Undergraduate Department of Chemistry

Programme for B.Sc. Chemistry from 2015 batch

SEM	Part	Course No.	Course Title	Hours	Credits	Marks
3	I	**TAM/FRE/HIN**		3	2	30
3	II	**ENG 2201**	Study Skills	3	2	30
3	IIIC	**CHE 2511**	Organic Chemistry - II	5	5	75
3	IIIC	**CHE 2513**	Inorganic Chemistry - III	5	5	75
3	IIIC	**CHE 2515**	Physical Chemistry - II	5	5	75
3	IIIC	**CHE 2431**	Inorganic Qualitative Analysis	4	4	60
3	IIIS	**MAT/BOT**	Mathematics / Botany	5	4	60
3	V		NSS/NCN/NCC/PED/SLP			
			Total	30	29	435
4	I	**TAM/FRE/HIN**		3	2	30
4	II	**ENG 2202**	Career Skills	3	2	30
4	IIIC	**CHE 2512**	Organic Chemistry - III	5	5	75
4	IIIC	**CHE 2514**	Inorganic Chemistry - IV	5	5	75
4	IIIC	**CHE 2516**	Physical Chemistry - III	5	5	75
4	IIIC	**CHE 2432**	Organic Estimation & Gravimetric Analysis	4	4	60
4	IIIS	**MAT/BOT**	Mathematics / Botany	5	4	60
4	V		NSS/NCN/NCC/PED/SLP			
			Total	30	29	435

Third Semester Supportive courses for Chemistry students

MAT 2431 Maths for Chemistry – I
BOT 2439 Botany for Chemists – I

Fourth Semester Supportive courses for Chemistry students

MAT 2432 Maths for Chemistry – II
BOT 2440 Botany for Chemists – II

CHE 2511 Organic Chemistry–II 5 hr/5 cr

This course will enable the students to learn and understand the concepts of aromaticity and basic nature of arenes, polynuclear hydrocarbons and halogen containing compounds. They will be able to comprehend the reactivity and physical nature of functional groups like alcohols, ethers, thiols, thioethers, epoxides and phenols.

UNIT I: Aromaticity and Arenes

Structure of benzene–Resonance model–MO picture–concept of aromaticity–Huckel's rule, non-aromatic, antiaromatic

Arenes–Nomenclature of benzene derivatives–General methods of preparation–physical properties–chemical properties–orientation effect of substitution on electrophilic aromatic substitution–activating group, deactivating group, orientation and o/p ratio, energy profile diagram–free radical substitution–addition reaction–oxidation reaction–Birch reduction.

Biphenyl–preparation and reactions.

UNIT II: Polynuclear hydrocarbons

Naphthalene–isomerism–orbital picture–synthesis–physical properties–chemical properties–electrophilic aromatic substitution–orientation of disubstitution–addition reaction–uses–naphthol and napthylamine.

Anthracene–nomenclature and isomerism–synthesis–physical properties–chemical properties–reduction, electrophilic substitution reaction, oxidation, electrophilic addition reaction–anthraquinone.

Phenanthrene–synthesis–structure–properties.

UNIT III: Haloalkanes and Haloarenes

Classification and nomenclature of alkyl halides–Physical properties–Preparation and reactions of alkyl halides–Nucleophilic aliphatic substitution–S_N1 and S_N2 mechanism and kinetics with energy profile–E_1 and E_2 elimination–orientation–vinyl and allyl halide–preparation and property–Poly halogen compounds (chloroform, carbon tetrachloride, freons)–Preparation and reactions of aryl halides–nuclear and side chain reactions–Reactivity and orientation in aromatic substitution reactions–Benzyne mechanism–Relative reactivity of alkyl vs allyl, vinyl and aryl halides–Synthesis and uses of DDT, BHC

UNIT IV: Alcohols, Thiols, Ethers, Thioethers and Epoxide

Classification and Nomenclature–Monohydric alcohol–physical properties–synthesis of alcohols from alkenes via oxymercuration and demercuration, hydroboration, oxidation, reduction–Reactions of alcohols-distinction between 1^o, 2^o and 3^o alcohols-hydrogen bonding–acidic nature of alcohols

Dihydric alcohol–physical properties–method of formation–chemical reaction–oxidative cleavage via lead tetraacetate and periodic acid–pinacol-pinacolone rearrangement.

Trihydric alcohol–method of formation–chemical reaction–glycerol, dynamite, cordite–Estimation of number of hydroxyl groups

Thiols–Preparation and chemical reactions of thiols–comparison with alcohols–mustard gas.

Ethers–Structure and nomenclature of ethers–physical properties–preparation– Williamson's synthesis–Alkoxymercuration and demercuration–chemical reactions–cleavage and auto oxidation–analysis of ether–Ziesel's method–crown ethers (brief introduction).

Thioethers–Preparation and chemical reactions.

Epoxides–synthesis–reactions–acid and base catalyzed ring opening of epoxides–orientation of cleavage of epoxide–reaction with Grignard and organolithium reagents.

UNIT V: Phenols

Classification and nomenclature of monohydric, dihydric and trihydric phenols–preparation of phenol–physical properties of phenol–acidic nature–comparison with alcohols–resonance stabilization of phenoxide ion–reactions of phenol as acid, reaction pertaining to -OH group and benzene ring of phenol–electrophilic aromatic substitution–Mechanism of Fries, Claisen rearrangement, Gattermann synthesis, Houben-Hoesch reaction, Lederer-Manasse reaction, Libermann Nitroso reaction, Kolbe reaction, Reimer-Tiemann reaction, phthalein reaction–Analysis of phenol.

Textbook:

1. Jain. M.K. and Sharma. S.C., Textbook of Organic Chemistry, Vishal publishing Co, 4th edition, 2014.

References:

1. Morrison and Boyd., Organic Chemistry, Pearson publication, 7th edition, 2003.
2. Mehta. B. and Mehta.M., Organic Chemistry, Prentice–Hall of India Private limited, 2007.
3. Soni. P.L. and Chawla. H.M.,Textbook of Organic Chemistry , Sultan Chand and Sons, 28th edition, 2007.

CHE 2513 Inorganic Chemistry-III 5 hr/5 cr

This is a course intended to impart knowledge about the solid state, metallic bond and chemistry of nitrogen, chalcogen and halogen groups. This course also deals with the theory behind the laboratory course and aims at enriching student's analytical learning and skill.

UNIT I: Solid state

Crystalline and amorphous solids–characteristics of solid–symmetry in crystals–laws of crystallography–unit cell–space lattice–basic crystal systems–Bravais lattices–number of atoms per unit cell–interplanar spacing in a crystal system–Miller indices–X ray diffraction–Bragg equation, experimental methods

Metallic Bond–Free electron and band theory–electrical properties of solids–super conductivity (elementary ideas only)

UNIT II: Group V

General characteristics–unique features of nitrogen–a comparative study of hydrides–preparations, properties and uses of N_2H_4, NH_2OH, HN_3–oxo acids of nitrogen–nitric acid–oxidising properties–structures of oxides and oxoacids of phosphorus and nitrogen–halides of phosphorus–phosphazines.

UNIT III: Group VI

Gradient in properties–oxidation state–differences between oxygen and other elements–chemistry of ozone and H_2O_2–oxides of sulphur–thionyl and sulphuryl chlorides–oxoacids of sulphur–sulphuric, permono, perdisulphuric acid–SF_6, SCl_2, S_2Cl_2–preparation, properties and structures.

UNIT IV: Group VII
General characteristics–bond energies in X_2 molecules–oxidising power–reaction with water–reactivity of elements–peculiarities of fluorine–hydrogen halides–properties–energy cycle showing their acid strength–oxides of halogens–structures–oxyacids of chlorine– strength of oxyacids of halogen–interhalogen compounds–poly halides–basic properties of halogens–pseudohalogens and pseudohalides.

UNIT V: Analytical Chemistry-II
Gravimetric method of analysis–principle–mechanism and desirable properties of precipitates–common ion effect–solubility and ionic product–gravimetric factor–particle size, purity of precipitate–types of precipitate–surface adsorption–occlusion–coprecipitation–post precipitation–precipitation from homogeneous solution–digestion–filtration–washing– drying and incineration–organic and inorganic precipitants–applications.
Evaluation of analytical data–Significant figures–types of error–sources and minimisation of errors–precision and accuracy– methods of expression–confidence limits– rejection of a result–Q test.

Textbook:
1. Puri. B.R., Sharma. L.R. and Kalia. K.C., Principles of Inorganic Chemistry, Milestone Publishers, 2012.

References:
1. Lee. J.D., Concise Inorganic Chemistry, Chapman & Hall, 5th edition, 2000.
2. Soni. P.L., Mohan Katyal, A Textbook of Inorganic Chemistry, Sultan Chand& Sons, 12th edition, 2006.
3. Day. R.A. Jr, Underwood. A.L., Quantitative analysis ,Prentice Hall of India, New Delhi, 6th edition, 2006.
4. Mendham. J., Denney. R.C., Barnes. J. D., Thomas. M.J.K., Vogel's Textbook of Quantitative Chemical Analysis, Pearson Edu. Ltd, Singapore, 6th edition, 2000.

CHE 2515 Physical Chemistry–II 5 hr/5 cr

This course deals with the concepts and applications of thermodynamics. Properties of non-electrolytes along with colligative properties will be discussed.

UNIT I: First law of Thermodynamics and Thermochemistry Terminologies–thermodynamic equilibria–extensive and intensive properties–heat and work– first law–internal energy–state functions–cyclic rules–reciprocal relation–enthalpy–heat capacity–Cp and Cv–expansion of an ideal gas–isothermal expansion–adiabatic expansion– reversible and irreversible expansion–Joule Thomson effect–μ_{JT}–ideal gas coefficient–real gas coefficient–Zeroeth law of thermodynamics–absolute temperature scale.
Change of internal energy in a reaction–heat of reaction–q_p and q_v–standard enthalpy change–Kirchoff's equation–flame and explosion temperature–Hess's law and its applications–Bomb calorimeter–bond energies.

UNIT II: Second law of Thermodynamics
Limitations of I law–spontaneous process–cyclic process–Carnot cycle–entropy–second law of thermodynamics–entropy change in isothermal expansion of an ideal gas–entropy change in reversible and irreversible processes–phase change–calculation of entropy changes of an

ideal gas with change in P,V and T–entropy of mixing–standard entropy–physical significance of entropy–work and free energy functions–variation of T and P–Maxwell's relationship–criteria for reversible and irreversible process, Gibbs-Helmholtz equation, Open system–partial molar properties, Gibbs-Duhem equation, Clapeyron–Clausius equation, Fugacity and activity–activity coefficient, standard states.

UNIT III: Third law of Thermodynamics and Chemical equilibrium

Nernst heat theorem–third law of thermodynamics–determination of absolute entropy–experimental verification of III law–entropies of real gases–entropy change in a chemical reaction–Boltzmann equation–residual entropy.

Spontaneous reactions–standard free energy changes–Chemical equilibrium–law of mass action–van't Hoff reaction isotherm–Kp and Kc–Homogeneous equilibria–temperature dependence–van't Hoff equation–Heterogeneous equilibria–Le-Chatelier principle.

UNIT IV: Solutions of Non-Electrolytes

Solutions of liquids in liquids–Raoult's law–vapour pressure of ideal solution–temperature-dependence of vapour pressure of a solution–volume change of mixing for an ideal solution–entropy change of mixing–vapour pressure of real (non-ideal) solution–binary solutions–fractional distillation–Azeotropic mixture–Lever rule and fractional distillation–immiscible liquids–steam distillation–partially miscible liquids–critical solution temperature–phenol-water system–aniline-hexane system–Nicotine-water system–Solutions of gases in liquids–factors influencing solubility of a gas–Henry's law.

UNIT V: Colligative property and Nernst Distribution law

Colligative properties–vapour pressure lowering–osmotic pressure–theories of semi permeability–elevation of boiling point–depression of freezing point–abnormal results and van't Hoff factor–Nernst distribution law–application of Nernst distribution law–solvent extraction.

Textbook:

1. Puri. B.R., Sharma. L.R. and Pathania. M.S., Principles of Physical Chemistry, Vishal Publishing Co., 2014.

References:

1. Castellan. G.W., Physical Chemistry, Addison-Wesley, 3rd edition, 1983.
2. Atkins. P.W. and De Paula. J., Physical Chemistry, Oxford University press, 8th edition, 2008.
3. Glasstone. S., A Textbook of Physical Chemistry, Macmillan(India) Ltd, 1976.
4. McQuarrie. D.A., Simon. J.D., Physical Chemistry, University Science Books, 1996.

