গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

TEACHING PLAN

DEPARTMENT OF CHEMISTRY

JULY 2019 - JUNE 2020

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Odd semester, 2019

Subject: CHEMISTRY
Name of the Teacher: Mr. RANJIT DUTTA
Methods to be applied: Lecture, analytical and activity method, Group Work, Assessment for Learning, Assignments and Exercises, Group Activities and Discussions and Assessments.
Teaching Materials: White Board, Marker, Duster, text books, lectures, etc.

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Classes required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
Inorganic Chemistry C-101	Unit I: Atomic Structure	14	● Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of Ψ and Ψ^2. [4] ● Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. [3] ● Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. [2] ● Shapes of s, p, d and f- orbitals. Contour boundary and probability diagrams. [2] ● Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations. Variation of orbital energy with atomic number]. [3]	2
	Unit III: Chemical Bonding	26	● Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. [2] ● Packing of ions in crystals. Born-Lande equation with derivation, lattice energy, Madelung constant [2] ● Born-Haber cycle and its application, Solvation energy. [2] ● Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). [2] ● Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Resonance and resonance energy [2] ● Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p	3

			mixing and orbital interaction to be given). Formal charge [4] ● Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ- and π- bond approach) and bond lengths. [3] ● Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. [2] ● Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference. [2] ● Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. [2] ● Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) [3]	
CHEMISTRY-C-101-LAB	Inorganic Chemistry	30	● Titrimetric analysis ● Acid-base titrations ● Oxidation-reduction titrimetry	1
CHEMISTRY-GE-101	Unit II: Chemical Bonding and Molecular Structure	16	● Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. [3] ● Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. [2] ● Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. [2] ● Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. [3] ● Concept of resonance and resonating structures in various inorganic and organic compounds. [2] ● MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p	2

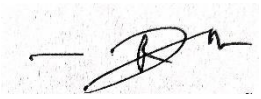
			combinations of atomic orbitals, nonbonding combination of orbitals [2] ● MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches. [2]	
CHEMISTRY-GE-101-LAB	Inorganic Chemistry	30	● Inorganic Volumetric Analysis [30]	1
Inorganic Chemistry-I **MM-301**	UNIT – I: Coordination compounds	30	● Types of ligands: monodentate, bidentate, ambidntate, polydentate and macro cyclic ligand. [4] ● Nomenclature of complex compounds, Isomerism in 4- and 6-coordinate compounds. Inner complex and chelates. [4] ● Effective atomic number rule, VB, crystal field, MO and introduction to ligand field theories and their applications. [6] ● Spectroscopic terms, RS coupling, Mullikan's symbol (A, B, E, T). [4] ● Spectrochemical and naphelauxetic series, electronic spectra of simple T_d and O_h complexes [4] ● Selection rules and Orgel diagram (d^1 to d^9 system). [4] ● Magnetic properties: Paramagnetism, diamagnetism, magnetic properties of octahedral complexes, Antiferromagnetism. [4]	2
MM-302	Inorganic Lab	26	● Inorganic Qualitative analysis	2
MM-503	UNIT –I: Organometallic compounds	12	● Definition, electron count, 18 electron rule, isolobal analogy [2] ● Structure and bonding in some Organometallic compounds (Metal –Olefins compound, metal – ligand sigma-bonded compounds, ferrocene). [3] ● Oxidative addition and reductive elimination reaction. [2] ● Uses of some organometallic compounds in catalysis (Wilkinson's catalyst, Vaska's compound and $HCo(CO)_4$) [3] ● Metal carbonyls: Structure, bonding and IR spectral studies of terminal and bridged carbonyls. [2]	2
	UNIT – II: Transition metal clusters	10	● Definition of cluster, metal – metal bond in cluster, synthesis of metal carbonyl cluster of Cr, Fe and Mo (only low nuclearity clusters up to 4 metal atoms). [3]	2

			● Closed shell electronic requirement for cluster compounds –rules for Polyhedral Skeletal Electron Pair Theory. [3] ● Nitrosyl compounds: Synthesis, properties and structures of nitrosyls of Fe, Co and Ni [4]	
MM-504	Inorganic Lab.	16	● Volumetric titrations ● Estimation of total hardness of water samples	1
MM-508	Inorganic Lab.	18	● Quantitative analysis	1

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester, 2020

Subject: CHEMISTRY
Name of the Teacher: Mr. RANJIT DUTTA
Methods to be applied: Lecture, analytical and activity method, Group Work, Assessment for Learning, Assignments and Exercises, Group Activities and Discussions and Assessments.
Teaching Materials: White Board, Marker, Duster, text books, lectures, etc.

