SRI RAMAKRISHNA MISSION VIDYALAYA COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS), COIMBATORE - 641 020

Name of the Programme: B.Sc Chemistry **Month &Year of Revision:**May 2020

S.No.	Course Title	Course Code	% of Revision
1	Core: General Chemistry - I	20UCH1C01	75
2	Core: General Chemistry - II	20UCH1C02	35
3	Core: General Chemistry - III	20UCH2C03	55
4	Core: General Chemistry - IV	20UCH2C04	100
5	Core: Inorganic, Organic and Analytical Chemistry	20UCH3C05	70
6	Core: Physical, Organic and Analytical Chemistry	20UCH3C06	30%
7	Core: Coordination Chemistry	20UCH5C07	35%
8	Core: Organic Chemistry	20UCH5C08	35%
9	Core: Electrochemistry	20UCH5C09	25%
10	Elective: Industrial Chemistry	20UCH5EA1	100%
11	Elective: Environmental Chemistry	20UCH5EB1	100%
12	Elective: Polymer Chemistry	20UCH5EC1	100%
13	Core: Inorganic Chemistry	20UCH6C12	20%
14	Core: Stereochemistry, Free radicals, and biomolecules	20UCH6C13	50%
15	Core: Physical Chemistry	20UCH6C14	20%
16	Elective: Dye Chemistry	20UCH6EA2	100%
17	Elective: Bio Chemistry	20UCH6EB2	100%
18	Elective: Introduction to Nanochemistry& Applications	20UCH6EC2	100%
19	Elective Practical: Industrial Chemical Analysis	20UCH6CP4	20%
20	Modular Course: Chemistry for Entrepreneurship	20UCH6MC1	100%

Note:

No.of Courses offered by the Department (A)	33

No.of Courses revised in BoS (>20% Revision) (B)	20
Formula for Syllabus revision: (B/A)*100	**60.06%**

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
General Chemistry-I	20UCH1C01	**I**	Rutherford's nuclear model of atom- Experiment, postulates and objections. Black body Radiation, Planck's quantum theory of radiation, Photoelectric effect with Einstein's explanation and Compton effect. Bohr'smodel of the atom-postulates, calculation of radius of Bohr's orbits, velocity of electron and energy of electron, significance of negative value of energy of electron. Bohr's Explanation of hydrogen spectrum, Sommerfiled's extension of Bohr's theory and shortcomings of Bohr's Theory.	**Basic mathematical concepts:** Basic SI and derived units, inter conversion of units, significant figures, scientific notation, exponential numbers and logarithms. Basic idea on differential and integral calculus. Graph plotting - slopes, maxima and minima. **Basic Chemical concepts**: Mole calculations. Concentration terms. Equivalent weight – acid, base, salt, ions and oxidising - reducing agents, principle of volumetric analysis. ***Self-study:*** *Differential and integral calculus applications in chemistry. Applications of mole concept*	**(20%)**
		II	Wave mechanical model - derivation of de Broglie's equation, verification by Davisson and Germer experiment. Schrodinger wave equation- derivation, application to hydrogen atom, physical significance of Ψ and Ψ^2. Charge cloud concept and shapes of s, p, d and f orbitals. Origin, description and salient features of quantum numbers (n, l and m). Zeeman effect and spin quantum number. Pauli's exclusion principle and Hund's rule, aufbau principle, (n + l) rule, stability of half-filled and completely filled orbitals	**Classification and Nomenclature of organic compounds:** Homologous series and its characteristics, functional groups. Systems of naming organic compounds- trivial, derived and IUPAC rules. IUPAC system of nomenclature of aliphatic hydrocarbons with mono and poly functional groups, alicyclic, bicyclic, spiro and aromatic compounds. ***Self-study:*** *IUPAC naming of hydrocarbons in petrochemistry and hydrocarbons containing*	**Reshuffled to Unit I of 20UCH2C03** **(10%)**

				both double and triple bonds.	
		III	Description of the latest IUPAC periodic table, periodicity and periodic properties- Atomic radii- covalent radii, multiple bond radii, hybridisation and atomic radius, variation of atomic radius along period and group,ionic radii- size of cation and anion, comparison with neutral atom, isoelectronic ions, variation of ionic radius along a group and a period. Ionisation energy -first and successive, factors governing, variation along groups and II period. Electron affinity-factors governing, variation along periods and halogen group. Electronegativity – variation along a period and group, Mulliken -Jaffee concept- oxidation state, hybridization, charge and bond order.	**Electronic effects and reaction intermediates:** Polar, non-polar molecules, electron donating and withdrawing groups. Polar effects- inductive, mesomeric, electromeric, resonance, hyperconjugation and steric effects. Homolytic and heterolytic fission. Reactive intermediates- Carbocations, carbanions, free radicals and their structures and stabilities. Carbenes, Nitrenes and benzyne (electronic structure only). ***Self-study:*** a) *Influence of polar effect on the strength of organic acid and bases.* b) *Comparison of stability of reaction intermediates*	(5%)
		IV	Classification of organic compounds, functional group, homologous series. Systems of naming organic compounds- trivial, derived and IUPAC. Rules of IUPAC system of nomenclature of acyclic compounds, IUPAC system of nomenclature of complex organic compounds- aliphatic hydrocarbons, with mono and poly functional groups. Polar, non-polar molecules, electron donating and withdrawing groups. Polar	**Laboratory hygiene and safety:** Storage and handling of chemicals-corrosive, inflammable, explosive, toxic, poisonous and carcinogenic chemicals. First aid procedures for laboratory accidents involving toxic and poisonous chemicals, electrical shock, cuts and burns from hot objects. Filtration, Heating and stirring techniques. **Handling of Glassware:** Cleaning agents and cleansing methods. Interchangeable glass ground joint apparatus and their advantages.	(20%)