CHE 2431 Inorganic Qualitative Analysis 4 hr/4 cr

This is a laboratory course designed to improve the analytical skill of the students in the identification of the cations and anions in the mixture of inorganic salts.

A mixture of inorganic salts which contains two cations and two anions will be given. Among them, one of the anion must be an interfering ion.

CHE 2411 Chemistry For Physicists–I 5(3+2) hr/4(3+1)cr

There will be two components in this course. Theory component deals with atomic structure, properties, chemical bonding, elementary aspects of organic chemistry, basics of energetic, chemistry of solutions and fundamentals of titrimetry and chromatography. Lab component is to train the students to estimate volumetrically metal ions like iron, Manganese, magnesium, zinc.

THEORY COMPONENT (3hrs / week)

UNIT I: Atomic structure, Periodic properties and Chemical bonding
Shapes of s, p and d orbitals–eelectronic configuration up to 30 elements–periodic properties–atomic size, ionization energy, electron affinity and electro negativity–Ionic bond–lattice energy–Born-Haber cycle–covalent bond–VSEPR model–BCl_3, CH_4, NH_3, H_2O–atomic orbit overlap concept–hybridization–sp^3, sp^2, sp–MO theory–MO diagram for H_2, He_2, N_2, O_2, F_2.

UNIT II: Basics of Organic Chemistry
Tetravalent carbon–aliphatic and aromatic compounds–structure–functional groups–nomenclature–types of organic reactions–substitution, addition, elimination, oxidation, reduction, rearrangement reactions–reactive intermediates–carbocations, carbanions, free radicals–generations and their stability–hydrogen bond–types–consequences of hydrogen bonding.

UNIT III: Energetics
Spontaneous and non-spontaneous changes–criterion for spontaneity–Entropy–Second law of thermodynamics–measurement of entropy–free energy and chemical equilibrium–law of mass action–eentropy change in phase transformation–Le-Chatelier principle–application of thermodynamics to biological systems.

UNIT IV: Solution Chemistry
Aqueous solution–acid-base equilibria–pK_a, pK_b and pH–Buffer solutions– Henderson equation–Solubility and Ksp–Types of solutions based on nature and amount of solvent/solute–determination of concentration of solutions expressed in various scales–percentage–molarity–molality and normality–diffusion in solutions–osmosis and osmotic pressure–measurement of osmotic pressure–isotonic solutions–reverse osmosis–significance of osmosis in biological systems.

UNIT V: Analytical Chemistry
Titrimetry–basic requirement for a titration–acid-base titrations–theory of acid-base indicators–redox titrations–complex metric titrations involving EDTA–metallochromic indicators. Chromatography–introduction–classification of chromatographic techniques–paper chromatography–thin layer chromatography–column chromatography–principle and applications.

LAB COMPONENT: **(2 hours / week)**

This course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc etc.

1. Preparation of solutions
2. Estimation of Sodium Carbonate
3. Estimation of acetic acid in vinegar
4. Estimation of Manganese dioxide in pyrolusite
5. Estimation of Fe(II)-Permanganometry
6. Estimation of Fe(II)-Dichrometry/Internal indicator
7. Estimation of Fe(II)-Dichrometry/External indicator
8. Estimation of Zn (II)-Complexometry
9. Estimation of Ca (II)-Complexometry
10. Estimation of Hardness of water

References:

1. Chang. R., Chemistry, Tata-McGraw Hill, 1st Indian Edition, 2007.
2. Gopalan. R., and Sundaram. S., Fundamentals of Chemistry, Sultan Chand and Sons, 1988
3. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Inorganic Chemistry, Shobanlal Nagin Chand and Co, 1995.
4. Gopalan. R., and Sundaram. S., Allied Chemistry, Sultan Chand and Sons, 1993.
5. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Physical Chemistry, Vishal Publications, 1998.
6. Soni. P. L., Textbook of Organic Chemistry, Sultan Chand & Sons, 1998.

CHE 2413 Chemistry For Zoologists–I 5(3+2) hr/4(3+1)cr

There will be two components in this course. Theory component deals with atomic structure, chemical bonding, thermodynamics and solutions. It also deals the stereochemistry of organic compounds and photo chemistry. The objective of the lab component is to train the students to estimate volumetrically metal ions like iron, manganese, calcium, zinc.

THEORY COMPONENT **(3hrs / week)**

UNIT I: Atomic structure, Periodic properties and Chemical bonding

Shapes of s, p and d orbitals, electronic configuration for elements up to atomic number 30– Periodic properties–atomic size, Ionization energy, electron affinity and electro negativity– ionic bond–covalent bond–coordinate covalent bond–weak interactions–vander Waals, hydrophobic, London, dipole-dipole, ion-dipole and hydrogen bond–Metallic bond–electron sea model.

UNIT II: Nomenclature andStereochemistry of Organic Compounds

Classification of organic compounds–nomenclature of hydrocarbons–substituted hydrocarbons– Functional groups and their priority–isomerism–geometrical and optical– chirality–enantiomers and diasteroisomers–absolute and relative configuration–D/L, d/l, R/S, E/Z notations– examples–racemic mixture–mesocompound.

UNIT III: Photochemistry
Comparison between thermal and photochemical reactions, laws of photochemistry–quantum yield–fluorescence–phosphorescence–chemiluminescence–bioluminescence, common photochemical reactions–photosensitization and its application to biological systems–photosynthesis.

UNIT IV: Thermodynamics
First, Second, third laws of thermodynamics–spontaneous and non spontaneous changes, criterion for spontaneity, entropy–entropy change in phase transformation–free energy and chemical equilibrium–Le-Chatelier principle–application of thermodynamics to biological systems.

UNIT V: Solution Chemistry
Aqueous solution–acid-base equilibria–pK_a, pK_b and pH–Buffer solutions, Henderson equation–Solubility and Ksp–Types of solutions based on nature and amount of solute/solvent–determination of concentration of solutions expressed in various scales– percentage, molarity, molality and normality–diffusion in solutions–osmosis and osmotic pressure– isotonic solutions, reverse osmosis–significance of osmosis in biological systems.

LAB COMPONENT **(2hrs / week)**
This course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc.

1. Preparation of solutions
2. Estimation of Sodium carbonate
3. Estimation of Manganese Dioxide in Pyrolusite
4. Estimation of Fe(II)–Permanganometry
5. Estimation of Fe(II)–Dichrometry/Internal Indicator
6. Estimation of Fe(II)–Dichrometry/External Indicator
7. Estimation of Zn(II)–Complexometry
8. Estimation of Ca(II)–Complexometry
9. Estimation of Hardness of Water

Textbook:
1. Fisher. J. and Arnold. J.R.P., Instant notes in chemistry for biologists, Viva Books Private Ltd., Series editor B.D.Hames- Bio Scientific Publishers Ltd., 2002.

References:
1. Gopalan. R., Inorganic Chemistry for Undergraduates, Universities Press, 2009.
2. Jain. M.K. and Sharma. S.C., Modern Organic Chemistry–Vishal publishers, 2014.
3. Chang. R., Chemistry, Tata Mcgraw Hill Publishing Ltd, 2005.

CHE 2512 Organic Chemistry–III 5 hr/5 cr

This course is aimed at giving ample information on structure, reactivity, and properties of aldehydes, ketones, carboxylic acids, amines, nitro compounds and heterocyclic compounds. After the completion of this course, the students will be able to appreciate the mechanism and reactivity of these functional groups.

UNIT I: Aldehydes and Ketones

Structure and nomenclature (aliphatic and aromatic)–synthesis–aldehydes and ketones–with particular reference to the synthesis from acid chloride, nitriles, ozone, Grignard reagent, alkyne, carboxylic acids–relative reactivities of aldehyde and ketone–Reactions-mechanism of nucleophilic addition to carbonyl group with particular emphasis on condensation reactions–Benzoin, Aldol, Crossed Aldol (with special reference to acraldehyde, crotonaldehyde, cinnamaldehyde), Perkin, Claisen-Schmidt, Knoevenagel reaction–condensation with ammonia and its derivatives, nitriles, nitroalkanes, alcohols–Wittig and Mannich reaction.

Oxidation of aldehyde–Baeyer-Villiger oxidation of ketones, Cannizaro reaction–Reduction–Meerwein-Pondoroff-Verely, Clemmensens, Wolff-Kishner, $LiAlH_4$, $NaBH_4$–Halogenation of enolizable ketones–Haloform reactions–introduction to α,β-unsaturated aldehyde and ketones–Distinction between aldehyde/ketone and aliphatic/aromatic aldehyde ***(mechanism not required for all the reactions***)

UNIT II: Carboxylic acids and derivatives

Structure, bonding and nomenclature (aliphatic and aromatic) –physical properties–acid strength and effect of substitution on acid strength–preparation and reactions of carboxylic acids–Hell-Volhard-Zelinsky reaction–reduction and decarboxylaton–nucleophilic substitution at acyl carbon.

Preparation and chemical reactions of hydroxy acids–malic acid, tartaric acid, citric acid.

Acid derivatives-structure and nomenclature of acid chloride, ester, amides, acid anhydrides–relative strength of acyl derivatives–physical properties–Interconversion of acid derivatives by nucleophilic acyl substitution–preparation and chemical reactions of acid derivatives–Mechanism of esterification and hydrolysis(acid and base catalyzed).

UNIT III: Amines and diazonium compounds

Structure and nomenclature of amines–physical properties-separation of 1^o, 2^o and 3^o amines–basicity of amines–preparation of alkyl and aryl amines-reduction of nitro, nitrile, reductive amination of aldehyde and ketonic compounds, Hofmann, Curtius, Lossen, Schmidt, Wolff rearrangement, Gabriel phthalimide reaction, Hofmann-bromamide reaction–Reactions of amines–alkylation, Schiff's reaction, electrophilic aromatic substitution in aryl amines, Schotten-Bauman reaction, reactions of amines with nitrous acid.

Synthesis and chemical reaction of aryl diazonium salts–Sandmeyer reaction, Gattermann reaction, Baltz-Sciemann reaction, Gomberg reaction, azo coupling.

UNIT IV: Nitro compounds and nitriles

Nomenclature-acidity of nitroalkanes-preparation of nitroalkanes and nitroarenes–chemical reactions of nitroalkanes, nitroarenes and their reduction in acid, neutral and alkaline media–Picric acid.

Nomenclature- Preparation of alkane nitriles and iso-nitriles-chemical properties.

UNIT V: Heterocyclic compounds

Nomenclature–aromaticity of five and six membered heterocyclics–furan, pyrrole, thiophen, pyridine, piperidine–methods of synthesis- chemical reactions with special emphasis on mechanism of electrophilic and nucleophilic substitutions–comparison of basicity of pyridine, piperidine and pyrrole–condensed five and six membered heterocyclics- indole, quinoline, isoquinoline–synthesis with special reference to Fischer-indole, Skraup, Beisler-Napieralski synthesis-mechanism of electrophilic substitution reaction of the above.

Textbook:

1. Jain. M.K. and Sharma. S.C., Textbook of Organic Chemistry, Vishal publishing Co, 4th edition, 2014.

References:

1. Morrison and Boyd., Organic Chemistry, Pearson publication, 7th edition, 2003.
2. Mehta. B. and Mehta.M., Organic Chemistry, Prentice–Hall of India Private limited, 2007.
3. Soni. P.L. and Chawla. H.M.,Textbook of Organic Chemistry , Sultan Chand and Sons, 28th edition, 2007.
4. Finar. I.L., Organic Chemistry, ELBS publication, 7th edition, 1998.

CHE 2514 Inorganic Chemistry- IV 5 hr/5 cr

The objective of the course is to provide an in-depth knowledge of transition elements. This will enable the students to understand the details of bonding, reactivity, applications of coordination compounds and inorganic polymers.

UNIT I: d-Block elements

An introduction to the transition elements–electronic configuration–metallic character–variable valency–oxidation states–size of atoms–density–melting point–boiling point–reactivity–ionization energy–magnetic properties–color–catalytic properties–differences between first, second and third row transition elements–metallurgy of Cr, Fe, Ni and Au.

