DEPARTMENT OF CHEMISTRY

PREAMBLE

B Sc Chemistry

- In semester VI, Core Course XIII FBCHC61PW– Project work to be done by a group of two students either in the laboratory or in a chemical industry or in institutions (CECRI, Agricultural Research Station, Water testing centers, Pharmaceutical laboratories etc.). In the above reason, the group of two students are converted into group of five students because of class strength increase upto 49 to 41 students.

Programme Outcomes

PO1: **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
PO2: **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO3: **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO4: **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO5: **Ethics:** Recognize different value systems including your own, understand the moral dimensis of your decisions and accept responsibility for them.

M Sc CHEMISTRY
[2-year Regular Programme]
(For those who joined since 2018-19)

PSO 1: To make students capable of studying chemistry in academic and industrial courses
PSO2: To promote understanding of basic facts and concepts in advance Chemistry
PSO3: To expose the students to different processes used in industries and their applications.

Programme Structure – 2018-19 onwards

Sem	Subject Code	Course	Subject Title	Hrs/ wk	Credit	CIA	ESE	Total
I	GMCHC11	Core Course – I	Organic Chemistry-I	6	5	40	60	100
	GMCHC12	Core Course – II	Inorganic Chemistry-I	6	5	40	60	100
	GMCHC13	Core Course – III	Physical Chemistry-I	6	5	40	60	100
	GMCHC14P	Core Course – IV	Organic Chemistry Practical	6	5	40	60	100
	GMCHE1A/	Elective-I	a. Instrumental methods of	6	5	40	60	100

	GMCHE1B		analysis (or) b. Green and Environmental Chemistry					
	GMCHX1/ GMCHX1O	Extra Credit	Molecular Spectroscopy/ Online course	-	2	-	100	100
			Total	**30**	**25+2**	**200**	**300 + 100**	**500 + 100**
II	GMCHC21	Core Course – V	Organic Chemistry-II	6	5	40	60	100
	GMCHC22	Core Course – VI	Inorganic Chemistry-II	6	5	40	60	100
	GMCHC23	Core Course – VII	Physical Chemistry-II	6	5	40	60	100
	GMCHC24P	Core Course – VIII	Inorganic Chemistry Practical	6	5	40	60	100
	GMCHE2A/ GMCHE2B	Elective-II	a Applied Electrochemistry (or) b. Polymer chemistry	6	5	40	60	100
	GMCHX2/ GMCHX2O	Extra Credit	Chromatographic techniques/Online course	-	2	-	100	100
			Total	**30**	**25+2**	**200**	**300 + 100**	**500 + 100**
III	GMCHC31	Core Course – IX	Organic Chemistry-III	6	5	40	60	100
	GMCHC32	Core Course – X	Inorganic Chemistry-III	6	5	40	60	100
	GMCHC33	Core Course – XI	Physical Chemistry-III	6	5	40	60	100
	GMCHC34P	Core Course – XII	Physical Chemistry Practical	6	5	40	60	100
	GMCHE3A/ GMCHE3B	Elective-III	a. Nanoscience and Nanotechnology (or) b. Material Chemistry	6	5	40	60	100
	GMCHX3/ GMCHX3O	Extra Credit	Agricultural and Drugs Chemistry/ Online course	-	2	-	100	100
			Total	**30**	**25+2**	**200**	**300 + 100**	**500 + 100**
IV	GMCHC41P W	Core Course – XIII	Project	30	15	100	100	200
	GMSED4	Extra credit	Skills for Employability Development	-	2	100	-	100
			Total	**30**	**15+2**	**100 + 100**	**100**	**200 + 100**
			Grand Total	**120**	**90 + 8**	**700 + 100**	**1000 + 300**	**1700 + 400**

Hrs/wk-Hours/Week CIA–Continuous Internal Assessment and ESE – End Semester Examination

*For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from spoken tutorial, EDX, NPTEL or Coursera

CORE I – ORGANIC CHEMISTRY-I
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 6**
Subject Code: GMCHC11 **Credits: 5**

CO 1: To enable the students to learn the principles of reaction mechanism and modern reagents used for various reactions
CO 2: Mechanistic aspects in nucleophilic and electrophilic substitution
CO 3: Understood the principles and reaction mechanism involving aliphatic and aromatic nucleophilic substitution reactions
CO 4: To acquire basic knowledge about the aliphatic and aromatic electrophilic substitution reactions
CO 5: Mechanisms of addition reactions of C=C and C=O bonds and elimination reactions.
CO 6: Learnt about the oxidation and reduction reaction

UNIT I **(18 Hours)**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding – Conjugation, Cross conjugation, Resonance, Hyperconjugation, Tautomerism. Aromaticity, Alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π-molecular orbitals, Annulenes, Antiaromaticity, Homo-aromaticity, PMO approach, Bonds weaker than covalent, Addition compounds, Non-covalent bonding and Inclusion complexes

UNIT II **(18 Hours)**

Aliphatic and Aromatic Nucleophilic Substitution Reactions: Bonding – Structure and reactivity of acids and bases (hard and soft acid base theory), Methods of determination and the study of reaction mechanisms. S_N^1, S_N^2, S_N^i and neighbouring group participation, Kinetics –Effects of structure, Solvent and leaving and entering group, Stereochemistry, Hydrolysis of esters – Wurtz reaction, Claisen and Dieckmann condensation, Williamson reactions. Different mechanisms of aromatic nucleophilic substitution – Ziegler alkylation, Chichibabin reaction, Cine substitution, Diazonium group as leaving group

UNIT III **(18 Hours)**

Aliphatic and Aromatic Electrophilic Substitution Reactions: S_E^1 and S_E^2 reactions - mechanisms and reactivity – Typical reactions involving migration of double bond, Keto-enol tautomerism, Halogenation of carbonyl compounds, Stork enamine reactions, Decarboxylation of aliphatic acids, Friedel Crafts acylation of olefinic carbon. Aromatic electrophilic substitution – Reactivity, Orientation and mechanisms, Nitration, Halogenation and Sulphonation, Friedel Crafts alkylation and arylation (Scholl reaction) and Acylation (Jacobsen reaction), Formylation with (i) Disubstituted formamides (Vilsmeyer- Haack reaction) (ii) Zinc cyanide and HCl (Gattermann reaction) (iii) Chloroform (Reimer - Tiemann reaction), Carboxylation, Hydroxyalkylation, Cyanodehydration of aldehydes and ketones