			effects-inductive, mesomeric, electromeric and hyperconjugation. Homolytic and heterolytic fission- free radicals, carbocations, carbanions and their structures and stabilities. Electrophiles and nucleophiles.	Calibration and grading of pipette, burette and volumetric flask. Effect of temperature on volumetric glassware. ***Self-study:*** *Weighing principle in chemical balance and single pan balance.*	
		V	Alkanes- preparation of alkanes by direct reduction of alkyl halides, Sabatier-Senderens reaction, Wurtz reaction, decarboxylation and Kolbes electrolysis. Relationship between structure and physical properties. Chemical properties of alkanes- isomerisation, aromatization, pyrolysis, combustion, controlled oxidation, nitration, sulphonation, halogenation with relative reactivities of halogens. Alkenes-general methods of preparation of alkenes- dehydrohalogenation, dehydration of alcohols, dehalogenation of vicinal dihalides, controlled reduction of alkynes, Electrophilic addition of alkenes- hydrogenation, halogenation, hydrohalogenation, (Markovnikov's rule and Kharasch effect with HBr), halohydrin formation, hydration, hydroboration, Oxidative cleavage reactions- ozonolysis and hydroxylation, Substitution reaction of propene at low and high temperature. Tests for alkenes.	**Principles and techniques of inorganic qualitative analysis:** Semi-micro qualitative analysis - anions (interfering and non-interfering), reactions of some common anions (carbonate, sulphide, sulphate, nitrate, halides, oxalate, borate and phosphate), principle of preparation of sodium carbonate extract and elimination of interfering anions. Classification of cations into groups, reaction of Pb^{2+}, Cu^{2+}, Al^{3+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, $Mg^{2+}$and NH_4^+cations, group reagents. Applications of Solubility, solubility product principle and common ion effect in group separation of cations. ***Self-study:*** *Preparation of solution for cation testing on semimicro scale.*	(20%)

Total Percentage of course content Modified/Revised	*(75%)*

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
General Chemistry – II	20UCH1C02	**II**	Alkadienes- classification, conjugated dienes-preparation from diol, alkyne, dihalide and alkane. Chemical properties- 1,2 and 1,4elecrtophilic addition, homo and intermolecular cyclisation, Diels-Alder reaction. Stability of conjugated dienes, Preparation of poly butadiene, Buna-N and Buna-S rubbers. Alkynes- preparation from gem and vicinal dihalides, tetrahalides, lower alkynes. Chemical properties- acidity of alkynes, catalytic and chemical reductions, hydrohalogenation, hydration, hydroboration, oxidation with neutral $KMnO_4$, ozonolysis and polymerization(dimer, trimer and tetramer), Tests for alkynes. Alkyl halides-preparation from alkanes,alkenes, alkynes, alcohols and by halide exchange and Hunsdiecker reaction. Chemical properties- reaction with aqueous alkali, alcoholic alkali (Saytzeff and Hoffmann orientation).Aliphatic nucleophilic substitution-S_N1, S_N2 and	**Periodicity and properties:** Description of the latest IUPAC periodic table. Atomic radii, ionic radii, covalent radii, ionisation energy (IE), electron affinity (EA) and electronegativity (EN) - variation along period and group. Ionic radii- comparison of size of cation and anion, neutral atom and isoelectronic species. Ionization energy–first and successive, factors affecting IE. Electron affinity-factors affecting EA. Electronegativity - Pauling's, Mullikan's and Allred Rachow'sscales. Percentage of ionic character. Variation of EN with oxidation state, hybridisation, charge and bond order. ***Self-Study:*** *Electronegativity calculations using Pauling, Mulliken and Allred-Rochow methods.*	(5%)

			SN^imechanisms, Relative reactivities of alkyl halides towards S_N1 and S_N2 mechanisms.		
		III	Cycloalkanes-synthesis by internal Wurtz reaction, Freund's method, decarboxylation and Dieckmann's condensation, Chemical properties - substitution and ring opening reactions of cyclopropane and cyclobutane. Baeyer's strain theory, Sache-Mohr theory. Aromaticity - Huckle's rule and its applications to benzene, naphthalene, antharacene, phenantharene, [10]annulene, [12]annulene pyridine, pyrrole, cyclopropenyl cation, tropylium cation and cyclopentadienyl anion. Mechanism of aromatic electrophilic substitution reactions of benzene and toluene- halogenation, nitration and sulphonation. Friedel-Crafts alkylation and acylation of benzene.	**Chemical bonding-I:** Ionic bonding- conditions for the formation of ionic bond, characteristics of ionic compounds.Lattice energy, Born-Lande equation (derivation not required), factors affecting lattice energy, Born-Haber cycle-enthalpy of formation of ionic compounds and stability.Covalentcharacter in ionic compounds-Fajan's rules, comparison of solubility, melting points, and thermal stability of typical ionic compounds. Covalent bond: characteristics of covalent compounds, formation of $BeCl_2$, BCl_3, CH_4, H_2O and C_2H_4. Partial ionic character. Coordinate bond- NH_4Cl, BF_3-NH_3, $[Co(NH_3)_6]Cl_3$and $AlCl_3$. ***Self-Study:*** *a) Solubility and thermal stability of ionic compounds of alkali and alkaline earth metals.* *b) Comparison of the characteristics of ionic and coordinate compounds.*	(5%)