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Classes required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
MM-603	UNIT – III: Chromatographic Methods	10	● Paper, Thin layer, Column [3] ● Gas chromatography – separation of compounds, development and R_f values. [4] ● HPLC – principle only [3]	1
MM-604	Inorganic Lab.	18	● Inorganic preparation & Crystallization	1



Signature of Faculty

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Odd semester 2019

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

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
MM 501	Unit I –Chemical Kinetics	15	● Molecularity and order of reactions, elementary and complex reactions rate laws [3] ● differential and integral forms of rate equations of zero,1st,	4

			2nd order reactions, half life periods of 1st and 2nd order reactions, [5] ● first order, opposite, parallel, consecutive reaction, chain reactions, chain branching, explosion limit, hydrogen – bromine thermal reaction Arrhenius equation, energy of activation, collision theory of bimolecular reactions, its limitation, [6] ● activated complex theory, Eyring equation, Lindeman's theory of unimolecular gas phase reaction [5]	
MM 502 Physical Lab	Physical Chemistry Practical	28	● pH metric titrations of (i) Strong acid and strong base (ii) Weak acid and strong base max values ● To determine the concentration of an optically active substance by polarimetric methodconcentration of KMnO4 ● To determine the specific reaction rate of hydrolysis of methyl acetate catalyzed by hydrogen ion concentration at room temperature ● Conductometric titration of (i) Strong acid and strong base (ii) Strong acid and weak base ● Viva Voce [2]	5

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester 2020

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

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Class Required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
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] ● Gibbs-Helmholtz equation; Maxwell relations [5]	4

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
MM 401	UNIT: II 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
	Unit I – Chemical Thermodynamics II	15	• Second law of thermodynamics, Carnot's theorem, Carnot cycle, efficiency of heat engines, thermodynamic scale of temperature [3]	3

			• concept of entropy, entropy change in a cyclic, reversible, irreversible processes [2] • Helmholtz free energy (A) and Gibb's free energy (G), variation of A and G with P,V,T, criteria for spontaneity and equilibrium [5] • Determination of absolute entropies of pure substance [2]	
MM 402 Physical Lab	Physical Chemistry Practical	16	1) To determine the coefficient of viscosity of solutions by Ostwald viscometer [3] 2) To determine the surface tension of solutions by Stalagmometer. [2] 3) Potentiometric titrations (i) Strong acid- strong base (ii) Weak acid-strong base [5]	4
NM 401 Physical Chemistry-I	Unit –I : Solution	6	• Types of solutions, concentration units, Solution of gases in liquids-Henry's law. [2] • Solution of liquids in liquids-Ideal solution-Raoult's law- Non ideal solution. Distillation of solutions [2] • Partial miscibility of liquids. Critical solution temperature. Solutions of solids in liquids, the solubility curves. Immiscibility of liquids [2] • Principle of steam distillation. The Nernst distribution law and its applications. Solvent extraction [2]	3
	UNIT: III Chemical Kinetics	8	• Elementary and complex reaction. Rate of a reaction , Order and molecularity of a reaction. Examples of first, second and zero order reactions [2] • Differential and integral forms of zero order, first order, second order rate equation. Half life period of zero order, first order and second order reaction [4] • determination of order of a reaction by method of half life period and isolation method [2] • Conceptof activation energy and its calculation from Arrhenius equation [1]	2

NM 402 Physical Lab	Physical Chemistry Practical	12	Surface Tension measurement a) Surface tension of Solutions by stalagmometer b) Study of the variation of surface tension of a detergent solution with concentration. [8] 2) Viscosity measurement a) Viscosity of solution by Ostwald's viscometer.[4]	2
MM 601	Unit II- Macromolecules	15	• Step reaction polymerization, degree of polymerization, addition polymerization, free radical polymerization, anionic [5] • anionic, cationic polymerization [2] • carother equation, Zeigler Natta catalysts, Co-polymerisation [4]	4
	Unit V -Statistical Thermodynamics	13	• tatistical methods (Basic ideas)- Boltzmann method (or Maxwell- Boltzmann statistics) [3] • BoseEinstein statistics, Fermi Dirac statistics, [2] • Stirling approximation, Boltzmann distribution law, Partition function, Total molecular partition function [5] • relationship between molar partition function and molecular partition function, expression for thermodynamic function in terms of molar partition function [3] • rotational and vibrational partition functions [2]	
MM 602 Physical Lab	Physical Chemistry Experiment		• To study the rate constant of hydrolysis of sucrose by polarimeter [2] • To study the distribution of iodine between CCl4 and water. [3] • To obtain Freundlich isotherm for adsorption of oxalic acid on activated charcoal [2]	
MM 608	Project Work	48	• Project Work [48]	6