UNIT II: Coordination chemistry-I

Double salts–coordination compounds–coordination number and geometries–nomenclature–Werner's theory–physical methods in the study of complexes–stability of complex ions–step-wise and overall stability constants–chelate effect–isomerism in coordination compounds–application of complexes.

UNIT III: Coordination chemistry-II

Bonding in complexes–Valence bond theory–shortcomings–Crystal field theory as applied to octahedral and tetrahedral complexes–CFT and magnetic properties–factors affecting CFSE–spectrochemical series–application of CFT- drawbacks–Jahn-Teller effect–term symbols–Orgel diagrams and electronic spectra of d^1 and d^9 ions.

UNIT IV: Chemistry of transition metal compounds

Titanium tetrachloride- vanadium pentoxide–chromous acetate–peroxo compounds of chromium–potassium dichromate–tungsten bronzes–tungsten blues–potassium permanganate–potassium ferrocyanide–Prussian blue–sodium nitroprusside–nickel-dmg complex–halides of silver–forms of Pt and Au–verdigris–mercurous compounds–Nessler's reagent–alloys of Cu and Ni.

UNIT V: Inorganic polymers

Definition–special characteristics–glass transition temperature–solubility–classification–preparation, properties and uses of–boron nitride–silicones– polymeric sulphur nitride, chalcogenic glasses–polyphosphazene–borophosphate glass–coordination polymers– volan, quilon, metallophthalocyanine–factors affecting the formation of coordination polymers.

Textbook:

1. Puri. B.R., Sharma. L.R. and Kalia. K.C., Principles of Inorganic Chemistry, Milestone Publishers, 2012.

References:

1. Lee. J.D., Concise Inorganic Chemistry, Chapman & Hall, 5th edition, 2000.
2. Cotton. F.A., Wilkinson. G. and Paul. L.G., Basic Inorganic Chemistry, John Wiley and Sons, Singapore, 3rd edition, 2004.
3. James. E. Huheey, Keiter. E.A., Keiter. R.L., Inorganic Chemistry, Pearson Education (Singapore), Delhi, 4th edition, 2005.
4. Gopalan. R. and Ramalingam. V., Concise Coordination Chemistry, Vikas Publishing House, 2010.
5. Bhagi. A.K. and Chatwal. G.R., Inorganic Polymers, Himalaya Publishing House, Mumbai, 1st edition, 2001.

CHE 2516 Physical Chemistry–III 5 hr/5 cr

This course deals with electro chemistry, chemical kinetics, catalysis and ionic equilibrium. It also provides the student an overview of fuel cells.

UNIT I: Electro Chemistry-I

Electronic and electrical conductance–Faraday's laws of electrolysis–conductance–cell constant– specific conductance–equivalent conductance–ionic mobility–Hittorf's theory–transport number–and its determination–Kohlrausch's law and its application–applications of conductance measurements–Debye-Huckel theory of strong electrolytes–Onsager equation(no derivation)–Debye-Falkenhagen effect and Wein effect–Activity and activity coefficient– ionic strength–Debye-Huckel Liming Law (no derivation).

UNIT II: Electro Chemistry–II

Reversible and irreversible cells–EMF measurements–change in free energy and EMF–other thermodynamic parameters from EMF data–standard electrode potential–electrochemical series–various types of electrodes–metal, metal insoluble salts, gas and redox electrodes–chemical and concentration cells with and without transference–liquid junction potential and its determination–applications of EMF measurements–fuel cells and its construction and applications–overvoltage–determination of overvoltage–corrosion and passivity of metals–commercial cells and their principles.

UNIT III: Chemical Kinetics–I

Order and molecularity of a reaction–rate constant–factors influencing rate of a reaction–experimental determination of reaction rates–first order, second order, third order and zero order reactions–half-life periods–methods of determining order of a reaction– equilibrium and steady state approximation– effect of temperature on reaction rates–activation energy and its determinations–Arrhenius equation–theories of reaction rates–collision theory and its importance– evaluation of thermodynamic parameters.

UNIT IV: Chemical Kinetics–II and Catalysis

Lindemann theory of unimolecular reaction–consecutive and opposing reactions–chain reactions–Bronsted-Bjerrum equation–fast reactions–stop flow method–catalysis–types of catalysis–homogeneous and heterogeneous catalysis–characteristics of catalytic reactions–promoters–catalytic poisoning–negative catalysis–auto catalysis–activation energy and catalysis–theories of catalysis–generalized acid–base catalysis–enzyme catalysis–characteristics of enzyme catalysis.

UNIT V: Ionic Equilibrium

Various concepts of acid and bases–dissociation of polybasic acids–pH scale– common ion effect–buffer solution–buffer capacity–Henderson's equation–hydrolysis of salts–relationship between K_b, K_a and K_w–degree of hydrolysis–acid-base indicators–theory of indicators–solubility–solubility product and its applications.

Textbook:

1. Puri. B.R., Sharma. L.R. and Pathania. M.S., Principles of Physical Chemistry, Vishal Publishing Co., 2014.

References:

1. Castellan. G.W., Physical Chemistry, Addison-Wesley, 3rd edition, 1983.
2. Atkins. P.W. and De Paula. J., Physical Chemistry, Oxford University press, 8th edition, 2008.
3. Glasstone. S., A Textbook of Physical Chemistry, Macmillan(India) Ltd, 1976.
4. McQuarrie. D.A., Simon. J.D., Physical Chemistry, University Science Books, 1996.
5. Laidler. K.J., Chemical Kinetics, Harper and Row, 3rd edn, 1987.
6. Bockris. J.O.M. and Reddy. A.K.N., Modern Electrochemistry, Plenum, 2nd edn, 1998.

CHE 2432 Organic Estimation And Gravimetric Analysis 4 hr/4 cr

In this course students will be trained in the quantitative estimation of organic compounds like glucose, phenol, aniline, amino acids and formaldehyde and the gravimetric estimation of cations. This course also includes purification techniques of organic compounds.

I–ESTIMATION OF ORGANIC COMPOUNDS

- Aniline/ Phenol
- Glucose
- Glycine
- Formaldehyde

II–PREPARATION OF ORGANIC COMPOUNDS

- Benzoic Acid
- Oxime

III–GRAVIMETRIC ESTIMATION OF CATIONS

- Ba^{2+} as barium chromate
- Pb^{2+} as lead chromate
- Ca^{2+} as calcium oxalate
- Ni^{2+} as Ni-DMG
- Cu^{2+} as copper thiocyanate

CHE 2412 Chemistry For Physicists–II 5(3+2) hr/4(3+1)cr

There will be two components in this course. Theory component deals with chemical kinetics, thermo-chemistry, basic concepts of coordination chemistry, stereochemistry and elementary ideas on carbohydrates, amino acids and proteins. Lab component is to train the students in the qualitative analysis of inorganic salts.

THEORY COMPONENT (3hrs / week)

UNIT I: Chemical Kinetics and Catalysis
Rate, order and molecularity of a reaction–rate constant–rate equations–First, second and zero order reactions–half life time of a reaction–methods of determining order of a reaction–effect of temperature on reaction rate–activation energy–Arrhenius equation–Catalysis–enzyme catalysis–Michaelis-Menten hypothesis and its applications.

UNIT II: Thermochemistry
Internal energy changes in a chemical reaction–Changes of enthalpy in a chemical reaction–enthalpy of reaction at constant volume and at constant pressure–enthalpy of combustion, neutralization, dissociation, formation–Kirchoff's equation–Hess's law and its applications–Bomb Calorimeter.

UNIT III: Co-ordination Chemistry
Coordination compounds–shapes of d-orbitals–Werner's theory–coordination number–important ligands–nomenclature–concept of EAN–Pauling's theory–CFT–CFSE–crystal field splitting in Octahedral field–spectrochemical series–chelation–application of complexes in qualitative–volumetric and gravimetric analysis.

UNIT IV: Stereochemistry
Stereochemistry and stereoisomerism–tetrahedral carbon–optical activity–plane polarized light–polarimeter–specific rotation–chiral centres–enantiomers and optical activity–specification of R and S configurations–diastereomers–meso structures–racemic modification–resolution–Geometrical isomers–E/Z nomenclature.

UNIT V: Carbohydrates, Amino acids and Proteins
Classification of carbohydrates–Monosaccharide–Glucose, fructose–preparation, properties and structure (no structure elucidation)–mutarotation–Disaccharide–sucrose–properties, preparation and structure–General study of polysaccharides–Starch and cellulose.
Classification and preparation of amino acids–general reactions–Dipeptides–synthesis–structure and types of proteins.

LAB COMPONENT (2 hours / week)
This course is intended for students to qualitatively analyze the simple salts containing the following cations and anions.
Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) and NH_4^+
Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate.

References:

1. Chang. R., Chemistry, Tata-McGraw Hill, 1st Indian Edition, 2007.
2. Gopalan. R., and Sundaram. S., Fundamentals of Chemistry, Sultan Chand and Sons, 1988
3. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Inorganic Chemistry, Shobanlal Nagin Chand and Co, 1995.
4. Gopalan. R., and Sundaram. S., Allied Chemistry, Sultan Chand and Sons, 1993.
5. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Physical Chemistry, Vishal Publications, 1998.
6. Soni. P. L., Textbook of Organic Chemistry, Sultan Chand & Sons, 1998.

CHE 2414 Chemistry For Zoologists–II 5(3+2) hr/4(3+1)cr

There will be two components in this course. Theory component deals with chemical kinetics, catalysis, spectral techniques, and metals in biology. It also deals with basic organic reactions and purification methods. Lab component is to train the students in the qualitative analysis of inorganic salts.

THEORY COMPONENT (3hrs / week)

UNIT I: Basic Organic Chemistry

Types of bond fission–Reagents–electrophile, nucleophile, free radical–Reactive intermediates and their stability–carbocations, carbanions, free radicals–Types of organic reactions–substitution, addition, elimination, oxidation, reduction and rearrangement reactions.

UNIT II: Chemical Kinetics and Catalysis

Reaction rate–Order and Molecularity–determination of order, half-life period and its application in biology–Enzyme catalysis–Michaelis-Menton kinetics–Inhibition–Bio-chemical applications–Catalysis and Activation energy–thermodynamic and kinetic control.

UNIT III: Metals in Biology

Essential and Non-essential elements–Biological role–Hemoglobin, Vitamin B_{12}. Chlorophyll, Ion pump–Medicinal role–Calcium, Platinum, Lithium, Silver, Gold–Metal toxicity–Mercury, Lead, Chromium.

UNIT IV: Purification of Organic Compounds

Criteria for purity–Effect of impurity on physical properties and their application in biology–Methods of purification and their basis-Crystallization, Sublimation, Extraction with solvent, Soxhlet, Distillation–Simple, Steam, Fractional and Reduced pressure–Chromatography–Column, TLC and Paper.

UNIT V: Basic Spectral Techniques

Electromagnetic Spectrum–quantization of energy–regions of the spectrum–UV-Vis, spectrophotometry–Beer-Lambert law, electronic transition, spectral representation, chromophore and uses in biology–Infra red spectrophotometer–molecular vibrations, infrared spectrum and uses in biology–NMR–nuclear spin, nuclei with spin, NMR spectrum, chemical shifts, coupling constants, relaxation and applications in biology–Mass spectrometry–basic experiment, ion analysis, mass spectrum and ionization techniques.

LAB COMPONENT **(2hrs / week)**

This course is intended for students to qualitatively analyze the simple salts containing the following cations and anions.

Cations–Pb(II), Cu(II), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Ca(II), Mg(II) and NH_4^+

Interferring Anions–oxalate, tartrate, borate, fluoride, phosphate.

Textbook:

1. Fisher. J. and Arnold. J.R.P., Instant notes in chemistry for biologists, Viva Books Private Ltd., Series editor B.D.Hames- Bio Scientific Publishers Ltd., 2002.

References:

1. Jain. M.K. and Sharma. S.C., Modern Organic Chemistry–Vishal publishers, 2014.
2. Bhattacharya. P.K., Metal Ions in Biochemistry, Narosa Publishing House Pvt.Ltd., 2005.

CHE 1463 Chemistry For Botanists–I 5(3+2) hr/4(3+1)cr

There will be two components in this course. The objective of the lab component is to train students to estimate the metal ions volumetrically.