		IV	Gas Laws - Boyle's, Charles's, Gay Lusac's, Avgadro's, Dalton's and Graham's. Postulates of kinetic theory of gases- derivation of kinetic gas equation-derivation of gas laws,and ideal gas equation. Maxwell's distribution of molecular velocities (derivation not necessary). Root mean square velocity, average velocity and most probable velocity, Mean free path, Collision diameter and collision frequency	**Chemical bonding-II:**Valance bond theory- arrangement of electrons in molecules, hybridization of atomic orbitals and geometry of molecules. VSEPR model-effect of bonding and nonbonding electrons on the structure of molecules, illustration of structures by VSEPR model- BeF_2, BF_3, CH_4, NH_3, H_3O^+,SF_4, ClF_3, ICl_4^-, ICl_2^-, IF_7, XeF_2, $XeOF_2$, XeF_4, XeF_6. Molecular orbital theory- MO diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO and their ions - bond order and stability of molecules. Weak Chemical Forces - Hydrogen bonding, Vander Waals forces. ***Self-Study:*** *a) The importance of lone pair-lone pair and lone pair-bond pair electron interactions in determining structure of molecules and illustration.* *b) Calculation and comparison of bond order and determining stability of homo- and heterodiatomic molecules.*	**(5%)**
		V	Colloids- classification, preparation and purification. Origin of charge of colloidal particles, stability of colloids. Properties of Colloids- Tyndall effect, Brownian movement,Helmoltz electrical double layer, elctrophoresis, eletroosmosis, coagulation, protective action of sols (gold number). Applications- blue colour of the sky,clarification of water, formation of	**Alkanes:** Alkanes-preparation by the reduction of alkyl halides, Sabatier- Senderens reduction. Wurtz reaction, decarboxylation and Kolbe's electrolysis. Relationship between structure and physical properties. Chemical properties - isomerisation, aromatization, pyrolysis, combustion, controlled oxidation, nitration, sulphonation, relative reactivity and selectivity	(10%)

			delta, electrical precipitation of smoke. Solid state-crystalline and amorphous solids-differences between them-definitions of space lattice, Unit cell, Crystal systems, Bravais lattices. Weiss and Miller indices, Number of atoms in simple, face centred and body centred cubic cells, Structure of CsCl and NaCl.Liquid crystals-types, properties and applications.	of halogenations. **Cycloalkanes:**Synthesis by internal Wurtz reaction, Freund's method, decarboxylation and Dieckmann's condensation. Chemical properties - substitution and ring opening reactions of cyclopropane and cyclobutane. Baeyer's strain andSache-Mohr theories. ***Self-Study:*** *a) Comparision of boiling point, melting point and density of alkanes.* *b) Relative stability of ring compounds.*	
Total Percentage of course content Modified/Revised					25%

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General Chemistry III	20UCH2C03	**I**	**Metallurgy:** Concentration of ores- Gravity separation, Froth floatation, Magnetic separation, Chemical separation, Calcination and Roasting. Reduction of free metal- smelting, using CO, Alumino-thermic, Electrolytic reduction, Purification - electrorefining, zone refining, thermal decomposition-Mond's and Van Arkel processes. Ellingham diagram for oxidation of metals to metal oxides. ***s-Block* elements:** Properties- factors affecting lattice energy of ionic solids, factors affecting andvariation of hydration energy of ions in periodic table. Diagonal relationship (Li & Mg, Be & Al) in the periodic table. Extraction of Lithium. Complexes of alkali metals-the wrap around complexes and their biological importance.	**Atomic structure – II**: Wave mechanical model - verification by Davisson and Germer experiment. Schrodinger wave equation-derivation, physical significance of Ψ and Ψ^2. Charge cloud concept and shapes of *s*, *p*, *d* and *f* orbitals. Nodes and nodal planes. Origin, description and salient features of quantum numbers (*n*, *l* and *m*). Zeeman effect and spin quantum number. ***Self-Study:*** a) *Problems on de Broglie's equation.* b) *Filling of electrons in polyelectronic atoms*	**(5%)**
		II	***p-Block* elements:** Variation of properties - valency, atomic radius, ionisation energy, electron affinity, electronegativity, metallic character, oxidising and reducing properties, diagonal relationship between boron & silicon and inert pair effect. Oxides - Classification based on chemical behaviour and oxygen content. Hydrogen peroxide - preparation, properties, structure and uses (including volume calculation). Oxy acids of Sulphur -Preparation, properties and uses of sulphuric acid, Caro's	***s-Block* elements** -Properties – Lattice energy of ionic solids, hydration of ions, relative stability of different oxidation states, ionic conductance. Complexes of alkali metals - wrap around complexes. Comparison of Li and Be with their family members. Diagonal relationship between Li and Mg, Be and Al. Chemistry of sodamide and calcium carbide. Manufacturing and setting of Portland cement. ***Self-Study:*** *a) The factors favoring the formation of ionic compounds by s-block elements.* *b) Uses of s-block metals*	**(5%)**

			acid, Marshall's acid and oleum.		
		IV	**Alcohols:**General classification, monohydric alcohols - classification, nomenclature - common, IUPAC and carbinol. Preparation of alcohols with mechanisms - hydrolysis of alkyl halides, hydration of alkenes into primary, secondary and tertiary alcohols, hydroboration, oxymercuration/demercuration of alkenes, reduction of aldehydes, ketones &esters,and hydrolysis of esters. Manufacture of ethyl alcohol from molassesand starch, rectified spirit absolute alcohol and denatured alcohol. Physical properties - boiling points and solubility with reference to hydrogen bonding and hydrophobic nature. Chemical properties - acidic nature, reaction with-carboxylic acids, acid halides and anhydrides, hydrogen halides and phosphorous halides. Iodoform test, oxidation, dehydrogenation and dehydration. Distinction among primary, secondary and tertiary alcohols. Interconversion of alcohols-Lower primary to higher primary, primary to secondary, secondary to tertiary alcohols. Breath	**Alkyl halides**-preparation from alkanes,alkenes, alkynes, alcohols, Hunsdiecker reaction and halide exchange. Chemical properties- reaction with aqueous and alcoholic alkali (Saytzeff and Hoffmann orientation).Aliphatic nucleophilic substitution-S_N1, S_N2 and S_Ni mechanisms with stereochemistry, relative reactivities of 1^o, 2^o, and 3^o alkyl halides towards S_N1 and S_N2 mechanisms. ***Self-Study:****Application of Hoffmann and Saytzeff rules.*	Existing content moved to unit V of new course 20UCH3C05 (5%)