Signature of Faculty

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Odd semester 2019

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

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Class required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
CHEMISTRY GE-101	Unit IV: Stereochemistry	11	● Conformation with respect to ethane, butane and cyclohexane[1]. ● Interconversion of projection formula[2] ● Concept of chirality[1] ● Configuration: Geometrical[2] ● Optical isomerism; Enantiomerism Diastereomerism and Meso Compounds[2] ● Threo and erythro; D and L; Cis-trans nomenclature[1] ● CIP Rules: R/S and E/Z Nomenclature[2]	4
	Unit V: Aliphatic Hydrocarbons	8	● Alkanes: Preparation: and Reactions[2] ● Alkenes: Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule)[4] ● Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of	3

			HX(Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis[4]	
CHEMISTRY GE-101-LAB	Organic Chemistry practical	18	Section B: Organic Chemistry ● Detection of characterized element (N, S, Cl, Br, I) in an organic compound ● Separation of mixtures by Chromatography ● Viva [2]	4

Organic Chemistry-1 MM 303	Unit-I Chemistry of Halogenated Hydrocarbons	11	Alkyl halides ● Methods of preparation including Hunsdiecker reaction from silver or lead (IV) salts of carboxylic Acid)[1] ● Nucleophilic substitution reactions: SN1, SN2, and SNi. Nucleophilic substitution vs elimination. Haloform reaction[2] ● Aryl halides: Preparation from diazonium salts[1] ● Nucleophilic Aromatic Substitution SNAr, Benzyne intermediates[2] ● Relative reactivity of alkyl, allyl /aenzyl, vinyl and aryl halides towards nucleophilic substitution reactions[2] Organometallic Compounds: ● Mg and Li - Use in synthesis of organic compounds[3]	3
	Unit-III Carbonyl Compounds: Aldehydes and ketones (aliphatic and aromatic)	16	● Structure, Preparation and Reactions Relative reactivity of aldehydes, ketones,Nucleophilic addition reactions[2] ● Mechanism of Aldol, Benzoin, Stobbe, Darzen glycidic ester condensation, Perkin, Cannizzaro reaction. Beckmann and Benzil-Benzilic acid rearrangement, substitution, oxidation and reduction (Clemmensen, Wolf-Kishner and M P V reduction)[12]	4

			● Addition reactions of unsaturated carbonyl Compound: Michal addition. Unsaturated aldehydes (Acrolein, Crotonaldehyde, Cinnamaldehyde) Unsaturated ketone (MVK).[4]	
Organic Chemistry-II MM 304 LAB	Organic Chemistry practical	18	● A) Organic Qualitative analysis : Detection of elements (N, S and X) and functional groups; Determination of m.p., preparation of the derivative and determination of m.p. of the derivative and structure of the compounds and complete identification.[12] ● Organic preparation [4] ● Viva Voce [2]	6
Organic Chemistry-I NM 301	Unit-I:Aliphatic Hydrocarbons:Alkenes & Alkynes	12	● Alkenes (upto 5 carbons) Preparation[2] ● Elimination reaction- Mechanism of E1, E2, E1cB[3] ● Reactions of alkene[4] ● Alkynes (up-to 5 carbons) Preparations[1] ● Reactionsof alkyne[12	4
	Unit-II: Aromatic Hydrocarbons	8	● Preparation (only benzene) from phenol by decarboxylation, from acetylene, from benzene sulphonic acid[2] ● Reactions- Electrophitic substitution in benzene- nitration, halogenations, sulphonation, Fridel-Craft alkylation and acylation with mechanism[6]	2
	Unit – III Alkyl and Aryl halides	15	● Nucleophilic Substitution Reactions (SN2, SN1, & SNi)[4] ● Preparation: from alkenes and alcohols[1] ● Reactions[2] ● Elimination vs Substitution[1]	3

