic Polymers	8	• Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. [4] • Borazines, silicates and phosphazenes, and	2

			polysulphates. [4]	
CHEMISTRY -C-301- LAB	Inorganic Chemistry Practical	28	• Iodo / Iodimetric Titrations [12] • Inorganic preparations [14] • Viva Voce [2]	3
CHEMISTRY -DSE-501	Unit IV:Electro-analytical methods	05	• Theory of thermo-gravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture [5]	2
	Unit IV:Electro-analytical methods	10	• Classification of electro-analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.Techniques used for the determination of pKa values. [10]	2
	Unit V: Separation techniques	15	• *Solvent extraction [7]* • *Chromatography [8]*	2
CHEMISTRY -DSE-501- PRACT	*Analytical Methods in Chemistry Prctical*	28	• Paper chromatographic separation of Fe^{3+}, Al^{3+}, Cr^{3+}, Ag^{+}, Hg_2^{2+}, and Pb^{2+}. [6] • Determine the pH of the given aerated drinks fruit juices, shampoos and soaps. [6] • Determination of dissolved oxygen in water. [8] • Analysis of soil: determination of pH of soil. [6] • Viva Voce [2]	5
CHEMISTRY -GE-101	Unit I: Atomic Structure	14	• Wave Mechanics [9] • Pauli Exclusion principles, Hund's rule, Aufbau's principles [3] • Variation of orbital energy with atomic number [2]	3
CHEMISTRY -GE-101- LAB	Inorganic Volumetric Analysis	28	• Inorganic estimation of Iron and Copper [20] • Estimation of water of crystallization in Mohr's salt. [4] • Viva Voce [4]	3

GARGAON COLLEGE
TEACHING PLAN

Course: B. Sc.

Session: Even semester 2023

Subject: CHEMISTRY

Name of the Teacher: Dr. PLABAN JYOTI SARMA

Methods to be applied: Lecture, analytical and activity method, interaction and discussion.

Teaching Materials: Green Board, Chalk Pencil, Duster, Book, Journal, Laptop, Projector.

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Class required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
CHEMISTRY -C-401	Unit II: Transition Elements	18	• General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes. [8] • Stability of various oxidation states and e.m.f. (Latimer and Bsworth diagrams). Difference between the first, second and third transition series. [5] • Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excuding their metallurgy) [5]	4
	Unit IV: Bioinorganic Chemistry	10	• Metal ion present in biological systems, classification of elements according to their action in biological system. Geo chemical effect on distribution of metals. Sodium/ K-pump, carbonic anhydrase and carboxypeptidase. [5] • Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, use of chelating agents in medicine. [3] • Iron and its application in bio-systems, Haemoglobin, storage and transfer of iron. [2]	3

CHEMISTRY -C-401-LAB	Inorganic Chemistry practical	28	• Gravimetric Analysis [8] • Inorganic Preparation [8] • Chromatography of metal ions [8] • Viva-voce [4]	4
CHEMISTRY -C-601	Unit I: Theoretical Principles in Qualitative Analysis (H_2S Scheme)	10	• Basic principles involved in analysis of cations and anions and solubility products, common ion effect. [4] • Principles involved in separation of cations into groups and choice of group reagents. [3] • Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. [3]	3
	Unit II: Organometallic compounds	22	• Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. [3] • Metal carbonyls [10] • Zeise's salt [3] • Metal Alkyls. [3] • Ferrocene [3]	4
CHEMISTRY -C-601-LAB	Inorganic Chemistry Practicals	28	• Qualitative Inorganic Analysis: Salt analysis [25] • Viva – voce [3]	3
CHEMISTRY -DSE-601	Unit II: Fertilizers	8	• Different types of fertilizers [2] • Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate. [6]	3
CHEMISTRY -DSE-601-LAB	Inorganic Materials of Industrial Importance practical	28	• Determination of free acidity in ammonium sulphate fertilizer. [6] • Determination of free acidity in ammonium sulphate fertilizer. [6] • Determination of composition of dolomite [6] • Analysis of Cement [3] • Preparation of pigment [4] • Viva Voce [3]	4
CHEMISTRY	Project Work	48	• Project Work [48]	6

-DSE-603				
CHEMISTRY -GE-401	Unit I: Transition Series Elements (3d series)	12	• General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu [8] • Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only). [4]	3
CHEMISTRY -GE-401-LAB	Section A: Inorganic Chemistry	14	• Semi-micro qualitative analysis using H_2S of mixtures [11] • Viva Voce [3]	2

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