			analysis test.		
		V	**Phenols**: Classification and nomenclature, Preparation- from sulphonic acids, diazonium salts, aryl halides, sodium tests of carboxylic acids and cumene. Physical properties and chemical properties- Acidic character, effect of substituents on the acidity of phenol, reaction with neutral ferric chloride, sodium, zinc dust and ammonia. Oxidation, esterification and Williamsons synthesis. Electrophilic substitution- halogenation, nitration, sulphonation, Friedel-Craft's alkylation and acylation, phthalein fusion, mechanisms of reactions - coupling, Reimer-Tiemann, Kolbe-Schmidt, Liebermann and Gattermann. Dihydric phenols-Dakin's reaction, Houben -Hoeschreactionand Fluorescein formation. Tests for phenols.	**Aromaticity** - Huckle's rule. Aromaticity of benzene, naphthalene, antharacene, phenantharene, [10]annulene, [14]annulene, pyridine, pyrrole, cyclopropenyl cation, tropylium cation and cyclopentadienyl anion. Mechanism of aromatic electrophilic substitution reactions of benzene and toluene - halogenation, nitration, sulphonation, Friedel-Crafts alkylation and acylation. Activating and deactivating substituents, orientation and ortho/para ratio, side chain reactions (chlorination & oxidation) of toluene. ***Self-Study:***Orientation of electrophiles on mono substituted benzene.	(5%)
Total Percentage of course content Modified/Revised					**20**%

Course Title	**Course code**	**Unit**	**Existing Content**	**Modified/Revised content**	**% of Revision / Modification**
General Chemistry IV	20UCH2C04	**I**	***f*-Block elements:** Position in the periodic table, lanthanides - electronic configuration, oxidation states, lanthanide contraction - cause and consequences, complex formation, occurrence and	**Solid state**-crystalline and amorphous solids - space lattice, unit cell, crystal systems, Bravais lattices. Weiss and Miller indices, number of atoms in simple, face centred and body centred cubic cells. Structure of CsCl and NaCl.	(7%)

			extraction from monazite, separation of monazite by ion exchange method. Compounds of lanthanum - oxides and halides, uses of lanthanides. Actinides: general features of actinides - electronic configuration, oxidation states, ionic radius, actinide contraction, colour of ions and formation of complexes. Separation of Np, Pu and Am from uranium, trans uranic elements. Similarities and differences between lanthanide and actinides.	Packingof ions in solids - radius ratio, coordination number in ionic crystals. Liquid crystals - types, properties and applications.Crystal defects - stoichiometric defects - Schottky and Frenkel defects. Non – stoichiometric defects-metal excess and metal deficiency defects. ***Self-study:*** *Coordination numbers of cations and anions in ionic crystals from radius ratio*	
		II	**Nuclear Chemistry:** Composition of nucleus, properties of α, β and γ rays, nuclear forces (meson theory) - nuclear stability- mass defect, binding energy, packing fraction, n/p ratio and magic numbers. Isotopes, isobars, isotones and isomers and mirror nuclei (basic idea only). Detection of isotopes by Aston's mass spectrograph method. Radioactive disintegration- modes of decay, rate of disintegration, half-life period, average life and radioactive disintegration series. Nuclear fission- atom bomb, nuclear power generator, nuclear fusion - hydrogen bomb and stellar energy, uses of radioactive isotopes- in medicine, analytical chemistry and carbon dating.	**Ideal solutions**: Vapour pressure- composition diagrams of solutions. Raoult's law, positive and negative deviations from the law. Solubility of gases in liquids - Henry's law and its relationship with Raoult's law. Lowering of vapour pressure - thermodynamic derivation for elevation of boiling point and depression of freezing point. Relationship between osmotic pressure and vapour pressure. van't Hoff's theory of dilute solutions. **Colloids**- classification, preparation and purification. Properties- Tyndall effect, Brownian movement, Helmoltz electrical double layer, electrophoresis, electro-osmosis, coagulation and protective action of sols (goldnumber). ***Self-study:*** *Applications of Colloids*	(10%)

		III	**Thermodynamics:** Systems, Surroundings, Boundary, Intensive and Extensive properties. Concept of heat and work. State and Path functions, Thermodynamic processes. **First law of thermodynamics:** Statement, definition of internal energy and enthalpy. Heat capacity - at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU and dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. **Thermochemistry:** Standard state, standard enthalpy of formation. Hess's law of heat summation and its applications. Heat of reaction at constant pressure and volume. Enthalpy of combustion, Enthalpy of neutralisation. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.	**Gas Laws** - Boyle's, Charles's, Gay Lusac's, Avgadro's, Dalton's law of partial pressure and Graham's law of diffusion. Postulates of kinetic theory of gases-derivation of kinetic gas equation-derivation of gas laws and ideal gas equation. Maxwell's distribution of molecular velocities, root mean square velocity, average velocity and most probable velocity (derivation not necessary). Mean free path, collision diameter and collision frequency. Law of vander Waal's equation and critical state. Relationship between critical constants and vanderWaal's constants. ***Self-study:*** *Problems based on kinetic gas equation.*	(7%)
		IV	**Second law of thermodynamics:** Need for the law, different statements, Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: entropy as a state function, entropy as a function of V & T and P & T, entropy change in physical	**Ethers**-IUPAC nomenclature, preparation-dehydration of alcohols and Williamson synthesis. Chemical properties - formation of oxonium salts, etherate and peroxides, cleavage by acids and halogenation. Determination of alkoxy group by Ziesel's method. Crown ethers – 12 crown 4, and 15 crown 5. **Epoxides**- Preparation,chemical reactions – acid	**(20 %)**

			change, Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases, entropy change in natural processes.Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A and G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G, and A, with P, V, and T. **Third law of thermodynamics:** Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data.	hydrolysis, HBr, C_2H_5OH/ C_2H_5ONa, RNH_2 and RMgX. **Thioethers** - IUPAC nomenclature, preparation- from alkyl halide, mercaptans and alkenes. Chemical reactions– metal salts, alkyl halides, oxidation, hydrolysis and halogenation. ***Self-study:*** *a) Preparation, properties and uses of anisole.* b) *Orientation of epoxides in ring opening.*	
Total Percentage of course content Modified/Revised					44%