			● Aryl halides Preparation (chloro, bromo, iodo benzene only): From phenol, Sandmeyer & Gattermann reaction[2] ● Reactions of chlorobenzene[2] ● Reactivity and relative strength of carbon-halogen bond in alkyl, allyl, benzyl and vinyl and Aryl halide[3]	
Organic Chemistry NM 302-Lab	Organic Chemistry practical	16	a) Organic Qualitative analysis[12] b) Purification of Organic Compounds by crystallization (from water and alcohol) and distillation.[2] Viva[2]	4
Organic Chemistry-III MM 505	Unit-I Pericyclic reactions:	12	● Definition. The conservation of orbital symmetry, Woodward-Hofmann Rules, HOMO-LUMO approach.[3] ● Cyclo addition reactions: (2+2) and (2+4) cycloadditions[2] ● Diels Alder Reaction, 1,3- dipolar cycloaddition[1] ● Sigma tropic rearrangements -Cope and Claisen rearrangement[3] ● Electrocyclic reactions[3]	4
	Unit-II Bio-molecules	12	● Carbohydrates- Occurrence, classification and biological importance[1] ● General properties of glucose and fructose (open and cyclic structure)[1] ● Monosaccharides: Constitution and absolute configuration of glucose and fructose[4] ● Epimerization, Mutarotation[1] ● Determination of ring size of glucose. Haworth projections and conformational structures[2]	4

			• Ascending and descending in monosaccharides, Interconversions of Aldoses and Ketoses[3]	
	Unit-III Nucleic acids & Enzymes	10	• Components of Nucleic acids, Nucleosides and Nucleotides. Structure Synthesis and Reactions of Adenine, Guanine, Cytosine, Uracil & Thymine. Polynucleotides: Structure of DNA and RNA, Genetic code. Biological roles of DNA and RNA, Replication. Transcription and Translation [6] • Enzymes and their functions as catalyst – Classification- Active site, Specificity, Mechanism of Enzyme action, Co-enzyme, Application of Enzymes[4]	2
	Unit-IV Pharmaceutical compounds: Structure and Importance	12	• Introduction to natural and synthetic medicinal compounds: Azadirachtin (neem), Curcumin(haldi), Vitamin C- their medicinal values, Drug action[3] • Classification, structure, preparation and therapeutic uses of Antipyretics: Paracetamol[2] • Analgesic: Aspirin, Ibuprofens[2] • Antimalerials: Chloroquine[1] • Antacids: Ranitidine[1] • Antibacterial: povidone –Iodine solutions[1] • Sulphanilamide and other sulphadrugs[1] • An elementary treatment of Antibiotics and detailed study of chloramphenicol[12]	2
	Unit-V Terpenes	7	• Occurrence, classification Isoprene Rule[2] • Elucidations of structure and synthesis of Citral, Neral and α-Terpineol[5]	1
Organic ChemistryMM 506-LAB	Organic Chemistry practical	8	Organic Quantitative analysis • Determination amount of glucose by titration with Fehling's solution[2]	4

			● ii) Determination of equivalent mass of an acid by direct titration method[1] ● Determination of glycine by formal titration [1] Food Analysis [2] Viva [2]	

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester 2020

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.

Paper Code/Title	Allotted Unit/ Topic	No. of Class required	Detail of the topics to be taught & class required	No. of tutorials
Organic Chemistry C-201	Unit II: Stereochemistry	16	● Definition and classification of stereoisomers [1] ● Representation of organic molecules in two & three dimensions[2] ● Geometrical isomerism: Physical & Chemical properties of Geometrical isomers [2] ● Cis–trans and, syn-anti isomerism, E/Z notations with C.I.P rules[2] ● Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers[2] ● Diastereoisomers, meso structures & Epimers[2] ● Racemic mixture and resolution, Threo & Erythro forms, Relative and absolute configuration[2] ● D/L and R/S designations[3]	4

	Unit III: Chemistry of Aliphatic Hydrocarbons	4 14	A. Carbon-Carbon sigma bond ● Chemistry of alkanes: Formation and Reactions [2] ● Halogenation -relative reactivity and selectivity[2] B. Carbon-Carbon pi bonds: ● Formation of alkenes and alkynes by elimination reactions[2] ● Mechanism of E1, E2, E1cb ● reactions of alkene [8] ● 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction[2] ● Allylic and benzylic bromination and mechanism[1] ● Reactions of alkynes[1]	1 6
Organic Chemistry C2 -Lab	Organic Chemistry Practical	12	● Purification of organic compounds by crystallization using the following solvents[3] ● Determination of the melting points of above compounds and unknown organic compounds [3] ● Chromatography[4] ● Viva[2]	4
Chemistry GE-201	Section B: Organic Chemistry Unit IV: Aromatic Hydrocarbons	8	● Preparation and Reactions of aromatic hydrocarbons (Case benzene)[6] ● Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene)[2]	2
	Unit V: Alkyl and Aryl Halides	8	● Alkyl Halides: (Up to 5 Carbons) preparation[1] ● Nucleophilic Substitution (SN1, SN2 and SNi)[2] ● Reactions of alkyl halides[1] ● Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case) and Aromatic nucleophilic substitution reaction[2]	4