THEORY COMPONENT **(3 hours / week)**

UNIT I: Atomic Structure and Periodic properties

Atom-Atomic number–Build-up of elements-Hunds' rule–sequence of energy levels–Arrangement of elements in periodic table–Electronic configuration (upto Z=30)–Definition–atomic size, Ionization energy, electro affinity, electronegativity.

UNIT II: Chemical bonding

Octet rule–Ionic bond-examples and properties–Covalent bond–Shapes of s, p and d orbitals–A.O overlap concept of σ and π bond–Coordinate bond–Weak interactions–vander Waal's, hydrophobic, London, dipole-dipole and ion-dipole–Hydrogen bond-types– importance–metallic bond–electron sea model.

UNIT III: Basics of Organic Chemistry

Tetravalent Carbon-Aliphatic and Aromatic compounds-Hybridization–sp^3, sp^2, sp–Functional groups–nomenclature–types of organic reactions–oxidation, reduction, substitution, addition, elimination–rearrangement.

UNIT IV: Solution Chemistry

Aqueous solution–Acid-Base equilibria–pK_a, pK_b and pH–Buffer solutions–Types of solutions–based on nature and amount of solute/solvent–Determination of concentration of solutions expressed in various scales–percentage, molarity, molality, normality and ppm.

UNIT V: Chemistry of Biomolecules

Introduction, classification, synthesis, chemical properties and biological interests of amino acids–Structure and applications of protein–nucleic acids–Introduction and classification of carbohydrates–D/L configuration–Manufacture of Glucose and Sucrose.

LAB COMPONENT **(2 hours / week)**

This course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc etc.

1. Preparation of solutions
2. Estimation of Na_2CO_3
3. Estimation of Fe(II)-Permanganometry
4. Estimation of Fe(II)-Dichrometry/Internal indicator
5. Estimation of Fe(II)-Dichrometry/External indicator
6. Determination of Acetic acid in Vinegar
7. Determinationof percentage purity of pyrolusite
8. Estimation of Zn(II)-Complexometry
9. Estimation of Ca (II)-Complexometry
10. Estimation of Hardness of water

Textbook:

1. Fisher. J. and Arnold. J.R.P., Instant notes in chemistry for biologists, Viva Books Private Ltd., Series editor B.D.Hames- Bio Scientific Publishers Ltd., 2002.

References:

1. Gopalan. R., and Sundaram. S., Fundamentals of Chemistry, Sultan Chand and Sons, 1988
2. Gopalan. R., and Sundaram. S., Allied Chemistry, Sultan Chand and Sons, 1993.
3. Gopalan. R., Inorganic Chemistry for Undergraduates, Universities Press, 2009.
4. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Inorganic Chemistry, Shobanlal Nagin Chand and Co, 1995.
5. Bahl. B. S. and Arun Bahl, A textbook of Organic Chemistry, S. Chand and Co., 1989.
6. Soni. P. L., Textbook of Organic Chemistry, Sultan Chand & Sons, 1998.
7. Bahl. B. S. and Arun Bahl, A textbook of Physical Chemistry, S. Chand and Co., 1989.
8. Puri. B. R., Sharma. L. R. and Kalia. K. C., Principles of Physical Chemistry, Vishal Publications, 1998.

CHE 1464 Chemistry For Botanists–II 5(3+2) hr/4(3+1)cr

There will be two components in this course. Theory part deals with atmosphere, water, soil, food, phyto and photo-chemistry. The objective of the lab component is to train the students for qualitative analysis of inorganic salts.

THEORY COMPONENT: **(3 hours / week)**

UNIT I: Atmospheric Chemistry

Atmosphere structure–composition of atmosphere–particulates–types and formation–Chemical and photochemical reactions in atmosphere–Oxygen and ozone chemistry–Greenhouse effect and global warming–Acid rain–Photochemical smog.

UNIT II: Water Chemistry

Water Pollution–Control of pollution–DO–OD–COD–BOD–Reverse Osmosis–Deioniser–Hard water–water in crystals–Hygroscopy and deliquescence–efflorescence–Soft water–permanent and temporary hardness–removal of hardness–potable water–standards of drinking water (WHO)–algal bloom.

UNIT III: Soil Chemistry

Importance of soil–composition and types of soil–pH of soil–Acidity & alkalinity and their causes (6 causes)–Emphasis towards industrial waste–Radioactive pollutants– Agricultural pesticides–Soil pollution by soluble salts.

UNIT IV: Food Chemistry

Physical and Chemical properties of natural fats and oils–scope of food and vegetables preservation–additives–flavours–synthetic and natural colorants–Principles and methods of preservation.
Milk-Types, composition, chemical analysis, adulteration and checks for purity– pasteurization–value added milk products (cheese, paneer and ghee).

UNIT V: Photochemistry

Laws of photochemistry–quantum yield–Fluorescence–Phosphorescence–Chemiluminescence–Bioluminescence–Photosensitization and its application to biological systems–photosynthesis.

LAB COMPONENT: (2 hours / week)

This course is intended for students to qualitatively analyse the simple salts containing the following cations and anions.

Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II)
and NH_4^+
Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate.

Textbooks:

1. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd., Second Edition, 1992.
2. Kaur. H., Environmental Studies, Pragati Praksahan, First edition, 2005.

References:

1. Gopalan. R., and Sundaram. S., Fundamentals of Chemistry, Sultan Chand and Sons, 1988
2. Sodhi. G. S., Fundamental concepts of Environmental Chemistry, Narosa Publications House, New Delhi, 2002.
3. Bahl. B. S. and Arun Bahl, A textbook of Organic Chemistry, S. Chand and Co., 1989.
4. Soni. P. L., Textbook of Organic Chemistry, Sultan Chand & Sons, 1998.
5. Sharma. B. K., Industrial Chemistry, Goel Publishing and Co., 1995.
6. Chang. R., Chemistry, Tata McGraw Hill Publishing Ltd., 2005.

THE AMERICAN COLLEGE, MADURAI

DEPARTMENT OF CHEMISTRY (UG)

Program for Choice Based Credit System – 2015 – 2016

SEM	Part	Course No.	Course Title	Hours	Credits	Marks
1	I	TAM/FRE/HIN		3	2	30
1	II	ENG 1201	Conversational Skills	3	2	30
1	IIIC	CHE 1511	Physical Chemistry – 1	5	5	75
1	IIIC	CHE 1513	Inorganic Chemistry – 1	5	5	75
1	IIIC	CHE 1331	Inorganic Quantitative Analysis	3	3	45
1	IIIS	PHY	Physics	5	4	60
1	IV	XXX	Non Major Elective – 1	3	2	30
1	IV	XXX	Life Skill – 1	3	2	30
1	V		NSS/NCN/NCC/PED/SLP			
			Total	30	27	405
2	I	TAM/FRE/HIN		3	2	30
2	II	ENG 1202	Reading & Writing Skills	3	2	30
2	IIIC	CHE 1512	Organic Chemistry – 1	5	5	75
2	IIIC	CHE 1514	Inorganic Chemistry – 2	5	5	75
2	IIIC	CHE 1332	Organic Analysis and Preparation	3	3	45
2	IIIS	PHY	Physics	5	4	60
2	IV	XXX	Non Major Elective – 2	3	2	30
2	IV	XXX	Life Skill – 2	3	2	30
2	V		NSS/NCN/NCC/PED/SLP			
			Total	30	27	405
3	I	TAM/FRE/HIN		3	2	30
3	II	ENG 2201	Study Skills	3	2	30
3	IIIC	CHE 2511	Organic Chemistry – 2	5	5	75
3	IIIC	CHE 2513	Inorganic Chemistry – 3	5	5	75
3	IIIC	CHE 2515	Physical Chemistry – 2	5	5	75
3	IIIC	CHE 2431	Inorganic Qualitative Analysis	4	4	60
3	IIIS	MAT/BOT	Mathematics / Botany	5	4	60
3	V		NSS/NCN/NCC/PED/SLP			
			Total	30	29	435
4	I	TAM/FRE/HIN		3	2	30
4	II	ENG 2202	Career Skills	3	2	30
4	IIIC	CHE 2512	Organic Chemistry – 3	5	5	75
4	IIIC	CHE 2514	Inorganic Chemistry – 4	5	5	75
4	IIIC	CHE 2516	Physical Chemistry – 3	5	5	75
4	IIIC	CHE 2432	Organic Estimation and Gravimetric Analysis	4	4	60
4	IIIS	MAT/BOT	Mathematics / Botany	5	4	60
4	V		NSS/NCN/NCC/PED/SLP			
			Total	30	29	435

SEM	Part	Course No.	Course Title	Hours	Credits	Marks
5	IIIC	CHE 3611	Organic Chemistry – 4	6	6	90
5	IIIC	CHE 3613	Inorganic Chemistry – 5	6	6	90
5	IIIC	CHE 3615	Physical Chemistry – 4	6	6	90
5	IIIC	CHE 3531	Physical Chemistry Lab	5	5	75
5	IV	CHE 3200	Environmental Studies	4	2	30
5	IV		Life Skill – 3	3	2	30
			Total	30	27	405
6	IIIC	CHE 3612	Organic Chemistry – 5	6	6	90
6	IIIC	CHE 3614	Applied Chemistry	6	6	90
6	IIIC	CHE 3616	Physical Chemistry – 5	6	6	90
6	IIIC	CHE 3532	Special Lab Techniques	5	5	75
6	IV	VAL	Value Education	4	2	30
6	IV		Life Skill – 4	3	2	30
			Total	30	27	405
			Grand Total	180	158	2430

LIFE SKILL COURSES

Sem	Part	Course No	Course Title	Hours	Credits	Marks
1	IV	CHE 1271	Cosmetics and Consumer Products	3	2	30
2	IV	CHE 1272	Chemistry in Crime Investigation	3	2	30
5	**IV**	**CHE 3215**	**Medicinal Chemistry**	**3**	**2**	**30**
6	**IV**	**CHE 3216**	**Dairy and Dairy products**	**3**	**2**	**30**

CHE3611 ORGANIC CHEMISTRY – IV 6 credits/6 hours

The primary objective of this course is to learn and appreciate the role of chemistry in nature. It is designed to systematically study the various biological aspects pertaining to proteins, enzymes, lipids, nucleic acids, carbohydrates, alkaloids and terpenoids.

Unit – I Proteins and Enzymes 15 hrs

Aminoacids – classification, structure and stereochemistry – Zwitter ion – isoelectric point – electrophoresis – preparation and reaction of amino acids – structure and Nomenclature of peptides and proteins – classification – determination of structure of peptide – end group analysis – classical peptide synthesis – solid phase peptide synthesis – protein structure (1^o, 2^o, 3^o and 4^o) – protein denaturation and renaturation.

Enzymes – specificity – prosthetic group – co-enzyme, apoenzyme, holoenzyme, co-factor – nomenclature and classification of enzyme – typical enzymes – sources – mode of enzyme action – enzyme inhibition – application of enzymes.

Unit – II Nucleic acids and Lipids 15 hrs Constituents of nucleic acids – bases, sugars, nucleotides, nucleosides – laboratory synthesis of nucleosides and nucleotides – DNA, RNA – genetic code and heredity. Lipids – classification – oils and fats – structure, chemical reactions, physical characteristics, rancidity, acid value, saponification value, iodine value, RM value, hydrogenation of oil

Unit – III Carbohydrates 15 hrs

Classification and nomenclature – monosaccharide and their configuration – erythro and threo – diasteromers – epimers – anomers – cyclic structure of monosaccharides – determination of ring size – mechanism of mutarotation – glycosides and their hydrolysis – formation of ethers and esters – reducing and non – reducing sugars – mechanism of osazone formation – interconversion of aldoses and ketoses – ascending and descending the sugar series – an introduction to disaccharide (sucrose, maltose and lactose) and polysaccharide (starch and cellulose).

Unit – IV Alkaloids 15 hrs

Nomenclature and classification – occurrence and extraction – general methods of structural elucidation of Coniine, Nicotine, Piperine and Atropine.

Unit – V Terpenoids 15 hrs

Occurrence of terpenoids – classification – isoprene rule – structural elucidation of Citral, Limonene, Menthol and Camphor.

Text Book:

M.K. Jain and S.C. Sharma, Textbook of Organic Chemistry, Vishal publishing Co, 2012, IV (Revised edition).

Reference:

Robert Thornton Morrison and Robert Neilson Boyd, Organic Chemistry, Pearson publication, 7th edition, 2012.