UNIT IV **(18 Hours)**

Addition and elimination reactions: Addition to C-C and C-O multiple bonds – Electrophilic, Nucleophilic and Free-radical additions, Additions to conjugated systems Orientation, Birch reduction, Hydroboration, Michael addition, 1,3 dipolar additions, Carbene

addition to double bonds. Mannich reaction, Meerwein-Pondorf reduction, Grignard reactions, Aldol, Claisen, Stobbe, Darsen, Wittig, Cannizarro reaction
Elimination reactions - E^1 and E^2 Mechanisms, Orientations, Hofmann and Saytzeff rules, Elimination versus substitution – Chaugav reaction, Dehydration of alcohols, Dehydrohalogenation – Mechanisms and Orientation in pyrolytic elimination

UNIT V **(18 Hours)**

Oxidation and Reduction: Formation of C=C, C-C bonds by dehydrogenation, Formation of C-C bond in phenol coupling, Acetylene coupling, Allylic oxidation, Oxidation of alcohols, Glycols, Halides and amines to aldehydes and ketones, Ozonolysis, Oxidation of olefinic double bonds and unsaturated carbonyl compounds, Oxidative cleavage of the C-C bond, Sommelet reaction and selectivity in reduction, Metal hydride reduction, Metal alkoxide reduction, Reduction by dissolving metals, Clemmensen reduction, Wolf Kishner reduction, Metal ammonia reduction (Birch reduction), Reduction of nitro compounds, Acyloin condensation and Catinanes, Carbenes and Nitrenes – structure and generation, Addition reaction with Alkenes and insertion reactions

Text Book:

1. J. Clayden, N. Greeves, S. Warren, and P. Wothers, **Organic Chemistry,** Oxford University Press, UK, 2nd Edition, 2012.

Reference Books:

2. J. March and M. B. Smith, **March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure,** Wiley, New York, 7th Edition, 2013.
3. F. A. Carey and R. J. Sundberg, **Advanced Organic Chemistry; Parts A and B,** 5th Ed., Springer, Germany, 2007.
4. O.P. Aggarwal, **Organic Chemistry Reactions and Reagents,** Krishna Prakashan Media, 47th Edition, 2011.
5. Peter. A Sykes, **Guide Book to mechanism in Organic Chemistry,** Longman, 6th Edition, 1989.
6. R. T. Morrison and R. N. Boyd, **Organic Chemistry,** Pearson, New Delhi, 7th Edition, 2011.
7. R. K. Bansal, **Organic Reaction Mechanisms,** Tata McGraw Hill, Noida, 11th Edition, 2006.
8. V.K. Ahluwalia and R.K. Parashar, **Organic Reaction Mechanisms,** Narosa Publishing House, New Delhi, 3rd Edition, 2009.
9. W. Carruthers, **Modern Methods of Organic Synthesis,** 3rd Edition, Cambridge University Press, UK, 2004.

CORE II – INORGANIC CHEMISTRY-I
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 6**
Subject Code: GMCHC12 **Credits: 5**

CO 1: To understand the role of various elements in the periodic properties
CO 2: To acquire basic knowledge about the structure and functions of Chemistry of some

main group elements

CO 3: To get an insight on the use of several inorganic rings, cages and clusters

CO 4: To know about the mechanism of binding interactions of metal complexes with biomolecules and metal based drug action

CO 5: Learnt about the various methods involved in nuclear and radiation Chemistry

CO 6: Expertise in solids of various types

UNIT I **(18 Hours)**

Periodic properties: Atomic size, Ionic radii, Ionization potential, Electron affinity and Electronegativity, Applications of electronegativity

General characteristics of s, p, d and f –block elements– Comparative Study with Reference to Electronic Configuration Oxidation States, Chemical Properties, Spectra and Magnetic Properties of d- and f- Block Elements. Survey of Essential and Trace Elements in Biological Systems

Chemcial bonding – Ionic Bond, Size Effect and Solubility, Covalent Bond, Simple Binary Systems, Hydrogen Bond, Water and in Biological Systems

Concepts of Acids and Bases – Arrhenius, Bronsted-Lowry, Lewis, Lux-Flood and Solvent System Concepts

Non-aqueous solvents – Classification of Solvents, Properties of Solvents (Dielectric Constant, Donor and Acceptor Properties), Protic (Anhydrous, H_2SO_4, Acetic Acid) and Aprotic Solvents (Liquid SO_2 and N_2O_4)

UNIT II **(18 Hours)**

Chemistry of Some Main Group Elements: Synthesis, Properties and Structure of Halides and Oxides, Polymorphism of Carbon, Phosphorus and Sulfur, Synthesis, Properties and Structure of Boranes, Carboranes, Borazines, Silicates, Carbides, Silicones, Phosphazenes, Sulphur-Nitrogen, Phosphorous- Nitrogen compounds, Peroxo compounds of Boron, Carbon and Sulphur, Oxy-acids of Nitrogen, Phosphorus, Sulphur and Halogens, Interhalogens, Pseudohalides and Noble gas compounds

UNIT III **(18 Hours)**

Nuclear Chemistry: Fission Products and Fission Yield. Neutron Capture Cross Section and Critical Size. Nuclear Fusion Reactions and their Applications, Chemical Effects of Nuclear Transformations. Positron Annihilation and Autoradiography, Synthesis of Transuranic Elements such as Neptunium, Plutonium, Curium, Berkelium, Einsteinium, Mendelevium, Nobelium, Lawrencium and Elements with Atomic Numbers 104 to 109

Radiation Chemistry : Analytical Applications of Radioisotopes-Radiometric Titrations, Kinetics of Exchange Reactions, Measurement of Physical Constants Including Diffusion Constants, Radioanalysis, Neutron Activation Analysis, Prompt Gama Neutron Activation Analysis and Neutron Absorptiometry, Applications of Radio Isotopes in Industry, Medicine, Autoradiography, Radiopharmacology, Radiation Safety Precaution, Nuclear Waste Disposal. Radiation Chemistry of Water and Aqueous Solutions

UNIT IV **(18 Hours)**

Inorganic Rings, Cages and Clusters: Inorganic Chains, Rings, Cages and Clusters, Catenation, Heterocatenation, Intercalation chemistry, One Dimensional Conductor Isopolyanions, Heteropolyanions, Borazines, Phosphazenes, Phosphazene Polymers, Ring Compounds of Sulphur and Nitrogen, Homocyclic Inorganic systems, Cages, Boron Cage

Compounds, Metal Clusters, Dinuclear clusters, Trinuclear clusters, Tetranuclear Clusters, Hexanuclear Clusters , Structural Prediction of Organometallic Clusters

UNIT V **(18 Hours)**

Structure and Properties of Solids: Defects in Solids, Point, Line and Plane Defects. Determination of Equilibrium Concentration of Schotky and Frenkel defects. Stoichiometric Imbalance in Crystals and Non Stoichiometric Phases, Color Center in Ionic Crystals, Band Theory, Band Gap, Metals and Insulators, Semiconductors, Hoping Semiconductors Rectifiers and Transistors, Bonding in Metals, Free Electron Theory, Electronic Specific Heat, Hall Effect, Electrical and Thermal Conductivity of Metals, Superconductors. Illustrative Examples of Ionic, Covalent and Hydrogen Bonded Solids; Perovskite, Iilmenite and Rutile; Spinel and Inverse Spinel

Text Book:

1. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, **Inorganic Chemistry,** Oxford University Press, UK, 5th Edition, 2013.