			• Benzyne Mechanism[1] • Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides[1]	
Chemistry GE-201 -Lab	Section B: Organic Chemistry:	10	• Purification of organic compounds by crystallization (from water and alcohol) and distillation[3] • Criteria of Purity: Determination of melting and boiling points[2] • Preparations of organic compounds[3] • Viva[2]	4
Organic Chemistry MM-403	Unit-I: Active Methylene Compounds:	8	• Keto-enol tautomerism[1] • Preparation and properties of Aceto • acetic ester and diethyl malonate. Knoevenagel Condensation[7]	2
	Unit-III: Amino acids and proteins	12	• Amino Acids and their classification[2] • Synthesis and Ionic properties, Reactions, Zwitter ions, pka values, isoelectric point & electrophoresis[3] • Study of peptides: Determination of their primary structure: end group analysis[2] • Principles of peptide synthesis[2] • Proteins: classification and biological importance and structure of proteins[3]	4
	Unit – V Heterocyclic Compounds	10	• Classification, Nomenclature and structure. Aromaticity in 5-membered and 6-membered rings containing one heteroatom[3] • Synthesis, reactions, properties of furan, pyrrole (Paal-knorr synthesis), thiophene, pyridine (Hantzsch synthesis), quinoline (Skraup synthesis, Knorr quinoline synthesis, Pfitzinger reaction) and isoquinoline (Bischler-Napieralski reaction)[7]	4
Organic Chemistry MM--402-LAB	Organic Chemistry Practical	8	• Chromatographic separation of the following mixtures and calculation of Rf value of the compounds[6] • Viva[2]	2

Organic Chemistry MM-605	Unit-I Disconnection approach in organic synthesis	10	● Elementary idea about disconnection[1] ● Simple examples of reaction leading to C-C bond formation (Corey-House, Wittig & aldol condensation), Retrosynthesis of monofunctionalised compounds[9]	4
	Unit II: 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] ● Interpretation of NMR spectra of simple compounds[2] ● Applications of IR, UV, NMR and Mass for identification of simple organicmolecules[8]	2
	Unit-III : Lipids	8	● Classification of Oils and Fats[1] ● Structure, properties and biological importance of triglycerides and phosphoglycerides[3] ● Change of flavor of oils, Reversion and Rancidity[2] ● Saponification value and Iodine number[2]	2
	Unit IV: 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
Organic Chemistry-MM-606-LAB	Organic Chemistry Practical	16	● Two step organic preparations (monitoring by TLC)	3
Molecular spectroscopy	Unit V Spin resonance spectroscopy	12	● Principle of NMR, chemical shift and low resolutions spectra, different scales[4] ● spin-spin coupling and high resolution spectra[2] ● Interpretation of PMR spectra of ethanol, 1- and 2-chloropropane, acetaldehyde, cyanohydrin and 1,2 & 1,3-dichloropropane[2]	4

			● Electron spin resonance (ESR) spectroscopy and its principle, hyperfine structure, ESR of simple free radicals, and copper (II) compounds[4]	
CHEMISTRY-MM-608	Dissertation (*Project Work*)	30	● Project Work [30]	2
Chemistry NM-601	UNIT -I Active Methylene Compounds	6	● Synthesis of ethylacetoacetate (Claisen ester condensation)[3] ● Diethylmalonate .Synthetic uses of ethylacetoacetate and diethylmalonate,Keto – enol Tautomerism[3]	2
	Unit-III- Preparation, properties and reaction of the Heterocyclic compounds & Polynuclear Hydrocarbon	10	Preparation, properties and reaction of the following Organic Compounds ● Aromatic Sulphonic acids- Benzene sulphonic acid, nitro sulphonic acid, amino sulphonic acid, sulphuryl chloride, saccharin, chloramines-T[2] ● Aromatic nitro compounds- Nitrobenzene, Dinitrobenzene, Nitro toluene, TNT, Reduction of nitro compounds in different conditions[2] ● Heterocyclic compounds- preparation and properties of five and six membered heterocyclic compounds: pyrrole, thiophene, furan, pyridine[3] ● Polynuclear Hydrocarbon : preparation and properties of Naphthalene and anthracene[3]	2
	Unit – IV : Aliphatic & aromatic carbonyl compounds	12	Study of the following reactions (Mechanisms are not required) – Rosenmund reduction, ● Stephen's reduction, Aldol condensation, Claisen condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemmensen reduction and Wolf Kishner reduction, Meerwein– Pondorf – Verley reduction and Haloform reaction[7] ● Aromatic aldehydes & Ketones – Preparation and reactions, Benzaldehyde, Salicyladehyde,	2