B. Mehta and M. Mehta, Organic Chemistry, Prentice – Hall of India Private limited,2007.

P.L. Soni and H.M. Chawla,Textbook of Organic Chemistry , Sultan Chand and Sons, 28th edition, 2007.

I.L. Finar, Organic Chemistry, Vol.I, ELBS publication, 6th edition, 2002.

CHE 3613 INORGANIC CHEMISTRY – V 6 credits/6 hours

This course exposes the students to the developing areas of organometallic catalysis and bioinorganic chemistry. It also imparts knowledge about the radioactivity and nuclear reactions**.**

Unit – I Organometallic chemistry 15 hrs Organometallic ligands – types of organometallic compounds – organometallic compounds of group 12 – 15 elements – metal complexes with pi – acceptor ligands – π acidity – metal carbonyls – types – EAN rule – theoretical basis – synthetic methods, reactivities, structure and bonding in $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Co_2(CO)_8$ and $Mn_2(CO)_{10}$ – synergism – vibrational spectra – mixed carbonyls – compounds with multinuclear centres – alkene complexes – carbocyclic systems – ferrocene – preparation, properties, structure and bonding (VB explanation).

Unit – II Reactions and mechanism of coordination compounds. 15 hrs

Lability and inertness – interpretation in terms of VBT – acid hydrolysis of octahedral complexes – S_N1 and S_N2 mechanism – factor influencing – base hydrolysis of octahedral complexes – S_N1CB mechanism – evidences – stereochemistry of intermediate of base hydrolysis – trans effect – π-bond theory – applications – transition metal complexes as catalyst – Wilkinson's catalyst – Ziegler-Natta catalyst – their catalytic cycles.

Unit – III Bioinoganic chemistry 15 hrs

Essential and non – essential metals – oxygen carriers – hemoglobin, myoglobin, hemocyanin – metalloenzymes – cyanocobalamine – carbonic anhydrase ,cytochrome P-450 – role of alkali metals – sodium ion pump – alkaline earth metals – toxicity of Hg, Pb, Cr – metals in medicine and diagnosis – chelate therapy, invivo fixation of nitrogen.

Unit – IV f – Block elements 15 hrs

Lanthanide series – occurrence – properties – electronic configuration, oxidation state – ionic radii – lanthanide contraction – colour , spectra, magnetic properties – complexes of lanthanides – separation of lanthanides – Actinide series – transuranic elements – properties – electronic configuration, oxidation state, ionic radii, colour – comparison with

lanthanides – extraction of thorium– extraction of uranium – compounds of uranium – uses of lanthanides – plutonium as source of energy.

Unit – V Nuclear chemistry 15 hrs

Nuclear particles – nuclear forces – packing fraction – mass defects and binding energy of nucleus – stability of nucleus – nuclear models – liquid drop model – nuclear reactions – Q values – spallation – nuclear fission – atomic bomb – the concepts of critical mass – nuclear fusion – Hydrogen bomb – radioactivity – artificial transmutation – half life period – radioactive displacement laws – modes of decay – applications of radioactivity – nuclear reactors – measurement of radioactivity – GM counter – Wilson cloud chamber – nuclear accelerator – cyclotron.

Text book:

B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers (2012)

References:

Lee. J.D, Concise Inorganic chemistry, V edition, Chapman and Hall Ltd, London (2000)

Cotton F.A., Wilkinson G., Basic Inorganic Chemistry, III Edition, John Wiley and Sons, Singapore (2004)

James. E. Huheey., Keiter E.A., Keiter R.L, Inorganic chemistry, IV edition, Pearson Education, (Singapore), Delhi (2005)

Gopalan R., Ramalingam V, Concise Coordination Chemistry, Vikas Publishing house, New Delhi, (2006)

Hay R.W, Bioinorganic Chemistry, Ellis Horwood (1984)

Bertini, Lippard, Gray, Bioinorganic Chemistry, Viva Book Pvt. Ltd (1998)

Arniker H .J., Essentials of Nuclear Chemistry, IV Edition, New Age International Ltd., New Delhi (1995)

CHE3615 PHYSICAL CHEMISTRY – IV 5 credits/6 hours

This course provides basic information regarding classical and quantum mechanical treatment of atom and nature and behavior of light. Nano chemistry gives an overall view on the concepts and applications in day today life. Outline on the macromolecule is dealt along with various methods of analysis of the same. Along with introducing phase rule, examples of each system have been covered.

Unit – I Quantum Mechanics – I 15 hrs

Dual nature of light – photoelectric effect, Compton effect – dual nature of electron – de Broglie relationship – Davison and Germer experiment – Heisenberg's uncertainty principle – Electron, Charge, Mass – Milliken's oil drop technique – Rutherford's experiment – Mosley's experiment – Rutherford's model – Radiant energy – electromagnetic spectrum – black body radiation – Plank's distribution law – hydrogen spectrum – Ritz combination

principle – Bohr's model of hydrogen atom and their comparison – Sommerfeld's extension of Bohr theory – failure of Sommerfeld theory.

Unit – II Quantum Mechanics – II 15 hrs

Time independent Schrödinger equation – Postulates of quantum mechanics – Operators in quantum mechanics – interpretation of wave function – operators – eigen values – orthonormal function – discussion of particle in a box problem (1D and 3D) – rigid rotor – simple harmonic oscillator(no derivation) – Bohr's correspondence principle – hydrogen atom problem – Schrödinger equation in polar coordinates – separation of variables – electron spin – Zeeman effect – spherical harmonics – radial distribution curve

Unit – III Macromolecules 15 hrs

Different types of polymers – classification of polymers – molecular weight of polymers – number average and weight averages – determination of molecular weight of polymer – viscosity, osmotic pressure – ultracentrifuge, sedimentation methods and light scattering methods – Conducting polymers: elementary ideas – polyacetylene, poly anilines.

Unit – IV Phase Diagram 15 hrs

Introduction – terminology – Gibb's phase rule and its derivation – one component system – water, sulphur, helium systems – freezing point curves – two component system – simple eutectic systems – Lead-Silver, Potassium Iodide-water system – two component system with compound formation – congruent and incongruent melting points – Zn-Mg, Ferric Chloride-water, sodium sulphate-water systems, Copper sulphate-water systems, industrial applications.

Unit – V Nano Chemistry 15 hrs

Nano and Nature – Nano: The beginning (1D, 2D and 3D) – Fullerenes – introduction – experimental set up to detect C_{60} – Carbon nanotubes – types – physical properties and applications – Difference between Langmuir Blodgett and self assembly techniques – Applications of Self assembled monolayers (SAMs) – Nanomedicines – nanoshells – nanopores – tectodendrimers

Text book:

Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 44th edition, Vishal Publishing company, 2010.

References:

Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publishing Co., 2014.

Textbook of Physical Chemistry, P.L. Soni, O.P. Dharmandam,

Essential of Physical Chemistry, Arun Bahl, B.S. Bahl and G.D. Tuli, S. Chand, 2014,

Physical Chemistry, G.W. Castellan, 3rd edition, Addison – Wesley, 1983.

Physical Chemistry, 8th edition, P.W. Atkins and J.de Paula, Oxford University press, 2008.

Inorganic Chemistry, 5th edition, P.W. Atkins, Oxford University press, 2009.

Nano: The essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw Hill publishing company, 2008.

CHE3531 PHYSICAL CHEMISTRY LAB 5credits/5hrs

This laboratory course imparts knowledge in the various fields of physical chemistry such as adsorption, chemical kinetics, phase equilibria, potentiometric and conductivity measurements etc.

Equivalent conductance – verification of Onsager equation

Conductometry – i) Titration of strong acid Vs strong base

Titration of weak acid Vs strong base

Potentiometry – redox titrations

Validity of Freundlich adsorption isotherm

Kinetics of acid catalysed hydrolysis of ester

Kinetics of Iodination of acetone

7. Critical solution temperature – phenol – water system

Phase diagram – simple eutectic system

Transition temperature – Thermometric method

Heat of solution – Solubility method

CHE3612 ORGANIC CHEMISTRY – V 6 credits/6 hours

This course is designed to study the application of basic spectroscopic techniques in structural elucidation of organic compounds. Students will be trained in theoretically analyzing the photochemical and thermal changes of organic compound. This course will also provide basic knowledge on uses and preparation of dyes, organometallic and active methylene compounds

Unit – I UV-Vis, IR spectroscopy and Mass spectrometry 15 hrs

UV- Visible spectroscopy

Types of electronic transitions – Beer Lambert's law – terminologies used in UV Visible spectrum – seleection rules – effect of conjugation – effect of solvent – Woodward – Fieser rules – dienes and enones – applications of UV – Visible spectra.

IR Spectroscopy

Selection rules – Hooke's law – different molecular transitions – factors affecting vibrational frequencies – characteristic frequencies of important functional groups – Finger print region – Examination of IR spectra.

Mass Spectrometry

Basic principle – molecular ion peak – nitrogen rule – terms used in mass spectra (m/e, $M^{+\cdot}$ etc..) – isotopic pattern – even– electron rule – general rules of fragmentation – fragmentation pattern (alkane, alcohol, alkyl halide, aryl halide, aldehyde and ketone)

Unit – II NMR spectroscopy 15 hrs

$_1$H NMR Spectroscopy

Theory – relaxation processes – shielding, deshielding and chemical shift – factors affecting chemical shift – peak area and proton counting – splitting of signals and coupling constants – chemical and magnetic equivalence – simple problems in $_1$H NMR.

$_{13}$C NMR Spectroscopy

Basic principles – Off resonance and Broad band decoupling techniques

Unit – III Pericyclic reactions 15 hrs Photochemical vs thermal reactions – MO theory – LCAO method – bonding and antibonding MO's – electronic configuration of some molecules – 1,3 – butadiene – allyl systems – benzene – Woodward – Hofmann rules – electrocylic, cycloaddition and sigmatropic reactions using FMO

Unit – IV Dyes, Color and Constitution 15 hrs

Color and structure – Witt theory – Quinonoid theory – Modern theory – Classification of dyes (based on structure, based on its mode of application on fabrics) –

Preparation and application of dyes – Methyl orange, Congo red, Bismuth brown, Malachite green, Phenolphthalein, Eosin, Fluorescein

Unit – V Organometallic and Active methylene compounds 15 hrs

Organometallic reagents – organomagnesium, oganozinc, organolithium, organocopper, and organosilicon – preparation and reactions.

Reactions and synthetic applications of active methylene compounds – diethylmalonate, ethyl acetoacetate, cyanoacetic ester

Text Book:

M.K. Jain and S.C. Sharma, Textbook of Organic Chemistry, Vishal publishing Co, IV (Revised edition), 2012.

Reference:

Robert Thornton Morrison and Robert Neilson Boyd, Organic Chemistry, Pearson publication, 7th edition, 2012.

B. Mehta and M. Mehta, Organic Chemistry, Prentice – Hall of India Private limited, 2007.

P.L. Soni and H.M. Chawla,Textbook of Organic Chemistry , Sultan Chand and Sons, 28th edition, 2007.

JagMohan, Organic spectroscopy: Principles and applications, Narosa publishing House, 2nd edition, 2005

CHE3616 PHYSICAL CHEMISTRY – V 6 credits/6 hours

The students get to know the principles of various spectroscopic analytical tools available for analysis of chemical compounds. Derivations of the spectroscopic methods are taught at basic level to enhance the student's knowledge on the roots of these available techniques. The chemistry point of group theory is presented at the introductory level with some applications. It also covers various photo chemical pathways and their applications.

Unit – I Spectroscopy – I 15 hrs

Molecular Spectroscopy: Introduction – regions of the spectrum –basic elements of practical spectroscopy – signal to noise ratio – resolving power – the width and intensities of spectral lines.

Microwave Spectroscopy: The rotation of the molecules – rotational spectra of diatomic molecules – linear polyatomic molecules.

IR Spectroscopy: Vibrating diatomic molecules – simple harmonic and unharmonic – diatomic vibrating rotator –Born Oppenheimer approximation – breakdown – vibrations of polyatomic molecules – overtones and combinations – analysis of IR spectra – skeletal vibrations and characteristic group vibrations – Instrumentation

Unit – II Spectroscopy – II 15 hrs

Raman Spectroscopy: Introduction – molecular polarizability – selection rules – pure rotational Raman spectra – linear molecules – vibrational Raman spectra – mutual exclusion principle – structural determination from Raman and IR spectra - nitrate, carbonate

Electronic spectra of diatomic molecules – Franck-Condon principle – dissociation constant of a diatomic molecule.