Reference Books:

2. F. Albert Cotton, Geoffrey, Wilkinson, Carlos A. Murillo, and Manfred Bochmann, **Advance Inorganic Chemistry,** Wiley Student Edition, John Wiley and Sons, INC, New York, 6th Edition, 2004.
3. G. L. Miessler and D.A. Tarr, **Inorganic Chemistry**, Pearson Education, 3rd Edition, 2004.
4. C.E. Housecroft and A.G. Sharpe, **Inorganic Chemistry**, Pearson Education Ltd., 2nd Edition, 2005
5. F.A. Cotton, G. Wilkinson and P.L. Gaus, John, **Basic Inorganic Chemistry**, Wiley and Sons, 3rd Edition, 2002.
6. J.E. Huheey, E.A. Keiter and R.L. Keiter, **Inorganic Chemistry**, Pearson Education, 4th Edition, (2002).
7. Satya Prakash, G.D. Tuli, S.K. Basu, and R.D. Madan, **Advanced Inorganic Chemistry, Volume-I,** S. Chand and Company, New Delhi, India, 2008.
8. B.R. Puri, L.R. Sharma and K.C Kalia, **Principles of Inroganic Chemistry (UGC Syllabus)**, Milestone Publishers, New Delhi, India, 2008.
9. James E. House, **Inorganic Chemistry,** First Indian Reprint, Academic Press, USA, 2010.
10. D.N. Singh, **Basic Concepts of Inorganic Chemistry,** Pearson Education, New Delhi, 2010.
11. H.J. Arnikar, **Elements of Nuclear Chemistry,** New Age Publishers, 4th edition, 2008.
12. **C**.N.R. Rao and J. Gopalakrishna, **New Directions in Solid State Chemistry,** Cambridge University Press, 1997.
13. Walter Loveland, David Morrissey and Glenn Seaborg, **Modern Nuclear Chemistry**, Wiley-Interscience, Hoboken, NJ, 2006.

CORE III – PHYSICAL CHEMISTRY-I

(For those who joined from since 2018-19)

Semester: I **Hours/Week: 6**
Subject Code: GMCHC13 **Credits: 5**

CO 1: Debye-Huckel theory and determination of activity and activity coefficient
CO 2: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, theories of specific heat for solids
CO 3: Redox processes in electrochemical systems
CO 4: Different mechanisms of polymerization
CO 5: Processing of thermoplastic and thermosetting polymers
CO 6: The students will acquire the knowledge of ionic conductors, semiconductors and superconductors technologies, and their applications

UNIT I **(18 Hours)**

Classical Thermodynamics: Concepts involved in first, second and third law of thermodynamic, Thermodynamic equation of state, Maxwell relations, Free energy and entropy of mixing, Partial molar quantities, Gibbs-Duhem equation, Equilibrium constant, Temperature-dependence of equilibrium constant, Phase rule for one and two component system, Thermodynamic description of phase transitions, Concept of fugacity and determination of fugacity

UNIT II **(18 Hours)**

Statistical Thermodynamics: Combinatory rule, Probability theorem, Permutations and combinations, Concept of ensembles energy states and energy levels, Macro-states and micro-states, Maxwell-Boltzmann statistics, Thermodynamic probability, Sterling's approximation, Legrange's undetermined multiplier, Distribution functions

Partition function and thermodynamic functions, Molar partition function, Entropy and third law, Separation of partition function, Translational, Rotational, Vibrational and electronic partition functions, Combined partition function, Equilibrium constant and partition function. Quantum statistics – Bose-Einstein and Fermi-Dirac statistics, Photon gas -degeneracy and Bose Einstein condensation, Application to liquid He - negative Kelvin temperature

UNIT III **(18 Hours)**

Introduction of chemical kinetics: Order and molecularity of reaction, influence of temperature on reaction rates

Theories of reaction rates : Arrhenius equation and its limitations, collision and absolute reaction rate theories, statitstical derivation of rate equation (Eyring equation), thermodynamic formulation of reaction rates, free energy of activation, heat of activation and its relationships with various kinds of activation energies, relationship between stearic factor and entropy of activation, transmission coefficient, unimolecular reactions, Lindmann theory, Hinshelwood theory, RRK theory, RRKM theory

Fast Reactions: Study of kinetics by flow techniques, Equation for contact time, stopped flow and continuous flow methods. Relaxation method, equation for relaxation time, temperature jump and pressure jump methods, flash photolysis, pulse radiolysis and shock tube method. Potential energy surface, theoretical calculation of energy of activation

UNIT IV **(18 Hours)**

Polymers: Fundamentals of polymers - Monomers, repeat units, degree of polymerization. Linear, branched and network polymers, Classification of polymers. Polymerization - condensation, addition, free radical, ionic, co-ordination polymerization, Zeigler –Natta Polymerisation and ring opening polymerization. Kinetics of free radical polymerisation Molecular weight and size, Polydispersion, Average molecular weight concepts – number,

weight and viscosity average molecular weight, Determination of molecular weights - viscosity method, light scattering method and ultra-centrifugation methods

UNIT V **(18 Hours)**

Semiconductors: Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity – electrons and holes, temperature dependence on conductivity, optical properties – Absorption spectrum, photoconductivity, photovoltaic effect and luminescence, Junction Properties – metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors

Superconductors: Meissner effect, type I and II super conductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices

Text Book:

1. Peter Atkins, **Atkins' Physical Chemistry**, Osford University Press, New York, 8th Edition, 2010.

Reference Books:

2. K.J. Laidler, **Chemical Kinetics**, Pearson Education Pvt. Ltd., New Delhi, 3rd Edition, 2004.
3. D. A. McQuarrie and J. D. Simon, **Molecular Thermodynamics,** University Science Books, California 2004.
4. D. A. McQuarrie, **Statistical Mechanics,** University Science Books, California 2005.
5. E. Thomas and R. Philip, **Thermodynamics: Statistical Thermodynamics and Kinetics,** Pearson Education, 1st edition, 2007.
6. R.J., Silbey, R.A. Alberty and M.G. Bawendi, **Physical Chemistry,** Wiley-Interscience Publication, 4th edition, 2013.
7. A. Peter and J. de. Paula, **Physical Chemistry,** Oxford University Press, 9th edition, 2011.
8. M. Mortimer and P. G. Taylor, **Chemical Kinetics and Mechanism**, Royal Society of Chemistry, UK, 1st Edition, 2002.
9. J. Rajaram and J. C. Kuriacose, **Thermodynamics for Students of Chemistry - Classical, Statistical and Irreversible**, Pearson Education, New Delhi, 2013.
10. Fred W. Billmayer, **Textbook of Polymer Science**, John Wiley & Sons Pvt. Ltd., Singapore, Indian Edition, 3rd Edition, 2007.
11. Malcolm P. Stevans, **Polymer Chemistry,** Oxford University Press, New York, First Indian Edition, 2008.
12. P. Bahadur and N.V. Sastry, Principles **of polymer science**, 2nd edition, Narosa Publishing house, Chennai, 2005.

CORE IV – ORGANIC CHEMISTRY PRACTICAL
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 6**
Subject Code: GMCHC14P **Credits: 5**

CO 1: The students to understand the basic principles of lab techniques adopted in organic laboratories

CO 2: Learnt about the quantitative and qualitative analyses by separation.

CO 3: Learnt the preparation of organic compounds
CO 4: Preparation and purification of different organic compounds
CO 5: To teach the synthesis of organic compounds and their characterization with instrumental techniques.
CO 6: Safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents.

PART-I (30 Hours)

1. Qualitative analysis:

Separation, purification and identification of organic compounds in binary mixtures by chemical tests and preparation of their derivatives

Phenols, Carbonyl compounds (Aldehydes & Ketones), Acids, Nitro compounds, Amines, Amides and Carbohydrataes. (2 compounds are to be given for analysis with preparation of one solid derivative for each). **Examination:** One experiment or a part of it has to be carried out and the product has to be purified by recrystallisation. The yield of the crude product and the m.p. of the recrystallized product are to be noted. Both crude and recrystallised products are to be submitted.

PART-II (30 Hours)

2. Quantitative analysis:

Estimation of phenol, aniline, ketone and reducing sugars - estimation of functional groups like hydroxyl, methoxyl, carbonyl and nitro groups

PART-III (30 Hours)

Preparation of organic compounds (Double stage)

1. p-bromo acetanilide from aniline (acetylation and bromination)
2. benzillic acid from benzoin (rearrangement)
3. p-amino benzoic acid from p-nitro toluene (oxidation and reduction)
4. p-bromoaniline from acetanilide (bromination and hydrolysis)
5. 1, 2, 4-triacetoxy benzene from hydroquinone (oxidation and acylation)

Reference Books:

1. V. K. Ahluwalia, P. Bhagat, and R. Agarwal, **Laboratory Techniques in Organic Chemistry**, I. K. International, 2005.
2. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford and P. W. G. Smith, **Vogel's Textbook of Practical Organic Chemistry**, 5th Edition, Prentice Hall, 1989.
3. S.P. Bhutani and A. Chhikara, **Practical Organic Chemistry: Qualitative Analysis,** ANE books-new Delhi, 1st Edition, 2009
4. Brian S. Furniss, **Vogel's Textbook of Practical Organic Chemistry**, Pearson India, 5th Edition, 2005.
5. F.G. Mann and B.C Saunders, **Practical Organic Chemistry**, Pearson India, 4th Edition, 2009.
6. Renu Aggarwal and V. K. Ahluwalia, **Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis** Universities press, India, 2001
7. Arun Sethi**, Systematic Laboratory Experiments in Organic Chemistry**, New Age International, 2003.
8. V. K. Ahluwalia and Sunitha Dhingra, **Comprehensive Practical Organic Chemistry: Qualitative Analysis,** Orient Longman, 1st Edition, 2004.

9. N. K. Vishnoi, **Advanced Practical Organic Chemistry,** Second edition, Vikas Publishing House Pvt. Ltd, 1996.

ELECTIVE I (A) – INSTRUMENTAL METHODS OF ANALYSIS
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 5**
Subject Code: GMCHE1A **Credits: 5**

CO 1: Learnt about the various methods involved in analytical techniques
CO 2: Learnt about the various methods involved in Electro analytical techniques
CO 3: Learnt about the various methods involved in Thermo analytical techniques
CO 4: Learnt about the various methods involved in Spectro analytical techniques
CO 5: Learnt about the Error analysis of sample
CO 6: Learnt about the Precipitation techniques of solution

UNIT I (15 Hours)

Error analysis: Classification of errors, accuracy and precision, minimization of errors, significant figures, significant figures in computation, statistical treatment of data – mean, median, standard deviations, variance, relative standard deviation – spread, errors – standard deviation of computed results, Student's t-test, F-test , comparison of the means of two samples, correlation and regression: linear regression (least square analysis)

UNIT II (15 Hours)

Precipitation Techniques: Introduction, properties of precipitates and precipitating reagents, colloidal precipitates. Co-precipitation, post precipitation, precipitates from homogeneous solution, surface adsorption, drying and ignition of precipitates, application of gravimetric methods

UNIT III (15 Hours)

Electro analytical methods

Electro analytical techniques: Electro gravimetry, theory of electro gravimetric analysis, electrolytic separation and determination of metal ions. **Coulometry** – Electrolytic cell, working electrodes, auxiliary electrode and reference electrode, coulometric titrations. **Voltammetry** – stripping voltammetry, chronopoteniometry, **Amperometry**– Amperometric titrations

UNIT IV (15 Hours)

Thermo analytical Methods: Thermal analysis, theory and principles of DTA and TGA, factors affecting the position of DT and TG traces, application of DTA and TGA to the thermal behavior of the following compounds, crystalline copper sulphate, calcium oxalate monohydrate, calcium acetate monohydrate, zinc hexafluorosilicate, complementary nature of DTA and TGA , principle and application of DSC, determineation of degree of conversion of high alumina cement, purity determination phase transition study in forensic laboratory

UNIT V (15 Hours)

Spectro analytical Methods: **Colorimetry** – Beer and Lambert's law, terminology – condition for a satisfactory colorimetric analysis, method of colour measurement or

comparison, principles of colorimetric determinations of NH_3, Cr, Cu, Fe, Mn, simultaneous spectrophotometer determination of Cr and Mn

Nephelometry and turbidimetry – principle – determination of sulphate and phosphate – **fluorimetry–** principle, application of fluorimetry in the determination of Cd, Ca and Zn and determination of codeine and morphine in a mixture, **flame spectrometry** –theory, interferences, **AAS** – applications in the determination of Mg^{+2} and Ca^{+2} in tap water, V in lubricating oil, trace lead in a ferrous alloy and trace elements in contaminated soil

Text Book:

1. D.A. Skoog, E.J. Holler, S.R. Crouch, **Instrumental Analysis,** Indian Reprint, Cengage Learning India Pvt. Ltd., New Delhi, 11th Edition 2012.