			Cinnamaldehyde, acetophenone, benzophenone[5]	
	Unit – V Organic Chemistry of life	12	• Carbohydrates : Classification and General properties[2] • Amino Acids: classification, preparation and properties Glycine, Alanine and Phenylalanine (Strecker synthesis and Gabriel phthalimide method)[2] • Reactions of amino acids[2] • Elementary ideas of peptides and proteins[2] • Elementary ideas of nucleoside, nucleotide, nucleic acid (DNA, RNA)[2] • Elementary ideas of enzyme and co-enzyme, lipids and fatty acids[2]	4
Chemistry practical NM-602-Lab	A: Organic Lab	8	• Organic preparation[4] • Separation of mixtures by chromatography: Separation, identification and determination of Rf values of the components of a given mixture of two amino acids by paper chromatography[2] • Viva[2]	2

(Signature)

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.

Session: Odd semester 2019

Subject: CHEMISTRY
Name of the Teacher: Mr. Rituraj Tahu
Methods to be applied: Lecture, practical demonstration, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Book, Journal, Laptop, Projector, Pointer, etc

Paper Code/Title	Allotted Unit/ Topic	No. of Class required	Detail of the topics to be taught & class required	No. of tutorials
CHEMISTRY MM 303	Unit II: Chemistry of C-O Bond Trihydric alcohol Other aromatic Hydroxy compounds Ethers and Epoxides	14	● Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3° alcohols. Bouvealt Blance Reduction and Baeyer-Villiger Oxidation Preparation and properties of Glycol: Oxidation by OsO4, alkaline, KMnO4, periodic acid and lead tetracetate. Pinacol Pinacolone rearrangement with mechanism. [4] ● Trihydric alcohol: Glycerol: preparation & properties. Phenols: Preparation and properties:- acidity-comparison with alcohol. Substitution reaction, Reimer- Tiemann and Kolbe-Schmidt reaction, Fries rearrangement with mechanism. [4] ● Other aromatic Hydroxy compounds: Cresol, nitrophenols, picric acid, benzyl alcohol, dihydric phenols. Ethers and Epoxides: Preparation and reactions with acids. [4]	4
	Unit IV: Carboxylic Acids and their Derivatives:	10	● Preparation and properties and reactions of, monocarboxylic acids: effect of substituent on acidity, HVZ reaction and Schmidt reaction. [2] ● Typical reactions and uses of dicarboxylic acids, Hydroxy acids,Unsaturated acids-: Succinic,phthalic, lactic, malic,	7

			tartaric, citric, maleic and fumaric acids. [2] ● Preparation and reactions of acid chlorides, anhydrides, esters, amides: Mechanism of acidic and alkaline hydrolysis of esters. [3] ● Claisen Ester Condensation, Dieckmann and Reformatsky Reaction, Hofmann bromamide degradation, Curtius rearrangement. [3]	
CHEMISTRY MM304-Organic lab	Organic Chemistry practical	18	A) Organic Qualitative analysis B) Organic preparation	3
CHEMISTRY MM 507	Unit – I: Symmetry and Group theory	18	● Symmetry elements and symmetry operations. Definition of group, symmetry group, point group and space group. [6] ● Perspective sketch and point group of some common molecules (H2, HF, CO2, C2H2, C2H4, CHCl3, PCl5, NH3, BF3, [PtCl4]2-, BrF5), symmetry and mathematical tools, matrix algebra, reducible and irreducible representation, great orthogonality theorem (deduction not [8] ● Character table for C2v and C3v point groups, Determination of i for C2v and C3v point groups [4]	8
	Unit – II :Quantum Chemistry and Chemical Bonding	25	● Black body radiation – Planck's hypothesis, photoelectric effect, de Broglie hypothesis andHeisenberg's uncertainty principle. Postulates of quantum mechanics, quantum mechanical operators. [5] ● Normalization of wave functions-expectation values. Interpretation of the wave function – orthogonal and ortho normal wave functions. Schrodinger equation and its application to a particle in a box (vigorous treatment one and three dimensional boxes) energy levels, wave functions, probability	8