PES – principles of photoelectron spectroscopy and its applications

Unit – III Spectroscopy – III NMR **15 hrs**

spectroscopy: basic principle – instrumentation – chemical shifts – spin – spin coupling

ESR spectroscopy: basic principle – hyperfine structure – presentation of ESR spectra – nitrogen rule – g-factor – splitting – applications of ESR spectroscopy – comparison between ESR and NMR

Mossbauer Spectroscopy: introduction, principle and applications

Unit – IV Group Theory 15 hrs

Properties of a group – group multiplication table – cyclic groups – subgroups – classes – symmetry elements and operations and its relation to optical activity – symmetry point groups – identification of point groups – matrices of geometric transformations – representations of groups – reducible and irreducible representations – rules governing irreducible representation and their characteristics – relationship between reducible and

irreducible representations – character tables C_{2v}, C_{3v}, C_{2h} – group theoretical selection rule in vibrational spectroscopy.

Unit – V Photochemistry 15 hrs

Photochemical and thermal reactions – comparison – Jablonski diagram – laws of photochemistry – Grotthus-Draper law – Stark- Einstein law – photochemical reactions in solution – Beer-Lambert's law – limitations – Quantum yields – Determination of Quantum yields – Photochemical rate law –kinetics of HBr and HCl formations – photochemical equilibrium – Photochemical process – secondary photochemical processes – photosensitization – Quenching – Stern-Volmer equation – photosynthesis – chemiluminescence – laser and maser – applications of laser

Text book:

Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 44th edition, Vishal Publishing company, 2010.

References:

Principles of Physical Chemistry, Puri, Sharma and Pathania, Vishal Publishing Co., 2014.

Textbook of Physical Chemistry, P.L. Soni, O.P. Dharmandam,

Essential of Physical Chemistry, Arun Bahl, B.S. Bahl and G.D. Tuli, S. Chand, 2014.

Physical Chemistry, G.W. Castellan, 3rd edition, Addison – Wesley, 1983.

Physical Chemistry, 8th edition, P.W. Atkins and J.De Paula, Oxford University press, 2008.

Fundamentals of Molecular Spectroscopy, 4th edition, C.N. Banwell, Tata McGraw Hill publications, 1995.

Chemical applications of Group theory, 3rd edition, F.A. Cotton, Wiley, 1990.

CHE 3614 APPLIED CHEMISTRY 6 credits/6 hrs

This course deals with the application of various chemical concepts in different fields. Ideas pertaining to the techniques of water treatment for domestic purpose, polymers and paints in our daily life are discussed. Also the chemistry behind fertilizers, ceramics and refractory materials will be covered. Through this course the students will be able to appreciate the significance of their knowledge of chemistry in their day to day life.

Unit – I : Water Treatment 15 hrs

Hardness of water – temporary hardness, permanent hardness – Units of hardness – Estimation of hardness – EDTA method – Estimation of total hardness – Water softening methods – Lime–Soda process, Zeolite process, Ion – exchange – Desalination – Reverse osmosis – Potability of water – Plumbosolvency – Nano filters

Unit – II : Polymers 15 hrs Synthetic polymers – Preparation, properties and uses of Polyethylene, PVC, Teflon, Nylon, Phenol formaldehyde, Urea Formaldehyde, Epoxy resin Rubber – natural and synthetic – vulcanisation

Biodegradable polymers – classification – biomedical applications – medical sutures, pins,

dental implants

Biostable polymers – Biomedical applications – cardiovascular applications – bones, joints, dental polymers – contact lenses and IOL – hemodializer materials – tissue
engineering polymers – controlled release of drugs – polymeric blood substitutes – Nano biopolymers and application

Unit – III : Fertilizer **15 hrs**

Plant Nutrients – nutrients functions – need and requirements of fertilizers – classification – Nitrogenous fertilizers – types, preparation and uses – Phosphate fertilizers – types, preparation and uses – Potassium fertilizers – NPK fertilizers – ill effects of fertilizers – Biofertilizers – manures, compost, sawdust, biogas manures – Nano fertilizers – elementary ideas and uses

Unit – IV : Ceramics and Refractories

Ceramics – properties and types – basic raw materials – Clay – formation, types, properties – Glazing – Porcelain and China

Refractories – classification, properties – super refractories – preparation, properties and uses of Silicon carbide, graphite, oxides, Cermets, insulating refractories Nano ceramics – elementary ideas and applications

Unit – V : Paints and Explosives **15 hrs**

Paints – classification – constituents – Pigment Volume Concentration – Distember – Varnishes – Lacquers - Pigments – name and formula of different coloured pigments and their uses – Toners – Nano paints

Explosives – classification – characteristics – chemistry of Nitrocellulose, nitroglycerine, gun powder, RDX – Toxic chemicals – important requirements – mustard gas, phosgene, nerve gas, adamsite, chloroacetophenone, chloropicrin – Screening smokes – Incendiaries - Pyrotechniques

Text book:

Industrial Chemistry, B.K.Sharma, 7th edition, 1995, ISBN – 8185842531, GOEL publishing house.

Reference books:

Environmental Chemistry, A.K. De, 4th edition, 2000, New Age International (P) Ltd.
Applied Chemistry, K. Bagavathi Sundari, 2006, ISBN 818094025X, MJP publishers. (Unit – 2)
Contemporary Polymer Chemistry, Harry R. Allcock, Frederick W. Lampe, James E. Mark, 3rd edition, 2005, Pearson Prentice hall. (Unit – 2)
Fundamental Concepts of Applied Chemistry, Jayashree Ghosh, 2nd edition, 2006, S. Chand publishing. (Unit – 3)

CHE 3532 SPECIAL LAB TECHNIQUES 5 credits/5hrs

This course deals with the various techniques like chromatography, viscosity, optical, emf and pH measurements etc. Students will be trained in analyzing commercial samples.

Column chromatography

Paper chromatography

Thin layer chromatography

Polarimetry – Inversion of sucrose

Ostwald viscometer – Measurement of Viscosity of liquids

Potentiometry – Dissociation constant of weak acid

Spectrophotometer – Validity of Beer – Lambert's law

Standardisation of pH meter and dissociation constant of weak acid

Conductometry – Titration of strong acid and weak acid in a mixture Vs strong base

Saponification value of an oil.

CHE 3200 ENVIRONMENTAL STUDIES 2Credits/4 hrs

In this course various types of pollutions, different types of pollutants the need and ways of controlling them will be discussed. Socio-environmental issues will also be dealt with.

Unit – I Introduction 10 hrs

Definition, scope, awareness – concept of environmental receptors, sink, pathways of pollutants speciation, environmental segments.

Composition of the atmosphere – atmospheric structure – formation of inorganic and organic particulate matters – photochemical reactions

Unit – II Ecology 10 hrs

Definition and kinds, biological cycles – Natural resources, renewable and non – renewable resources – food resources – mineral resources – forest resources – role of an individual in conservation of natural resources.

Unit – III Water and Soil Pollution 10 hrs

Source – BOD, COD, sewage treatment, primary and secondary treatment – industrial waste water treatment. Potable water and their standards. Soil pollution – treatment of soil pollution – disposal of radioactive waste

Unit – IV Air Pollution 10 hrs Pollutants –particulate pollution – smog, acid rain – global warming – green house effect –

metal pollution – monitoring of air pollution. Thermal and radioactive pollution – source – nuclear power plant. Noise pollution – source and effect. Noise level index

Unit – V Socio-environmental issues 10 hrs

Environmental act: air and water – wild life protection act – forest conservation act – issues involved in enforcement of environmental legislation. Human population and environment – population growth – variation among nations – population explosion – family welfare program – environment and human health – human rights – women and child welfare – value education – role of information technology in human health – case study.

References:

B.K. Sharma and H. Kaur, Environmental Chemistry, Goel Publishing House, Meerut, 1996.

H.Kothandaraman and G.Swaminathan. Principles of Environmental Chemistry. B.I. Publications, Chennai, India. 1997.

A.K.De, Environmental Chemistry. 4th Edition, New Age International (P) Ltd., New Delhi, India. 2000.

Abnubha Kaushik, C.P.Kaushik "Perspectives in Environmental Studies" New Age International Publishers, 3rd Edition, 2009.

S.S. Dara, A Textbook of Environmental Chemistry and Pollution Control, 8th Edition, S. Chand and Sons, New Delhi, 2008.

LIFE SKILL COURSES

CHE 3215 MEDICINAL CHEMISTRY 2Credits/3 hrs

This course intended to impart knowledge about the development of drugs and the need for conversion of drugs into medicines. This course also deals with pharmacokinetics, pharmacodynamics and pharmaceutical marketing.

Unit – 1 Basic Concepts 8 hrs

Drug – definition – requirements of an ideal drug – history of drug development – nomenclature of drugs – classification of drugs based on Sources, Chemical structure and Therapeutic actions. – Terminologies – pharmacology, pharmacy, pharmaceutics, toxicology, chemotherapy, pharmaco – dynamics, pharmaco – kinetics.

Unit – II Need for Drugs 8 hrs

Deficiency, disorder and diseases – Disease causing organisms – bacteria – types, fungi, virus and their activities – differences between them – specific diseases caused by various organisms – Immunity, Vaccination – Adverse drug reactions, types and minimisation.

Unit – III Pharmacokinetics and Pharmacodynamics 8 hrs

Pharmacokinetics: Introduction – Absorption, distribution, metabolism and excretion (ADME) – LD_{50}, ED_{50} Therapeutic index.

Pharmacodynamics: Elementary treatment of drug action, mechanism – enzyme stimulation, enzyme inhibition and drug design – Lead, analog, prodrug, Significance of drug metabolism in medicinal chemistry.

Unit – IV Formulation of Drug 8 hrs Need for conversion of drugs into medicine – additives and their role – classification of formulations – route wise and form wise: tablets, capsules, syrups, suspensions, powders, ointment, creams, gels, lotions, sprays suppositories, injections.

Unit – V Pharmaceutical Marketing: **8 hrs**

Manufacture, packaging, distribution and stocking. Pharmaceutical Market, Pharmacy – Channels of distribution – Wholesaler and retailer – Departmental stores and chain stores – mail order business – Drug house management.

Traits and demands of medical representatives –Salesmanship – Uniqueness of pharma selling– Theories of selling – Planning – Detailing of products.

References:

G L David Krupadanam, D Vijaya Prasad, K Varaprasad Rao, K L N Reddy C Sudhakar, Drugs, Universities Press, Hyderabad (2001).

Graham Patrick, Instant notes – Medicinal chemistry, Pragati Prakashan Viva books (pvt) Ltd, 2002.

Alka and Gupta, Medicinal chemistry, Pragati Prakashan, II Edn , 2008.

Sekhar mukhopadhyay, Pharmaceutical selling – A text book, Sterling publishers private Ltd.1997.

CHE 3216 DAIRY AND DAIRY PRODUCTS 2 Credits/3 hrs

This course enriches the student's understanding about the milk and the various techniques involved during the processing and preservation of milk. This course also deals with various dairy products such as special milk, milk derivatives, and fermented milk products derived from milk.