Course Title	**Course code**	**Unit**	**Existing Content**	**Modified/Revised content**	**% of Revision / Modification**
Inorganic, Organic and Analytical Chemistry	20UCH3C05	**I-V**		New Course introduced with shuffling the existing content with 30% of revised content.	**30%**
Total Percentage of course content Modified/Revised					**30%**

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
Physical, Organic and Analytical Chemistry	20UCH3C06	**I-V**		New Course introduced with shuffling the existing content with 30% of revised content.	**30%**
Total Percentage of course content Modified/Revised					**30%**

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
Coordination Chemistry	20UCH5C07	**III**	Applications of coordination compounds in quantitative analysis - gravimetric estimation of nickel using DMG and aluminum using oxine, estimation of hardness of water using EDTA.Structures and functions of chlorophyll and hemoglobin. Metal carbonyls-general methods of preparation, nature of M-CO bond, structure of $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Mn_2(CO)_{10}$ and $Co_2(CO)_8$	**Magnetic properties**-types of magnetic behaviour, spin-only formula, calculation of magnetic moment, experimental determination of magnetic susceptibility – Gouy method. **Applications**- complexometric titrations – principle and applications. Qualitative separation of silver and mercury, copper and cadmium ions.Gravimetric estimation of nickel using DMG and aluminium using oxine. Estimation of hardness of water using EDTA. ***Self-study:*** *Qualitative analysis of Cobalt, Zinc and Iron.*	**10%**
		IV	Calculation of number of atoms in simple cubic (SC), face centered cubic (FCC) and body	**Organometallic compounds**-introduction - definition and classification of organometallic compounds based on bond type.Nature of Metal-Carbon bond. Metal carbonyls - 18 electron rule,	**10%**

			centered cubic (BCC) unit cells. Symmetry in crystals - symmetry operations and symmetry elements - plane of symmetry, axis of symmetry and centre of symmetry.Symmetry elements of a cubic crystal.Semiconductors - intrinsic and extrinsic - n-type and ptype.Electron gas theory and band theory of metals	electron count of mononuclear and binuclear complexes of 3*d* series. General methods of preparation, properties and structure of $Ni(CO)_4$, $Mn_2(CO)_9$, $Fe(CO)_5$, $Co_2(CO)_8$. ***Self-study:****Preparation, properties and uses of Zeise's salt and Ziegler-Natta Catalyst*.	
		V	Alloys - simple mixtures, solid solutions, substitutional and interstitial alloys. Hume - Rothery ratios and their applications. Structure of the ionic crystals - AX type - NaCl, CsCl and ZnS -(zinc blende and wurtzite structures), AX_2 type - CaF_2 and TiO_2. Limiting radius ratio rule- coordination number and shape of the ionic crystals. Defects in crystal structures: stoichiometric defects - Schottky and Frenkel defects. Non - stoichiometric defects-metal excess and metal deficiency defects.	**Bio-Inorganic chemistry:**Biological functions and toxicity of trace elements: Cr, Mn, Cu, Ar, Hg, Cd, Fe, Mo. Se. Zn, I, Pb. Role of Na^+, K^+, Mg^{2+}, and Ca^{2+}in biological system. Structure and functions ofhemoglobin and chlorophyll. Structure and functions of carbonic anhydrase.Nitrogen fixation in atmosphere. ***Self-study:****Structure and functions of myoglobin and Carboxy peptidase.*	**15%**
Total Percentage of course content Modified/Revised					***35 %***

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
Organic Chemistry	20UCH5C08	**I**	Preparation and properties of benzene suphonic acid and suphanilic acid.Preparation andbacterostatic action of sulphanilamide. Phenol - preparation, resonance structures, bromination, nitration, oxidation, reduction, Schotten-Baumann, phthalein fusion and coupling reactions. Mechanisms of Reimer-Tiemann and Kolbe-Schmidt reactions.Tests for phenol.Preparation and properties of o-cresol, catechol, resorcinol and pyrogallol.	**Aliphatic and Aromatic Aldehydes & Ketones**–structure, reactivity and preparation. Mechanism of nucleophilic addition reaction - ammonia and its derivatives.Mechanisms of aldol (Simple & Cross), benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro, Wittig and haloform reactions.Oxidation with Ag_2O, $KMnO_4$, PCC, and PDC. Reduction with $LiAlH_4$, and $NaBH_4$. Michael addition.Tautomerism of ethyl acetoacetate. ***Self-study:****Reduction with $NaCNBH_3$ and oxidation with pyridine-N-oxide*.	**20%**
		II	Preparation and properties of formic and acetic, benzoic, oxalic and malonic acids.Action of heat on formic, acetic, oxalic, malonic and succinic acids.Mechanism of hydrolysis of estersby $B_{AC}2$ and $A_{AC}2$.Diethyl malonate - preparation and synthesis of acetic acid, adipic acid,cinnamic acid, glycine and malonyl urea from diethyl malonate. Ethylacetoacetate - preparation and synthesis of succinic acid, crotonic acid, butanone, 4-methyl uracil and	**Carboxylic acids**- preparation and properties of formic, acetic, benzoic, oxalic, malonic and succinic acids. Relative acidity of carboxylic acids. Action of heat on formic, acetic, oxalic, malonic and succinic acids. Mechanism of hydrolysis of esters by $B_{AC}2$ and $A_{AC}2$. **Diethyl malonate** – preparation. Synthesis of acetic acid, adipic acid, cinnamic acid, glycine and malonyl urea from diethyl malonate. **Ethylacetoacetate**– preparation. Synthesis of succinic acid, crotonic acid, butanone, 4-methyl uracil and antipyrine from ethyl acetoacetate. ***Self-study:****Preparation and properties of maleic*	**5%**