			distribution functions. Nodal properties, degeneracy. [5] ● Qualitative treatment of (i) rigid rotator (ii) harmonic oscillator and (iii) hydrogen atom - Schrodinger equation for hydrogen atom: energy levels and quantum numbers, the radial and angular part of wave functions, two dimensional plots of probability density. [5] ● The hydrogen like wave functions –Stern Gerlach experiment, electron spin and spin quantum numbers, Pauli's exclusion principle – illustration by He atom.[5]	
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- NM 301	Unit – IV Alcohols, phenols and ether:	14	• Alcohol: Preparation of 1, 2 and 3 alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehyde, ketones, carboxylic acid and ester, amines. [3] • Reactions – With sodium, HX (Lucas test), esterification, Oxidation (alk. KMnO4, acidic dichromate, conc. HNO3) Oppenaur oxidation. [3] • Glycol - Oxidation of glycol, pinacol - pinacolone rearrangement. Glycerol : Preparation & reactions. [2] • Phenols- Preparation- cumene hydroperoxide method, from diazonium salts Reactions – Electrophilic substitution-Nitration, halogenation.[2] • Sulphonation, Reimer–Tiemann Reaction, Gattermann-Koch reaction, Houben-Hoesch reaction, Schotten-Baumann Reaction (Mechanisms are not required) [2] • Preparation, properties and reactions of other aromatic hydroxyl compounds-nitrophenols, Picric acid, amino phenols, benzyl alcohol.[2]	3
	Unit –VI Amines and Diazonium Salts	6	• Amines (Aliphatic & Aromatic) Preparation – from alkyl halides, Gabriel's phthalimide [2] • synthesis, Hofmann Bromamide reaction. Reactions: Carbylamine test, Hinsberg test, with HNO2, Electrophilic substitution (in case of aniline) –nitration, bromination, sulphonation. [2] • Diazonium Salts – Preparation from aromatic amines. Synthetic uses of benzene diazonium chloride including preparation of dyes.[2]	3
Organic Chemistry NM 302-Lab	Organic Chemistry practical	16	a) Organic Qualitative analysis[12] b) Purification of Organic Compounds by crystallization (from water and alcohol) and distillation.[2] Viva[2]	4

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester 2020

Subject: CHEMISTRY
Name of the Teacher: Mr. Rituraj Tahu
Methods to be applied: Lecture, practical demonstration, interaction and discussion.
Teaching Materials: White Board, Marker Pen, Duster, Book, Journal, Laptop, Projector, Pointer.

Paper Code/Title	Allotted Unit/ Topic	No. of Class required	Detail of the topics to be taught & class required	No. of tutorials
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	4

			Controlled & Thermodynamically 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]	2

			• Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC) [1] • Viva [2]	
CHEMISTRY-MM-403	Unit II: Nitrogen Containing Functional Groups	8	• Effect of substituent and solvent on basicity. Preparation and properties: Gabriel Phthalimide synthesis and Hoffmann bromamide degradation, carbylamines reaction [2] • Mannich Reaction, Hoffmann's Exhaustive methylation, Hoffmann-Elimination Reaction. Distinction between 1, 2 and 3 amines with Hinesburg reagent and nitrous acid. [2] • Nitro and nitroso compounds, Nitriles and isoritriles, cyanates and isocyanates: Preparation and important reactions. Diazomethane and diazoacetic ester with synthetic application. [2] • Diazonium salts: Preparation and their synthetic applications. [2]	2
	Unit IV: Alkaloids	5	• 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 [3]	
Organic Chemistry MM--402-LAB	Organic Chemistry Practical	8	• Chromatographic separation of the following mixtures and calculation of Rf value of the compounds[6] • Viva[2]	Organic Chemistry MM--402-LAB
CHEMISTRY-MM 605	Unit-II UV-visible Spectroscopy IR Spectroscopy	10	• Application of Woodward rules for calculation of λmax for the following system: α,β-unsaturated aldehydes, ketones. [5] • Application in functional group analysis.	4