Unit – I Composition of milk 8 hrs Composition and structure of milk – constituents of milk – lipids, proteins, carbohydrates, vitamins and minerals – – Properties of milk – odour,density,viscosity,optical properties, acidity, freezing point – Recknagel's effect – estimation of fats and total solids in milk

Unit – II Milk processing and preservation 8 hrs

Microbiology of milk – Destruction of microorganism in milk – pasteurisation –types of Pasteurisation – bottle, Batch and HTST – ultra high temperature pasteurisation – preservatives and neutraliser

Unit – III Milk Derivatives 8 hrs

Cream – composition – chemistry of creaming process
Butter – composition – desibutter – salted butter
Ghee – major constituents – common adulterants added to ghee and their detection – rancidity – definition – prevention – antioxidants

Unit – IV Special Milk 8 hrs

Definition – merits – flow diagram for manufacturing – reconstituted milk – homogenised milk – flavoured milk – vitaminised milk – toned milk – imitation milk – condensed milk – definition, composition and nutritive value

Unit V – Milk products 8 hrs

Fermented milk products – definition of culture – cultured cream – cultured butter milk – cheese – unripened cheese – ripened cheese – paneer – yohurt and mazzorola cheese
Ice cream – types – ingredients – manufacture – stabilizer – emulsifiers and their role
Milk powder – skimmed milk powder – whole milk powder – buttermilk powder – types of drying process

References:

Sukumar De, Outlines of Dairy Technology, Oxford University Press, New Delhi, (2001)
Lillian Hoagland Meyer, Food Chemistry, CBS Publishers, New Delhi.(2004)

THE AMERICAN COLLEGE, MADURAI
DEPARTMENT OF CHEMISTRY (UG-Aided)

Program for Choice Based Credit System – (2018 – 2019 onwards)

SEM	Part	Course No.	Course Title	Hours	Credits	Marks
1	I	TAM/FRE/HIN		3	2	30
1	II	ENG		3	2	30
1	IIIC	CHE 1521	Physical Chemistry – I	5	5	75

1	IIIC	CHE 1513	Inorganic Chemistry – I	5	5	75
1	IIIC	CHE 1331	Inorganic Quantitative Analysis	3	3	45
1	IIIS	PHY	Physics	5	4	60
1	IV		NME I	3	2	30
1	IV		LS I	3	2	30
1	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**27**	**405**
2	I	TAM/FRE/HIN		3	2	30
2	II	ENG		3	2	30
2	IIIC	CHE 1522	Organic Chemistry – I	5	5	75
2	IIIC	CHE 1514	Inorganic Chemistry – II	5	5	75
2	IIIC	CHE 1332	Organic Analysis and Preparation	3	3	45
2	IIIS	PHY	Physics	5	4	60
2	IV		NME II	3	2	30
2	IV		LS II	3	2	30
2	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**27**	**405**
3	I	TAM/FRE/HIN		3	2	30
3	II	ENG		3	2	30
3	IIIC	CHE 2521	Organic Chemistry – II	5	5	75
3	IIIC	CHE 2513	Inorganic Chemistry – III	5	5	75
3	IIIC	CHE 2515	Physical Chemistry – II	5	5	75
3	IIIC	CHE 2431	Inorganic Qualitative Analysis	4	4	60
3	IIIS	MAT/BOT	Mathematics / Botany	5	4	60
3	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**29**	**435**
4	I	TAM/FRE/HIN		3	2	30
4	II	ENG		3	2	30
4	IIIC	CHE 2522	Organic Chemistry – III	5	5	75
4	IIIC	CHE 2524	Inorganic Chemistry – IV	5	5	75
4	IIIC	CHE 2516	Physical Chemistry – III	5	5	75
4	IIIC	CHE 2432	Organic Estimation and Gravimetric Analysis	4	4	60
4	IIIS	MAT/BOT	Mathematics / Botany	5	4	60
4	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**29**	**435**

SEM	Part	Course No.	Course Title	Hours	Credits	Marks
5	IIIC	CHE 3611	Organic Chemistry – IV	6	6	90
5	IIIC	CHE 3613	Inorganic Chemistry – V	6	6	90
5	IIIC	CHE 3615	Physical Chemistry – IV	6	6	90
5	IIIC	CHE 3531	Physical Lab	5	5	75
5	IV	CHE 3200	Environmental Chemistry	4	2	30
5	IV		LS III	3	2	30
			Total	**30**	**27**	**405**
6	IIIC	CHE 3612	Organic Chemistry – V	6	6	90
6	IIIC	CHE 3614	Applied Chemistry	6	6	90
6	IIIC	CHE 3616	Physical Chemistry – V	6	6	90
6	**IIIC**	**CHE 3534**	**PROJECT**	**5**	**5**	**75**
6	IV	VAL	Value Education	4	2	30
6	IV		LS IV	3	2	30
			Total	**30**	**27**	**405**
			Grand Total	**180**	**158**	**2430**

MAJOR SUPPORTIVE COURSES

Sem	Part	Course No.	Course Title	Hours	Credit	Marks
1	IIIS	CHE 1381	Chemistry for Botanist - I	3	3	45
1	**IIIS**	**CHE 1183**	**Chemistry lab for Botanist-I**	**2**	**1**	**15**
2	IIIS	CHE 1382	Chemistry for Botanist-II	3	3	45
2	**IIIS**	**CHE 1184**	**Chemistry lab for Botanist-II**	**2**	**1**	**15**
3	**IIIS**	**CHE 2381**	**Chemistry for Physicist-I**	**3**	**3**	**45**
3	**IIIS**	**CHE 2181**	**Chemistry lab for Physicist-I**	**2**	**1**	**15**
3	**IIIS**	**CHE 2383**	**Chemistry for Zoologist-I**	**3**	**3**	**45**
3	**IIIS**	**CHE 2183**	**Chemistry lab for Zoologist-I**	**2**	**1**	**15**
4	**IIIS**	**CHE 2382**	**Chemistry for Physicist-II**	**3**	**3**	**45**
4	**IIIS**	**CHE 2182**	**Chemistry lab for Physicist-II**	**2**	**1**	**15**
4	**IIIS**	**CHE 2384**	**Chemistry for Zoologist-II**	**3**	**3**	**45**
4	**IIIS**	**CHE 2184**	**Chemistry lab for Zoologist-II**	**2**	**1**	**15**

NON MAJOR ELECTIVE

No.	Sem	Part	Course No	Course Title	Hours	Credits	Marks
NME I	1	IV	CHE 1261	Chemistry in Everyday Life	3	2	30
NME II	2	IV	CHE 1262	Food Chemistry	3	2	30

LIFE SKILL COURSES

No.	Sem	Part	Course No	Course Title	Hours	Credits	Marks
LS I	1	IV	CHE 1271	Cosmetics and Consumer Products	3	2	30
LS II	2	IV	CHE 1272	Chemistry in Crime Investigation	3	2	30
LS III	5	IV	CHE 3215	Medicinal Chemistry	3	2	30
LS IV	6	IV	CHE 3216	Dairy and Dairy products	3	2	30

SEMESTER I **MAJOR SUPPORTIVE**

CHE 1183 CHEMISTRY LAB FOR BOTANISTS–I [2 hr / 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises**.** Also this course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc. This course is also supported by STAR college programme.

Estimation of Sodium Carbonate
Estimation of acetic acid in vinegar
Estimation of Manganese dioxide in pyrolusite
Estimation of Fe(II)-Permanganometry
Estimation of Fe(II)-Dichrometry/External indicator
Estimation of Zn (II)-Complexometry
7.Spectrometric determination of the glucose level in jam
Preparation of silver nanoparticles by green synthesis method
Preparation of copper nanoparticles by green synthesis method
Disintegration and dissolution of drug molecules (tablets)
Analysis of pH , TDS, DO and Salinity of various water samples.
Determination of pH from various commercially available bevarages

SEMESTER II **MAJOR SUPPORTIVE**

CHE 1184 CHEMISTRY LAB FOR BOTANISTS–II [2 hr/ 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises Also this course is intended for students to qualitatively analyze the simple salts containing the following cations and anions. This course is also supported by STAR college programme.

Analysis of Salt-I
Analysis of Salt-II
Analysis of Salt-III
Analysis of Salt-IV
(Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) & NH^{4+} *Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate)*
Analysis of Ozone& CO_2 in air sample
Estimation of available nitrogen in soil samples
Estimation of available phosphorus in soil samples
Estimation of Borax in soil samples
Extraction, isolation and characterization of natural products
Measurement of density of various commercial milk samples.
Determination of fat content in milk and milk products.
Separation of cream from whole milk using cream separator

Extension activity:

Industrial visits to milk industry/ polymer industry/ beverage industry/ sugarecane industry

SEMESTER III **MAJOR SUPPORTIVE**

CHE 2181 CHEMISTRY LAB FOR PHYSICISTS–I [2 hr / 1cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc etc. This course is also supported by STAR college programme.

Estimation of Sodium Carbonate
Estimation of acetic acid in vinegar
Estimation of Manganese dioxide in pyrolusite
Estimation of Fe(II)-Permanganometry
Estimation of Fe(II)-Dichrometry/External indicator
Estimation of Zn (II)-Complexometry
7.Spectrometric determination of the glucose level in jam
Preparation of silver nanoparticles by green synthesis method
Preparation of copper nanoparticles by green synthesis method
Disintegration and dissolution of drug molecules (tablets)
Analysis of pH , TDS, DO and Salinity of various water samples.
Determination of pH from various commercially available bevarages

SEMESTER III **MAJOR SUPPORTIVE**

CHE 2183 CHEMISTRY LAB FOR ZOOLOGIST–I [2 hr / 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises**.** Also this course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc. This course is also supported by STAR college programme.

Estimation of Sodium Carbonate
Estimation of acetic acid in vinegar
Estimation of Manganese dioxide in pyrolusite
Estimation of Fe(II)-Permanganometry
Estimation of Fe(II)-Dichrometry/External indicator
Estimation of Zn (II)-Complexometry
7.Spectrometric determination of the glucose level in jam
Preparation of silver nanoparticles by green synthesis method
Preparation of copper nanoparticles by green synthesis method
Disintegration and dissolution of drug molecules (tablets)
Analysis of pH , TDS, DO and Salinity of various water samples.
Determination of pH from various commercially available bevarages

SEMESTER IV **MAJOR SUPPORTIVE**

CHE 2182 CHEMISTRY LAB FOR PHYSICISTS–II [2 hr/ 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to qualitatively analyze the simple salts containing the following cations and anions. This course is also supported by STAR college programme.

Analysis of Salt-I
Analysis of Salt-II
Analysis of Salt-III
Analysis of Salt-IV
(Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) & NH^{4+} *Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate)*
Analysis of Ozone& CO_2 in air sample
Estimation of available nitrogen in soil samples
Estimation of available phosphorus in soil samples
Estimation of Borax in soil samples
Extraction, isolation and characterization of natural products
Measurement of density of various commercial milk samples.
Determination of fat content in milk and milk products.
Separation of cream from whole milk using cream separator

Extension activity:

Industrial visits to milk industry/ polymer industry/ beverage industry/ sugarecane industry

SEMESTER IV **MAJOR SUPPORTIVE**

CHE 2184 CHEMISTRY LAB FOR ZOOLOGIST–II [2 hr/ 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises Also this course is intended for students to qualitatively analyze the simple salts containing the following cations and anions. This course is also supported by STAR college programme.

Analysis of Salt-I
Analysis of Salt-II
Analysis of Salt-III
Analysis of Salt-IV
(Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) & NH^{4+} *Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate)*
Analysis of Ozone& CO_2 in air sample
Estimation of available nitrogen in soil samples
Estimation of available phosphorus in soil samples
Estimation of Borax in soil samples

Extraction, isolation and characterization of natural products
Measurement of density of various commercial milk samples.
Determination of fat content in milk and milk products.
Separation of cream from whole milk using cream separator

Extension activity:
Industrial visits to milk industry/ polymer industry/ beverage industry/ sugarecane industry

SEMESTER VI **MAJOR CORE**

CHE 3534 **PROJECT** **[5hr/ 5 cr]**

Objectives: This course is designed to reinforce the concepts with analytical techniques. It will provide a platform for students to have a hands-on experience with instruments and present a report on a research topic.

Learning outcome
The students should be able to
analyze a research topic
acquire analytical skills
write a report of their findings
present a report

Students will be divided into group of five. As a group, students will do the project work on a title approved by the respective project supervisor. Students will maintain daily records and present oral reports while doing the project. All the above process will be duly assessed by the project supervisor. They will submit the dissertation at the end of the semester.