Reference Books:

2. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's **Textbook of Quantitative Chemical Analysis,** Pearson Education, New Delhi, India, 6th Edition, 2012.
3. H. H. Williard, L. L. Merritt and J. A. Dean, **Instrumental Methods of Analysis,** East-West press, New Delhi, 1988.
4. D.A. Skoog, E.J. Holler and T.A. Nieman, **Principles of Instrumental Analysis,** Thomson Aisa Pvt. Ltd., Singapore, 5th Edition, 2004.
5. J. Basset et al., **Vogel's text book of Qualitative Inorganic Analysis**, Longman, 5th Edition, ELBS, Essex, 1989.
6. Daniel C. Harris, **Quantitative Chemical Analysis**, W.H. Freeman and Company, New York, USA, 6th Edition, 2003.
7. J. G. Dick, **Analytical Chemistry**, Tata – Mc-Graw Hill, l973.
8. D.A. Skoog, D.M. West, E.J. Holler and S.R. Crouch, **Fundamentals of Analytical Chemistry,** Thomson Aisa Pvt. Ltd., Singapore, 8th Edition, 2004.

ELECTIVE III (B) – GREEN AND ENVIRONMENTAL CHEMISTRY
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 5**
Subject Code: GMCHE1B **Credits: 5**

CO 1: To teach the students the essential role of Ibuprofen in industries and to preserve the same
CO 2: To teach the importance of various types of green synthesis and their applications
CO 3: To create awareness on environmental pollution
CO 4: Concepts and applications of Green Chemistry
CO 5: To impart the knowledge on the chemistry of atmosphere and their crucial applications
CO 6: Learnt the knowledge of green chemistry

UNIT I **(15 Hours)**

Introduction of Green Chemistry: Principles of Green Chemistry, Concept of atom economy, Tools of Green Chemistry – Alternative feedstocks/starting materials, Reagents, Solvents, Product/target molecules, Catalysis and process chemistry. Evaluation of chemical product or process for its effect on human health and environment, Evaluation of reaction types and methods to design safer chemicals

UNIT II (15 Hours)

Applications of Green Chemistry: Planning a green synthesis, Lactic acid production, Green synthesis of Ibuprofen, Design and application of surfactants for carbon dioxide for precision cleaning in manufacturing and service industries, super critical carbon dioxide, Microbes as environmentally benign synthetic catalysts, Environmentally safe marine antifoulant, Use of molting agents to replace more toxic and environmentally harmful insecticides, Biodegradable polyaspartate polymers for inhibitors and dispersing agents, Recent applications in green chemistry

UNIT III (15 Hours)

Measuring an Emerging Green Technology and Alternative Energy Sources: Importance of measurement –Safer Gasoline, Introduction to life cycle assessment, Four stages of Life Cycle Assessment (LCA), Carbon foot printing, Green process Matrics, Eco labels, Integrated Pollution and Prevention and Control (IPPC), REACH (Registration, Evaluation, Authorization of Chemicals)**,** Design for Energy efficiency, Microwave technology on Chemistry, Microwave heating, and Microwave assisted reactions, Sono chemistry and Green Chemistry, Electrochemical Synthesis, Examples of Electrochemical synthesis

UNIT IV (15 Hours)

Atmospheric and Earth Chemistry: The structure of the earth's atmosphere, Chemistry of the lower and upper atmosphere. The chemistry of air pollution, depletion and consequences, Dioxins burning plastics, Other atmospheric chemicals, Smog, Radio activity and fallout, Greenhouse effect, Global warming, Oxides of carbon

UNIT V (15 Hours)

The Biosphere and Interactions: The structure of the biosphere, man's perturbation of the biosphere, man as a chemical factory, material use and waste, energy use and thermal pollution, ecological disruption, chemical sensation, hormonal imbalance and mutagens, internal pollution. Hydrosphere – lithosphere interaction, The structure of water at an interface, chemical composition of mineral water, weathering and the changing face of the land- the origin of the oceans sedimentation and the deposition of materials from the hydrosphere, chemical exchange between sediments and the water column atmosphere-biosphere interaction, soil chemistry – the prospects of agriculture, agricultural pollution, pesticides and other persistent pollutants, Biosphere – hydrosphere interaction: The chemistry of water pollution – sewage treatment, primary, secondary- and tertiary activated sledge ,trickling filters, denitrification , biology and energy chain

Text Book:

1. V. K. Ahluwalia, **Green Chemistry**, Ane Books Pvt Ltd., New Delhi, 2nd Edition, 2016.

Reference Books:

2. V. K., Ahluwalia and M., Kidwai, **New Trends in Green Chemistry**, Anamaya Publishers, 2004.
3. P. T. Anastas and J. C. Warner, **Green chemistry Theory and Practice**, Oxford University Press, New York, 2005.
4. R.A. Sheldon, I. Arends, and U. Hannefed**, Green Chemistry and Catalysis**, Wiley-VCH Verlag GmbH and Co., 2007.
5. P. Anastas, and T. C. Williamson, **Green Chemistry Frontiers in Benign Chemical Synthesis and Processe**s, Oxford University Press, 1999.

6. G.W. Van-Loon and S.J. Duffy **Environmental Chemistry**, Oxford University Press 3rdEdition,2005.
7. C.S. Rao, Environmental **Pollution Control Engineering**, New Age International Publishers, NewDelhi, 2nd Edition, 2006.
8. P.S. Sindhu, Environmental **Chemistry**, New Age International Publishers 2nd Edition,2002.
9. A.K. De, Environmental **Chemistry**, New Age International Publishers 6th Edition,2008.

EXTRA CREDIT I – MOLECULAR SPECTROSCOPY

(For those who joined from since 2018-19)

Semester: I **Credits: 2**

Subject Code: GMCHX1

CO 1: The student will be able to recognize the spectroscopic techniques in terms of interaction of EMR with molecules

CO 2: Principles of the rotational, vibrational, electronic, magnetic resonance spectroscopic and mass spectrometric techniques

CO 3: Apply the principles of spectroscopy to understand the structure of compounds.