			antipyrine from ethylacetoacetate.	*and fumaric acids*.	
		IV	Heterocyclic compounds- preparation and reactions of pyrrole and pyridine.Comparison ofbasicities of pyridine and pyrrole.Synthesis and reactions of quinoline, isoquinoline and indole. Vitamins - classification, sources and deficiency diseases. Terpenoids-isolation and isoprene rule. Structural elucidation and synthesis of geraniol and α-terpeniol. Alkaloids -structural elucidation and synthesis of coniine and nicotine.	**Heterocyclic compounds**– preparation, basicity, electrophilic & nucleophilic substitution, oxidation and reduction reactions of pyrrole, furan, thiophene and pyridine. Synthesis of quinoline (Skraup), isoquinoline (Bischler-Napieralski) and Indole (Fischer-Indole) – electrophilic and nucleophilic reactions.**Terpenoids**-isolation and isoprene rule. Structural elucidation and synthesis of α-terpeniol. ***Self-study:****Structural elucidation and synthesis of geraniol.*	**10%**
Total Percentage of course content Modified/Revised					**35%**

Course Title	**Course code**	**Unit**	**Existing Content**	**Modified/Revised content**	**% of Revision / Modification**
sElectrochemistry	18UCH5C07	**I**	Ohm's law and electrical units. Electrolysis – Faraday's law of electrolysis. Conductance of electrolytes - specific conductance, equivalent conductance and molar conductance - experimental determination of molar conductance. Types of electrolytes. Variation of	**Ionic mobility** - Ohm's law and electrical units. Arrhenius theory of electrolytic dissociation and its limitations.Electrolysis – Faraday's laws of electrolysis. Conductance of electrolytes.Variation of specific and molar conductance with dilution. Ionic mobility – abnormal mobilities of hydrogen & hydroxyl ions and Walden's rule. Transport number-determination by Hittorf's and moving	**5%**

			specific and molar conductance with dilution. Transport number and ionic mobility's- determination of transport number - Hittorf's and moving boundary methods. Kohlrausch's law and its applications. Abnormal mobilities of hydrogen and hydroxyl ions.	boundary methods.Kohlrausch's law and its applications. Applications of conductance measurements - determination of solubility product, degree of dissociation, ionic product of water and conductometric titrations – acid-base and precipitation. ***Self-study:****Types of electrolytes, Ostwald's dilution law and its limitations.*	
		II	Arrhenius theory of electrolytic dissociation and its limitations.A qualitative discussion of interionic forces and their influence on conductance.Applications of conductance measurements - determination of solubility product, degree of dissociation, ionic product of water and conductometric titrations – acid-base and precipitation.Activity and activity coefficient of strong electrolytes (definition only)	**Inter-ionic effects** - Debye-Huckel theory of strong electrolytes.Debye-Falkenhagenand Wein effects.Activity and activity coefficient of strong electrolytes (definition only).**Dissociation of weak acids and bases** – relative strengths.pH and pH scale, common ion effect and solubility product - applications of solubility product principle. **Buffer solutions** - types of buffers and buffer action - Henderson's equation. **Hydrolysis of salts** - hydrolysis constant and degree of hydrolysis of salts of weak acids& strong bases and weak acids & weak bases. ***Self-study:****Hydrolysis of salts - hydrolysis constant and degree of hydrolysis of salts ofstrong acids &weak bases.*	**5%**
		III	Dissociation of weak acids and bases – relative strengths.pH - definition, common ion effect and solubility product - applications of	**Electromotive force** - electrochemical cells - galvanic cells - cell terminology - representation of cell - calculation of EMF of the cell.Reversible and irreversible cells.	**2%**

			solubility product principle. Buffer solutions – typesof buffers and buffer action - Henderson's equation. Hydrolysis of salts - hydrolysis constant and degree of hydrolysis of salts - weak bases and strong acids , weak acids and strong bases and weak acids and weak bases.	Types of electrodes –metal-metal ion electrode, gas electrode- standard hydrogen electrode, amalgam electrode, metal-insoluble salt electrode-calomel and Ag/AgCl, oxidation-reduction electrodes. Single electrode potential - determination. Nernst equation for electrode and cell potentials. Electrochemical series and its applications. Thermodynamic concept of electrode potential.Relation between EMF and thermodynamic quantities ΔG, ΔH, ΔS and their significance. ***Self-study:****Weston standard cell*	
		V	Concentration cells - types - derivation of EMF of concentration cells with and without transference. Liquid Junction potential - definition (derivation not necessary) and its elimination. Application of EMF measurements - potentiometric titrations - acid base, precipitation and redox titrations – determination of solubility of a sparingly soluble salt,determination of pH using glass, quinhydrone and hydrogen electrodes. Commercial cells –Acid storage battery. Rechargeable cells – nickel cadmium and lithium ion cells. Fuelcells.Electrochemical principle of rusting of iron.	**Metallic coating** – introduction, anodic and cathode coatings. Coating processes – metal cladding and hot dipping – galvanishing, tinning, electroless plating. Electroplating and its applications.**Corrosion** – electrochemical principle of rusting of iron, prevention of corrosion-barrier, sacrificial and cathodic protections. Passivity of metals.**Commercial cells** – Acid storage battery. Rechargeable cells – nickel cadmium and lithium ion cells. Fuel cells – Hydrogen-oxygen fuel cell. ***Self-study:****Hydrocarbon-oxygen fuel cell*	**15%**