Evaluation

Project presentation	25 marks
Project progress	50 marks
Dissertation	25 marks

THE AMERICAN COLLEGE, MADURAI
DEPARTMENT OF CHEMISTRY (UG-SF)
Program for Choice Based Credit System – 2018 – 2019

	Part	Course No.	Course Title	Hrs	Credits	Marks
1	I	TAS/FRS/HIS		3	2	30
1	II	ENS		3	2	30
1	IIIC	CHS 1511	Physical Chemistry – I	5	5	75
1	IIIC	CHS 1513	Inorganic Chemistry – I	5	5	75
1	IIIC	CHS 1331	Inorganic Quantitative Analysis	3	3	45
1	IIIS	PHS	Physics	5	4	60
1	IV	XXX	NME I	3	2	30
1	IV	XXX	LS I	3	2	30
1	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**25**	**405**
2	I	TAS/FRS/HIS		3	2	30
2	II	ENS		3	2	30
2	IIIC	CHS 1512	Organic Chemistry –II	5	5	75
2	IIIC	CHS 1514	Inorganic Chemistry – II	5	5	75
2	IIIC	CHS 1332	Organic Analysis and Preparation	3	3	45
2	IIIS	PHS	Physics	5	4	60
2	IV	XXX	NME II	3	2	30
2	IV	XXX	LS II	3	2	30
2	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**25**	**405**
3	I	TAS/FRS/HIS		3	2	30
3	II	ENS		3	2	30
3	IIIC	CHS 2511	Organic Chemistry – II	5	5	75
3	IIIC	CHS 2513	Inorganic Chemistry – III	5	5	75
3	IIIC	CHS 2515	Physical Chemistry – II	5	5	75
3	IIIC	CHS 2431	Inorganic Qualitative Analysis	4	4	60
3	IIIS	MAS/ BCH	Maths/Biochemistry	5	4	60
3	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**27**	**435**
4	I	TAS/FRS/HIS		3	2	30
4	II	ENS 2202	Career Skills	3	2	30
4	IIIC	CHS 2512	Organic Chemistry – III	5	5	75
4	IIIC	CHS 2524	Inorganic Chemistry – IV	5	5	75
4	IIIC	CHS 2516	Physical Chemistry – III	5	5	75
4	IIIC	CHS 2432	Organic Estimation & Gravimetric Analysis	4	4	60
4	IIIS	MAS/ BCH	Maths/Biochemistry	5	4	60
4	V		NSS/NCN/NCC/PED/SLP			
			Total	**30**	**27**	**435**

	Part	Course No.	Course Title	Hrs	Credits	Marks
5	IIIC	CHS 3611	Organic Chemistry – IV	6	6	90
5	IIIC	CHS 3613	Inorganic Chemistry – V	6	6	90
5	IIIC	CHS 3615	Physical Chemistry – IV	6	6	90
5	IIIC	CHS 3531	Physical Chemistry Lab	5	5	75
5	IV	CHS 3200	Environmental Chemistry	4	2	30
5	IV	XXX	LS III	3	2	30
			Total	**30**	**27**	**405**
6	IIIC	CHS 3612	Organic Chemistry – V	6	6	90
6	IIIC	CHS 3614	Applied Chemistry	6	6	90
6	IIIC	CHS 3616	Physical Chemistry – V	6	6	90
6	**IIIC**	**CHS 3534**	**PROJECT**	**5**	**5**	**75**
6	IV	VAL	Value Education	4	2	30
6	IV	XXX	LS IV	3	2	30
			Total	**30**	**27**	**405**
			Grand Total	**180**	**158**	**2430**

MAJOR SUPPORTIVES COURSES

Sem	Part	Course No.	Course Title	Hours	Credit	Marks
1	IIIS	CHS 1371	Chemistry for Bio-chemistry-I	3	3	45
1	**IIIS**	**CHS 1173**	**Chemistry lab for Bio-chemistry-I**	**2**	**1**	**15**
1	IIIS	CHS 1372	Chemistry for Bio-chemistry-II	3	3	45
2	**IIIS**	**CHS 1174**	**Chemistry lab for Bio-chemistry-II**	**2**	**1**	**15**
3	**IIIS**	**CHS 2311**	**Chemistry for Physicist-I**	**3**	**3**	**45**
3	**IIIS**	**CHS 2111**	**Chemistry lab for Physicist-I**	**2**	**1**	**15**
4	**IIIS**	**CHS 2312**	**Chemistry for Physicist-II**	**3**	**3**	**45**
4	**IIIS**	**CHS 2112**	**Chemistry lab for Physicist-II**	**2**	**1**	**15**

NON MAJOR ELECTIVES

No.	Sem	Part	Course No.	Course Title	Hours	Credit	Marks
NME1	1	IV	CHS 1251	Dairy Chemistry	3	2	30
NME2	2	IV	CHS 1252	Chemistry in Today's World	3	2	30

LIFE SKILL COURSES

No.	Sem	Part	Course No.	Course Title	Hours	Credit	Marks
LS1	1	IV	CHS 1271	Cosmetics and Consumer Products	3	2	30
LS2	2	IV	CHS 1272	Chemistry in Crime Investigation	3	2	30
LS3	5	IV	CHS 3215	Medicinal Chemistry	3	2	30
LS4	6	IV	CHS 3218	Food processing and preservation	3	2	30

SEMESTER I **MAJOR SUPPORTIVE**

CHS 1173 CHEMISTRY LAB FOR BIO-CHEMISTRY-I [2 hr/ 1cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc etc. This course is also supported by STAR college programme.

Estimation of Sodium Carbonate
Estimation of acetic acid in vinegar
Estimation of Manganese dioxide in pyrolusite
Estimation of Fe(II)-Permanganometry
Estimation of Fe(II)-Dichrometry/External indicator
Estimation of Zn (II)-Complexometry
7.Spectrometric determination of the glucose level in jam
Preparation of silver nanoparticles by green synthesis method
Preparation of copper nanoparticles by green synthesis method
Disintegration and dissolution of drug molecules (tablets)
Analysis of pH , TDS, DO and Salinity of various water samples.
Determination of pH from various commercially available bevarages

SEMESTER II **MAJOR SUPPORTIVE**

CHS 1174 CHEMISTRY LAB FOR BIO-CHEMISTRY-II [2 hr/ 1cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to qualitatively analyze the simple salts containing the following cations and anions. This course is also supported by STAR college programme.

Analysis of Salt-I
Analysis of Salt-II
Analysis of Salt-III
Analysis of Salt-IV
(Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) & NH^{4+} Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate)
Analysis of Ozone& CO_2 in air sample
Estimation of available nitrogen in soil samples
Estimation of available phosphorus in soil samples
Estimation of Borax in soil samples
Extraction, isolation and characterization of natural products
Measurement of density of various commercial milk samples.
Determination of fat content in milk and milk products.
Separation of cream from whole milk using cream separator

Extension activity:

Industrial visits to milk industry/ polymer industry/ beverage industry/ sugarecane industry

SEMESTER III **MAJOR SUPPORTIVE**

CHS 2111 CHEMISTRY LAB FOR PHYSICISTS–I [2 hr / 1cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to quantitatively estimate metal ions like iron, manganese, calcium, zinc etc. This course is also supported by STAR college programme.

Estimation of Sodium Carbonate
Estimation of acetic acid in vinegar
Estimation of Manganese dioxide in pyrolusite
Estimation of Fe(II)-Permanganometry
Estimation of Fe(II)-Dichrometry/External indicator
Estimation of Zn (II)-Complexometry
7.Spectrometric determination of the glucose level in jam
Preparation of silver nanoparticles by green synthesis method
Preparation of copper nanoparticles by green synthesis method
Disintegration and dissolution of drug molecules (tablets)
Analysis of pH , TDS, DO and Salinity of various water samples.
Determination of pH from various commercially available bevarages

SEMESTER IV **MAJOR SUPPORTIVE**

CHS 2112 CHEMISTRY LAB FOR PHYSICISTS–II [2 hr/ 1 cr]

Specific objectives:

Main objective of this program is to encourage more hands-on training to undergraduate students by adding more individualized practical exercises. Also this course is intended for students to qualitatively analyze the simple salts containing the following cations and anions. This course is also supported by STAR college programme.

Analysis of Salt-I
Analysis of Salt-II
Analysis of Salt-III
Analysis of Salt-IV
(Cations: Pb(II), Cu(II), Cd(II), Bi(III), Fe(II), Mn(II), Ni(II), Co(II), Zn(II), Mg(II) & NH^{4+} Interfering Anions: Oxalate, tartrate, borate, fluoride, and phosphate)
Analysis of Ozone& CO_2 in air sample
Estimation of available nitrogen in soil samples
Estimation of available phosphorus in soil samples
Estimation of Borax in soil samples
Extraction, isolation and characterization of natural products
Measurement of density of various commercial milk samples.
Determination of fat content in milk and milk products.
Separation of cream from whole milk using cream separator

Extension activity:

Industrial visits to milk industry/ polymer industry/ beverage industry/ sugarecane industry

SEMESTER VI **MAJOR CORE**

CHS 3534 **PROJECT** **[5hr/ 5 cr]**

Objectives: This course is designed to reinforce the concepts with analytical techniques. It will provide a platform for students to have a hands-on experience with instruments and present a report on a research topic.

Learning outcome

The students should be able to

analyze a research topic
acquire analytical skills
write a report of their findings
present a report.

Group project

Students will be divided into group of five. As a group, students will do the project work on a title approved by the respective project supervisor. Students will maintain daily records and present oral reports while doing the project. All the above process will be duly assessed by the project supervisor. They will submit the dissertation at the end of the semester.

UNDERGRADUATE DEPARTMENT OF CHEMISTRY

Value Added Courses

w.e.f. 2020-2021

Sem	Course code	Course Title	Hours	Credit
I	CHE 121V	Water and Purification Techniques	2	2
II	CHE 122V	Household Products	2	2
III	CHE 221V	Chemistry in Fireworks	2	2
IV	CHE 222V	Softwares in Chemistry	2	2
V	CHE 321V	Basics of Analytical Techniques	2	2
VI	CHE 322V	Pharma and Nutraceuticals Marketing	2	2

CHE 121V *Water and Purification Techniques* *2Hrs/2 Cr.*

Preamble:

This course highlights the sources, properties, purification and conservation of water. This course is aimed at providing chemistry knowledge for the removal of impurities present in the water, the need and ways of rain water harvesting and the related environmental issues.

At the end of the course, the students will be able to:

i. Classify types of water and its sources.
ii. Explain the properties of water and their biological, chemical and industrial applications.
iii. Describe various water quality parameters
iv. Outline the various water purification methods.
v. Discuss the need and method of rainwater harvesting.

Unit 1: Introduction *(6 hrs)*

Water- available water sources, characteristics of different water sources, classification of water, vulnerability of the water sources to contamination, water quality criteria, water formation, HydrologicalCycle, importance of water, water requirements: Domestic, Institutional, Industrial, Public andAgriculture

Unit 2: Properties of pure water (6 hrs)

Properties of pure water-colour, odour, surface tension, viscosity, boiling point, freezing point, heat capacity, heats of vaporization and fusion, cohesion, polarity and hydrogen bonding, pH, electrical conductivity, molecular structure at various temperature, biological, chemical and industrial applications of water, water as coolant, as universal solvent.

Unit 3: Parameters of natural water (6 hrs)

Physical parameters of natural water- turbidity, temperature, colour, taste and odour, solids, Total dissolved solids (TDS), electrical conductivity.

Chemical parameters of natural water- pH, acidity, alkalinity, hardness, dissolved oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD).

Biological parameters of natural water-bacteria, viruses, algae, importance of water quality parameters, WHO limits for water quality of potable water.

Unit 4: Purification methods *(6 hrs)*

Definition: Hardness and alkalinity, Purification methods- Internal method- Lime – Soda process, Zeolite process, External method- Ion Exchange process, Sterilization and disinfection- Chlorination, Break point chlorination, Reverse Osmosis and Electro Dialysis.

Unit 5: Environmental effects on water (6 hrs)

Water for steam generation, Boiler troubles, Priming and Foaming, Scale formation, Boiler corrosion, Caustic embrittlement, environmental effects and controlling of BOD, COD, eutrophication and its causes, water pollution, water pollutants-sources, effects and controlling measures of water pollution, need for rain water harvesting and methods .

References:

1. B.K. Sharma and H. Kaur, Environmental Chemistry, Goel Publishing House, Meerut, 1996.
2. H.Kothandaraman and G.Swaminathan. Principles of Environmental Chemistry. B.I. Publications, Chennai, India. 1997.
3. A.K.De, Environmental Chemistry. 4th Edition, New Age International (P) Ltd., New Delhi, India. 2000.
4. AbnubhaKaushik, C.P.Kaushik "Perspectives in Environmental Studies" New Age International Publishers, 3rd Edition, 2009.
5. S.S. Dara, A Textbook of Environmental Chemistry and Pollution Control, 8th Edition, S. Chand and Sons, New Delhi, 2008.

Mapping of Bloom's Taxonomy with Course Outcome

CHE121V	K1	K2	K3	K4	K5
CO1	**1**				
CO2		**2**			
CO3		**2**			
CO4		**2**			
CO5			**3**		
Mean	**2.0**				