	Unit V: Polymers	8	● Types of polymers- Isotactic, syndiotactic and atactic polymers. Preparation and applications of plastics- [3] ● Thermo-setting (Urea–formaldehyde, Phenol-formaldehyde, polyurethanes and thermo softening (PVC, Polythene) polymer additives.[2] ● Synthetic fibers: Rayon, Nylon-6, terylene, Fabrics- natural and synthetic (acrylic, polyamido, polyester) Rubbers-natural and synthetic: Buna-S, chloroprene and neoprene, vulcanization[3]	4
Organic Chemistry- MM-606-LAB	Organic Chemistry Practical	16	● Two step organic preparations (monitoring by TLC)	3
MM 607	Unit-III Infrared and Raman spectroscopy	18	● Classical equation of vibration, vibrational energies of diatomic molecules, zero point energy, Concepts of normal vibration, force constant, effect of isotopic substitution, vibrational frequency, Fundamental frequencies [5] ● overtones, hot bands, degree of freedom of polyatomic molecules, and concept of group frequencies [5] ● Raman Effect, Polarizability tensor, Stokes and antistokes lines, structure elucidation by Raman spectroscopy (AB, A2B, and AB3), stretching frequencies of bonds and functional groups (Example from both organic and inorganic molecules). [8]	6
	Unit IV Electronic spectroscopy	7	● The Beer – Lambert Law, molar absorption coefficient, selection rules for electronic transitions, vibrational structures [4] ● Franck-Condon principle, chromophores, auxochromes, bathochromic and hypsochromic shift.[3]	3
CHEMISTRY-MM-608	Dissertation	30	● Project Work [30]	2

	(*Project Work*)			
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

Rituraj Tahu

Signature of the faculty

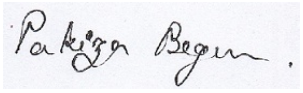
GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester, 2020

Subject: CHEMISTRY
Name of the Teacher: DR. PAKIZA BEGUM
Methods to be applied: Lecture, Group Work, Flipped Classroom, Problem-Based Learning, Experiential Learning, Assessment for Learning, Assignments and Exercises, Group Activities and Discussions, Feedback and Assessments.
Teaching Materials: White Board, Marker, Duster, Laptop, Projector, text books, multimedia, applications, software, digital learning resources including video, audio, text, websites, animations and images, lectures, Online Resources etc.

Paper Code/Title	**Allotted Unit/ Topic**	**No. of Class required**	**Detail of the topics to be taught & class required**	**No. of tutorials**
CHEMISTRY-C-202	Unit III: Chemical Equilibrium	8	● Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. [2] ● Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. [1] ● Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. [2] ● Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x. [1] ● Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase. [2]	3
	Unit IV: Solutions and	8	● Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. [2]	3

	Colligative Properties		● Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. [4] ● Applications in calculating molar masses of normal, dissociated and associated solutes in solution. [2]	
MM-401	UINT-III: Electrochemical cells	20	● Quantitative aspects of Faraday's laws of electrolysis, concept of oxidation/reduction of half-cell potentials [3] ● Application of electrolysis in metallurgy and industry, electrolytic and galvanic Cells [2] ● E.M.F of a cell and its measurement, free energy, entropy and enthalpy of cell reactions [3] ● Nernst equation, standard electrode potential [2] ● Types of electrodes- Hydrogen, calomel, quinhydron and glass electrodes. [2] ● Concentration cell with and without transference-liquid junction potential [2] ● pH determination using hydrogen, SbO/Sb2O3 electrode, glass, quinhydrone electrodes, potentiometric titration (acid, base and redox) [3] ● storage cells- Lead storage cell, mechanism of charging and discharging, fuel cells-hydrogen-oxygen cell. [3]	2
MM-603	UNIT – I: Bio inorganic Chemistry	15	● Metal ion in biological system, role of alkali and alkaline earth metals, iron, copper, cobalt, zinc and molybdenum. [4] ● Metalloprotein and metalloenzymes, hemoglobin, myoglobin, plastocyanin, vitamin B_{12}, carbonic anhydrase and nitrogenase. [6] ● Metal ion in medicine -- cisplatin and carboplatin. [3] ● Use of EDTA in chelation therapy. [2]	1
	UNIT-II: Introduction	10	● Idea about supra molecular interaction. [2]	2

	to material chemistry		● Solid state reactions. [2] ● Nano materials – synthesis and characterization. [3] ● C – C composite, polymer and nanocomposite. [1] ● Introduction of chemistry of clay (Kaolinite, Montmorillonite and Laponite) [2]	
	UNIT IV: Industrial chemistry	12	● Industrial water treatment: Demineralized (DM) water and effluent treatment. [2] ● Cement and ceramics: Various types of cements, their composition, manufacture [3] ● Paints: Constituents, role of binder and solvent, lead and zinc containing paints. [4] ● Introduction to Chemical Toxicology: Metal poisoning due to Pb, Cd and Hg, hazard from radioactive fallout [3]	2
MM-604	Inorganic Lab.	18	● Inorganic preparation & Crystallization	1



Signature of Faculty