Total Percentage of course content Modified/Revised	27 %

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
Inorganic Chemistry	20UCH6C12	**I**	Covalency and oxidation number, difference between oxidation number and valency. Rules for calculating oxidation number.Oxidation and reduction, common oxidising agents and reducing agents.Equivalent weight of common oxidising and reducing agents. Balancing redox equations using oxidation number method. Extraction of Mn, Co and Ni.Preparation, properties and uses of potassium permanganate, potassium dichromate and ferrous sulphate.	**Oxidation number** - covalency and oxidation number, difference between oxidation number and valency. Rules for calculating oxidation number. Oxidation and reduction, common oxidizing agents and reducing agents. Balancing redox equations using oxidation number method. **Oxides:**Classification based on oxygen content and chemical behavior. H_2O_2: preparation, structure, and properties. ***Self-Study:****Calculation of volume strength and uses of H_2O_2.*	**10%**
		II	Occurrence, extraction, chemical properties and uses of boron.Preparation, properties, structure and uses of diborane, sodium borohydride, boric acid, borax and boron nitride-borax bead test.Borazine-preparation, chemical properties and structure – comparison of borazine with benzene.	**Noble gases** – occurrence, isolation, inertness and uses. Clathrate compounds.Preparation, structure and properties of XeF_2, XeF_4, XeF_6, XeO_3 and $XeOF_4$.**Interhalogen compounds** - preparation, structure, properties and uses of ICl, IBr, ICl_3, IF_5, and IF_7. ***Self-Study:****Preparation, properties, uses and structures of ClF, and ClF_3.*	**5%**

		III	Compounds of silicon-quartz, tridymite, cristobalite and carborundum.Silicates-types, structures and uses.Isolation of noble gases from liquid air-clathrate compounds-types and properties. Preparation, properties and structures of – XeF_2, XeF_4, XeF_6, XeO_3 and $XeOF_4$ Inter halogen compounds: preparation, properties, uses and structures of-ICl, IBr, ICl_3, IF_5 and IF_7.	**Acids and Bases** - Arrhenius concept, Lowry - Bronsted concept - conjugate acid - base pair, Lewis concept. Relative strength of acids and bases-effect of solvent, levelling effect-polarity and dielectric constant. Hard and Soft Acids, Bases (HSAB) principle, and their applications.**Non-aqueous solvents**-classification of solvents, characteristic properties of a solvent. Physical properties, chemical reactions, advantages and limitations of liquid ammonia, and liquid sulphur dioxide. ***Self-Study:****Relative strength of acids and bases –effect of electron releasing and electron withdrawingsubstituents, oxidation number of central atom and resonance effect.*	**5%**
Total Percentage of course content Modified/Revised					20%

Course Title	**Course code**	**Unit**	**Existing Content**	**Modified/Revised content**	**% of Revision / Modification**
Stereochemistry, Freeradicals and Biomolecules	20UCH6C13		Isomerism: structural and stereoisomerism - geometrical isomerism-Cahn – Ingold - Prelog rules for priority of groups, E-Z notation, determination of configuration of geometrical isomers by physical and chemical methods. Optical isomerism, plane polarized light, chirality,	**Isomerism**-concept and types. Optical isomerism-elements of symmetry, plane polarized light, molecular chirality, dissymmetric, asymmetric, chiral and achiral molecules with two stereogeniccentres. Enantiomers and diastereomers, anomers, epimers and meso compounds. Racemization - resolution, mechanism of racemization.	**10%**

			enantiomers, diastereomers, anomers, epimers, optical isomerism in lactic acid and tartaric acid. R-S configuration.	Epimerization. Walden inversion, retention and asymmetric synthesis.Relative and absolute configuration. Sequence rules–R/S nomenclature. Geometrical isomerism, E/Z nomenclature. ***Self-study**: Determination of configuration of geometrical isomers by physical and chemical methods.*	
			Conformational analysis - distinction between conformation and configuration.Conformations and potential energy diagrams of ethane and n-butane. Conformations of cyclohexane- chair, half chair, boat and twist forms. Methyl cyclohexane, conformations and stabilities of 1,2 – dimethylcyclohexane, 1,3 – dimethylcyclohexane and 1,4 – dimethylcyclohexane, conformations in cyclohexanol, cyclohexane-1,3- diol and cyclohexane-1,4,-diol.	**Conformational analysis**-distinction between conformation and configuration, Conformational analysis of ethane, n-butane and cyclohexane. Axial–equatorial inter conversion-conformation and stabilities of methyl cyclohexane,1,2–dimethyl cyclohexane,1,3–dimethyl cyclohexane and 1,4–dimethyl cyclohexane. *Conformations in cyclohexanol, cyclohexane-1,3- diol and cyclohexane-1,4,-diol.* ***Self-study**: Cis-trans isomerism in substituted cycloalkanes*	**5%**
			Free radicals-classification, generation of free radicals, detection of free radicals, configuration of free radicals and relative stabilities of alkyl free radicals. Stability of triphenylmethyl free radical, reactions involving free radicals-polymerization, allylic bromination by NBS, autoxidation,	**Reaction intermediates** -free radicals - classification, generation, detection, and configuration. Relative stabilities of alkyl and triphenylmethyl free radicals. Reactions - polymerization, allylic bromination by NBS, autoxidation, Sandmeyer, Gomberg and Ullmannreactions. Generation of carbenes and	**5%**