CO 4: Interpret the spectroscopic data for any given compound

UNIT I

Electromagnetic Radiations:- Interaction of EM-radiations with matter, scattering, dispersion and transmission of radiation

UNIT II

UV-Visible Spectroscopy:-Nature of electronic excitation, origin of UV- band structure, principle of adsorption spectroscopy, instrumentation, presentation of spectra chromophore

UNIT III

IR (vibrational) Spectroscopy:- Infra red absorption process, stretching and bending, Infra-Red Spectrometer, IR-Spectrum, application of IR Spectrum

UNIT IV

Mass Spectrometry:- Basic principles, theory, instrumentation, mass spectrum, the nitrogen rule, general fragmentation modes, important features in mass spectroscopy

UNIT V: Application of Proton NMR Spectroscopy and Raman Spectroscopy

Text Books:

1. Colin N. Banwell and Elaine M. McCash, **Fundamentals of Molecular Spectroscopy**, Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2008.
2. D.L. Pavia, G. M. Lampman and G.S. Kriz, **Introduction to Spectroscopy**, Brooks/Cole Cengage Learning 4th Edition, 2008.

Reference Books:

3. W. Kemp, **Organic Spectroscopy,** Palgrave, New York, 3rd Edition, 2011.
4. J. R. Dyer, **Applications of Absorption Spectroscopy of Organic Compounds,** PHI Learning, New Delhi, 2009.
5. Y. R. Sharma, **Elementary Organic Spectroscopy – Principles and Chemical Applications**, S. Chand and Co., New Delhi, 1992
6. P. S. Kalsi, **Spectroscopy of Organic Compounds**, New Age International Publishers, New Delhi, 6th Edition, 2004.

7. G. Aruldhas, **Molecular Structure and Spectroscopy,** Prentice-Hall of India Pvt. Ltd., New Delhi, India, 2nd Edition, 2007.
8. K. Veera Reddy, **Symmetry and Spectroscopy of Molecules,** New Age International Pvt. Ltd., New Delhi, India, 1998.
9. P. M. Silverstein and F. X. Western, **Spectroscopic Identification of Organic Compounds**, John Wiley, New York, 8th Edition, 2014.

CORE V – ORGANIC CHEMISTRY-II
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 6**
Subject Code: GMCHC21 **Credits: 5**

CO 1: Mechanistic pathway of organic reactions
CO 2: Stereochemistry approach to planning organic syntheses
CO 3: Conversion of different functional group *via* rearrangement reaction
CO 4: To enable the students to learn the synthesis and the isolation of amino acids, proteins, enzymes and nucleic acids
CO 5: Learnt the knowledge of pericyclic reactions
CO 6: To impart the knowledge on photochemistry reactions

UNIT I **(18 Hours)**

Molecular rearrangements and reactions: Types of organic rearrangements – Anionic, Cationotropic, Prototropic, Free radical, Carbene, Nitrene and Long-range rearrangements, Mechanism of Wagner- Meerwein, Hofmann, Curtius, Schmidt, Lossen, Beckmann, Wolf, Fries, Hofmann-Martius, Orton, Smiles, Favorskii, Stevens, Wittig, Sommelet, Hauser, Bayer-Villiger, Neber, Zimmermann, Chapman, Hydroperoxide and borane rearrangements

UNIT II **(18 Hours)**

Stereochemistry: Elements of symmetry, Chirality, R-S nomenclature, Diastereoisomerism in Acyclic and Cyclic systems, E-Z isomerisms, Interconversion of Fischer, Newman and Sawhorse projections, Molecules with more than one chiral center, Threo and erythro isomers, Methods of resolution, Optical purity, Enantiotopic and diastereotopic atoms, Groups and faces, Stereospecific and Stereoselective synthesis

UNIT III **(18 Hours)**

Pericyclic Reactions: Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5- hexatriene and allyl systems. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams, FMO and PMO approach

Electrocyclic reactions – conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems.

Cycloaddditions – antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions

Sigmatropic rearrangements – suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements, Fluxional tautomerism, Ene reaction (with selected examples)

UNIT IV **(18 Hours)**

Photochemistry: Introduction, Photochemistry of Alkenes– Intramolecular reactions of the olefinic bond, Geometrical isomerism, Rearrangement of 1,4- and 1,5-dienes. Photochemistry of Carbonyl Compounds– Intramolecular reactions of carbonyl compounds, Saturated, Cyclic and Acyclic, β, γ-unsaturated and α, β-unsaturated compounds, Photochemistry of Aromatic Compounds– Isomerisations, Additions and Substitutions. Photo-Fries reactions of Anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions

UNIT V **(18 Hours)**

Bioorganic Chemistry: Amino Acids – Structure, Classification, Synthesis and Properties of Amino Acids, Isoelectric point, Biosynthesis of Amino Acids

Proteins– Classification and Properties (Denaturation, Isolelectric point and Electrophoresis), Primary, Secondary, Tertiary and Quaternary structures of proteins, Collagen and Triple helix

Enzymes – Examples of Typical Enzyme Mechanisms: Chymotrypsin, Ribonuclease and Vitamin B_{12}

Nucleic Acids – Nucleotides and Nucleosides, DNA: Primary and Secondary structure-replication of DNA. RNA and Protein synthesis: Messenger RNA synthesis-transcription, Ribosomes-rRNA, Transfer RNA, Genetic codetranslation

Text Book:

1. J. Clayden, N. Greeves, S. Warren, and P. Wothers, **Organic Chemistry,** Oxford University Press, UK, 2nd Edition, 2012.

Reference Books:

2. E. L. Eliel, and S. H. Wilen, **Stereochemistry of Organic Compounds**, John Wiley, New York, 1994.
3. E. L. Eliel, Stereochemistry **of Carbon Compounds**, Tata-McGraw Hill Publishing Company, New Delhi 1998.
4. D. Nasipuri, **Stereochemistry of Organic Compounds – Principles and applications,** New Age International Pvt. Ltd., New Delhi, Revised 2nd Edition, 2009.
5. J. D. Coyle, **Organic Photochemistry,** Wiley, New York, 1998.
6. J. M. Coxon, and B. Halton, **Organic Photochemistry,** Cambridge, University Press, UK, 2nd Edition, 1987.
7. J. Singh and J. Singh, **Photochemistry and Pericyclic Reactions,** New Age International (P) Ltd., 2nd Edition, 2005
8. J. Singh and L.D.S. Yadav, **Organic Synthesis – Design, Reagents, Reactions and Rearrangements,** Pragathi Prakashan, Meerut, India, 1st Edition, 2009.
9. S. N. Sanyal, **Reactions, Rearrangements & Reagents,** Bharati Bhavan 2004.
10. K. K. Rohatgi-Mukherjee, **Fundamentals of Photochemistry**, 2nd Revised Edition,New Age international Publishers, 2006.
11. Mukhergji and S. P. Singh, **Reactions mechanisms in organic chemistry**, Mc Millan 2015.
12. F.A. Carey and R.J. Sundberg, **Advanced Organic Chemistry Part A and Part B,** Plenum Press, New York, 4th Edition, 2001.

13. P.S. Kalsi, **Stereochemistry – Conformation and Mechanism,** New Age International Publishers, New Delhi, India, 7th Edition, 2008.

CORE VI– INORGANIC CHEMISTRY-II
(For those who joined from since 2018-19-19)

Semester: II **Hours/Week: 6**
Subject Code: GMCHC22 **Credits: 5**

CO 1: Learnt the detailed study of synthetic inorganic complexes owing to the preparation as well as their reactivity and application which is very useful in the modern era
CO 2: To make the students to understand different reactions leads to the formation of various inorganic complexes and the mechanism involved
CO 3: To enable the students to learn the "Inorganic Photochemistry"
CO 4: To enable the student to understand about Coordination chemistry–I, II and III
CO 5: Studied the recent development in polymeric materials of coordination complexes
CO 6: To enable the student to understand about the X-Ray, electron and neutron diffraction

UNIT I **(18 Hours)**

Coordination Chemistry–I: Bonding in coordination compounds, Crystal field and Molecular orbital theory, Splitting of d-orbitals in low-symmetry environments, Molecular orbitals energy level diagrams for common symmetries. Bonding involving π-donor ligands, Back-bonding, Jahn-Teller effect, Tanabe- Sugano and Orgel diagrams, Interpretation of electronic spectra including charge transfer spectra, Spectrochemical and Nephelauxetic series, Spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, Magnetism in coordination compounds– Dia-, Para-, Ferro- and Antiferromagnetism, Quenching of orbital angular moment and Spin-orbit Coupling, Spectroscopic states

UNIT II **(18 Hours)**

Coordination chemistry–II: Reaction Mechanism**–** Energy profile of a reaction, Reactivity of metal complexes, Inert and labile complexes, Kinetic application of valence bond and crystal field theories, Kinetics of octahedral substitution, Acid hydrolysis, Factors affecting acid hydrolysis, Base hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, Reactions without metal ligand bond cleavage. Redox reactions, Electron transfer reactions, mechanism of one electron transfer reactions, Electron transfer reaction in biological systems, Inorganic photochemistry, ligand field photochemistry of d_n complexes, Photochemistry of carbonyl compounds, Energy conversion (solar) and photodecomposition of water, Outer sphere type reactions, Cross reactions and Marcus-Hush theory, Inner sphere type reactions, Berry pseudorotation, Substitution reactions in square planar complexes, Trans effect, Mechanism of the substitution reaction

UNIT III **(18 Hours)**

Coordination chemistry–III: General characteristics of lanthanides–Electronic configuration, Term symbols for lanthanide ions, Oxidation state, Lanthanide contraction. Factors that mitigate against the formation of lanthanide complexes, Electronic spectra and magnetic properties of lanthanide complexes. Lanthanide complexes as shift reagents.

General characteristics of Actinides, difference between *4f* and *5f* orbitals, comparative account of coordination chemistry of lanthanides and actinides with special reference to electronic spectra and magnetic properties

UNIT IV **(18 Hours)**

Inorganic Photochemistry: Electronic transitions in metal complexes, Metal-centered and Charge-Transfer Transitions, Various photophysical and photochemical Processes of coordination compounds, Unimolecular charge-transfer photochemistry of cobalt (III) complexes, Mechanism of CTTM Photoreduction, Ligand-field photochemistry of chromium(III) complexes, Adamson's rules, Photoactive excited states, V-C Model, Photophysics and photochemistry Of ruthenium, Polypyridine complexes, Emission and redox properties, Photochemistry Of organometallic compounds, Metal Carbonyl compounds, Compounds with metal-metal bonding reinecke's salt chemical actinometer

UNIT V **(18 Hours)**

Bioinorganic Chemistry: Reversible oxygenation in life process O_2-uptake proteins – Myoglobin, Hemoglobin, Hemeerythrin, Hemocyanin and Model systems, Electron transport proteins – Fe-S proteins, Ferridoxin, Rubredoxin and Model systems, Respiratory electron transport chains– Cytochromes, Photosynthetic electron transport chain, Chlorophyll, PS-I and PS-II, Biological nitrogen fixation (Nitrogenase) and Abiological nitrogen fixation Metal dependent diseases Wilsons, Alzheimer, Vitamin B_{12} and B_{12} -Enzyme, Metal complexes in therapeutic use of chelated and non-chelated compounds, Chelation therapy

Text Book:

1. James E. Huheey, Ellen A. Keiter, Richard L. Keiter and Okhil K. Medhi, **Inorganic Chemistry – Principles of Structure and Reactivity**, Pearson Education, Indian Edition, New Delhi, India, 4th Edition, 2013.

Reference Books:

1. J.D. Lee, **Concise Inorganic Chemistry,** Blackwell Science Ltd., London, 5th Edition, 2003.
2. Stephen J. Lippard and Jeremy Berg, **Principles of Bioinorganic Chemistry**, Panima Publishing Corporation, New Delhi, India, 2005.
3. Bertini, Gray, Lippard and Valentine**, Bioinorganic Chemistry,** Viva Books, Pvt., Ltd. 2004.
4. Asim K. Das, **Bioinorganic Chemistry**, Books and Allied (P) Ltd, Kolkota, 2010
5. W. Kaim and B. Schewederski, **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life**, John Wiley and Sons, New York, USA, 2nd Edition, 2013.
6. A. W. Adamson and P. D. Fleischauer, **Concepts of Inorganic Photochemistry**, R. E. Krieger Pubs, Florida, 1984.
7. A. W. Adamson, **Concept of Inorganic Photochemistry**, John Wiley and Sons, New York, 1975.
8. J. Ferraudi, **Elements of Inorganic Photochemistry**, Wiley, New York, 1988.
9. J.E. Huheey, E. A. Keiter and R. L. Keiter, **Inorganic Chemistry**, Pearson Education 4th Edition, 2002.
10. D. Banerjea, **Coordination Chemistry**, Asian Books Private Limited, 2nd Edition,2007.
11. J.A. McCleverty and T.J. Meyer, **Comprehensive Coordination Chemistry II**, Elsevier, 2004.