			Sandmeyer reaction, Gomberg and Ullmann reactions.	nitrenes. ***Self-study**: Reactions involving carbene and nitrene-Reimer Tiemann reaction and Hoffmann rearrangement.*	
			Addition reactions of alkenes - electrophilic, nucleophilic and free radical addition reactions. Mechanisms of addition of H_2, halogens and hydrogen halides to carbon – carbon double bond systems, Markovnikov's rule and Kharasch-peroxide effect, cis-hydroxylation and hydroboration. Synthetic uses of diazomethane and perbenzoic acid.	**Carbohydrates** – classification, preparation and properties of glucose and fructose.Cyclic structures - pyranose and furanose forms. Mutarotation and its mechanism. Configuration of monosaccharides,epimerisation, chain lengthening and chain shortening of aldoses. Inter conversions of glucose and fructose. Disaccharides – reactions and structure elucidation of sucrose. ***Self-study**: Polysaccharides-structure of starch and cellulose, industrial uses of cellulose*	**15%**
			Carbohydrates- classification - elucidation of open chain structure of glucose and fructose, mutarotation, interconversions between glucose and fructose, reducing and non-reducing sugars. Amino acids and proteins: Amino acids-classification and general methods of preparation and properties. Peptide synthesis by Bergmann method, proteins-classification, primary and	**Amino acids** -classification, essential and non-essential amino acids, preparation and properties of α-amino acids. Synthesis of peptides, end-group analysis. **Proteins** – classification, primary and secondary structures. **Nucleic acids** – DNA and RNA-composition, structure of DNA and its role in heredity and DNA replication.	**15%**

			secondary and tertiary structures. Colour test for proteins.	***Self-study**: Denaturation and renaturation of proteins, colour test for proteins*	
Total Percentage of course content Modified/Revised					**50%**

Course Title	**Course code**	**Unit**	**Existing Content**	**Modified/Revised content**	**% of Revision / Modification**
Physical Chemistry	20UCH6C14	**I**	Phase rule – Definition of phase, component and degrees of freedom. Derivation of phase rule.Application of phase rule to one component systems – phase diagrams of H_2O, CO_2 and sulphur systems.Application of phase rule to two component systems – lead-silver and zinc-magnesium systems.Phase diagrams for two component liquid systems – completely miscible and partially miscible (Phenol-water, triethylamine-water and nicotine-water) systems.Principle of steam distillation. Nernst distribution law and its applications.	**Phase rule** – definition of phase, component and degrees of freedom. Derivation of phase rule.Application to one-component systems – H_2O, CO_2 and sulphur. Application to two component systems – lead-silver and zinc-magnesium. Two component liquid systems - Phenol-water, triethylamine-water and nicotine-water.Distillation of immiscible liquids-steam distillation. ***Self-study:** Phase diagrams of Bi-Cd and KI-H_2O systems*	**5%**
		II	Chemical Kinetics: Definition of rate and rate constant dimensions of rate and rate constant. Order and molecularity – differences.Derivation of rate constants for zero, first and second order	**Chemical Kinetics** - definition of rate and rate constant, dimensions of rate and rate constant. Order and molecularity – differences. Derivation of rate constants and half-life of zero, first and second order reactions. Pseudo first-order	**5%**

			reactions.Examples for fractional and higher order reactions. Various methods of determining order of a reaction. Effect of temperature on reaction rate, Arrhenius equation – calculation of energy of activation.	reaction – acidcatalyzed ester hydrolysis. Examples for fractional and higher order reactions. Various methods of determining order of a reaction. Arrhenius equation – calculation of energy of activation. Complex reactions - consecutive, reversible, parallel and chain reactions – definition and examples. ***Self-study:*** *Effect of temperature on reaction rate.*	
		V	Photochemical reactions. Difference between photochemical and thermochemical reactions. Laws of photochemistry – Lambert Beer's, Grotthus Draper law and Stark Einstein's law. Quantum yield – definition and experimental determination(actinometry). Photochemical reactions of low and high quantum yields.Kinetics of hydrogen-bromine and hydrogen-chlorine reactions.Photosensitization and quenching.Definition of chemiluminescence, fluorescence and phosphorescence.	**Photochemical reactions** -difference between photochemical and thermochemical reactions. Laws of photochemistry – Lambert Beer's, Grotthus Draper, and Stark Einstein's laws. Quantum yield – definition and types. Photochemical reactions of low and high quantum yields.Kinetics of hydrogen-chlorine and hydrogen-bromine reactions. Basic idea on fluorescence, phosphorescence, chemiluminescence and bioluminescence. **Group theory** - Symmetry elements and symmetry operation. Group-requirements and types-abelian and non-abelian. Point group of water and ammonia. Group multiplication table of C_{2V} point group. ***Self-study:****Group multiplication table of* C_{3V} *point group*.	**10%**
Total Percentage of course content Modified/Revised					20%

Course Title	Course code	Unit	Existing Content	Modified/Revised content	% of Revision / Modification
Industrial Chemical Analysis	20UCH5EP2	-	--	New Course Created by splitting the existing course 19UCHCH6CP4 with 25% of new content.	25%
Total Percentage of course content Modified/Revised					25%
Industrial Chemistry	20UCH5EA1			New Course pool created and one of the course chosen by the students will be delivered.	100%
Environmental Chemistry	20UCH5EB1				
Polymer Chemistry	20UCH5EC1				
Total Percentage of course content Modified/Revised					100%
Dye Chemistry	20UCH6EA2			New Course pool created and one of the course chosen by the students will be delivered.	100%
Biochemistry	20UCH6EB2				
Introduction to nanochemistry and applications	20UCH6EC1				
Total Percentage of course content Modified/Revised					
Modular Course: Chemistry for Entrepreneurship	20UCH6MC1			New Course Introduced	100%
Total Percentage of course content Modified/Revised					100%

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SRI RAMAKRISHNA MISSION VIDYALAYA
COLLEGE OF ARTS AND SCIENCE
COIMBATORE-641020.