12. F.A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, **Advanced Inorganic Chemistry**, John Wiley, 6th Edition,2003.

CORE VII – PHYSICAL CHEMISTRY-II
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 6**
Subject Code: GMCHC23 **Credits: 5**

CO 1: Schrodinger equation for a particle in a box and quantum chemical description
CO 2: Electronic and Hamiltonian operators for molecules
CO 3: Mechanism for chemical reactions for optimizing the experimental conditions
CO 4: Application of homogeneous and heterogeneous catalysis in chemical synthesis
CO 5: Importance of adsorption process and catalytic activity at the solid surfaces
CO 6: Concept of colloidal material and their stability for many practical uses

UNIT I **(18 Hours)**

Basics of quantum chemistry: Introduction of quantum chemistry, operators, postulates of quantum chemistry, eigen value and eigen function, normalization and orthogonality, Schrodinger wave equation

Application of quantum chemistry to simple systems

Translational motion – Particle in one dimensional box, particle in three dimensional box-rectangular and cubical box , particle with finite potential barrier, One finite potential barrier, two finite potential barrier, the quantum mechanical tunneling

Vibrational motion – Hooke's law, Harmonic oscillator, the quantum mechanical derivation for a harmonic oscillator model of a diatomic molecule, a harmonic oscillator accounts for IR spectrum of a diatomic molecule, physical interpretation of ψ and ψ^2

Rotational motion – Rigid rotator, Derivation of energy and wave function of rigid rotator, rotation in one plane, rotation in space

Hydrogen and Hydrogen like atoms – Spherically symmetric potential and the Hamiltonian, spherical coordinates , schrodinger wave equation in terms of r, θ ,Φ. radial eigen functions, atomic orbitals of hydrogen like atoms, significance of the quantum numbers n, l, m. graphical representation of the orbitals (s, p)

UNIT II **(18 Hours)**

Approximate methods: Variation principle-linear and non-linear variation theory, Perturbation theory-Ist, application of variation and perturbation theory to He atom

Theory of angular momentum **–** Angular momentum, quantum mechanical operator for angular momentum, ladder operator, eigen function and eigen values of angular momentum using ladder operator, orbital and spin motion, spin angular momentum, addition of angular momentum, coupled and uncoupled representation of angular momentum

Molecular orbital theory (MOT) – LCAO approximation, the H^{2+} ion, the LCAO MO wave fuction of H^{2+} ion, electron density and bonding in H^{2+}, physical representation, bond order, charge density calculation, free valence ,conjugated molecules, Huckel MOT of conjugated systems, Huckel rule of aromaticity, applications of Huckel MOT to ethylene, butadiene, Elementary idea of extended Huckel theory

UNIT III **(18 Hours)**

Kinetics of complex reactions: Parallel, consecutive and reversible reactions. Determination of order of reaction. Arrhenius equation, energy of activation and its experimental determination. Simple collision theory-mechanism of bimolecular reaction, Lindemann's theory, Hinshelwood's theory for unimolecular reaction (No derivation), Activated complex theory of reaction rate, Classical thermodynamic treatment, Partition function, Statistical thermodynamic treatment. Kinetics of reactions in solution-Salt effects, effect of dielectric constant (single sphere and double sphere model), Kinetics of heterogeneous reactions - Langmuir's theory, unimolecular and bimolecular surface reactions

UNIT IV **(18 Hours)**

Surface Chemistry

Different types of surfaces, thermodynamics of surfaces, Gibbs adsorption equation and its verification, surfactants and micelles, surface films, surface pressure and surface potential and their measurements and interpretation

Adsorption – The Langmuir theory, kinetic and statistical derivation, multilayer adsorption-BET theory, Use of Langmuir and BET isotherms for surface area determination, Application of Langmuir adsorption isotherm in surface catalysed reactions and the Langmuir-Hinshelwood mechanism, flash desorption

Colloids – Zeta potential, electrokinetic phenomena, sedimentation potential and streaming potential, Donnan membrane equilibrium

UNIT V **(18 Hours)**

Photochemistry: Fundamentals of photochemistry: Unimolecular photochemical processes, Jablonski diagram, quantum yield, chemical actinometry, excimers, exciplexes, E-type and P-type fluorescence, short range and long range energy transfer, quenching and sensitization. Kinetics of photochemical processes, Stern – Volmer equation, photochemical techniques– flash photolysis, radiation chemistry - pulse radiolysis, hydrated electron. Solar energy conversion and storage, solar cell and its working, photochemistry of environment, Ozone layer in the stratosphere**,** greenhouse effect and photochromism

Text Book:

1. R.K. Prasad, **Quantum Chemistry**, New Age International Publishers, New Delhi, 4th Edition, 2010.

Reference Books:

1. N. I. Levine, **Quantum Chemistry**, Prentice Hall, 5th ed., 2008.
2. A.K. Chandra, **Introduction to Quantum Chemistry**, Tata McGraw Hill, 4th ed., 2004.
3. P. Atkins and R. Friedman, **Molecular Quantum Mechanics**, Oxford University Press, 4th ed., 2005.
4. Donald A. McQuarrie, and John D. Simon, **Physical Chemistry – A Molecular Approach**, Viva Books Pvt. Ltd., New Delhi, 3rd Edition, 2011.
5. Peter Atkins, **Atkins' Physical Chemistry**, Osford University Press, New York, 8th Edition, 2010.
6. Ira N. Levine, **Quantum Chemistry**, Pearson Education Pvt. Ltd., New Delhi, 5th Edition, 2004.
7. K.J. Laidler, **Chemical Kinetics,** Pearson Education Pvt. Ltd., New Delhi, 3rd Edition, 2004.

8. David O. Hayward, **Quantum Mechanics for Chemists**, The Royal Society of Chemistry, UK, 2002.
9. John P. Lowe and Kirk A. Peterson, **Quantum Chemistry**, Academic Press, London, UK, 3rd Edition, 2009.
10. K. K. Rohatgi-Mukherjee, **Fundamentals of Photochemistry,** New Age International Pvt. Ltd., New Delhi, 3rd Edition, 2014.

CORE VIII – INORGANIC CHEMISTRY PRACTICAL
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 6**
Subject Code: GMCHC24P **Credits: 5**

CO 1: The students to understand the basic principles of lab techniques adopted in inorganic laboratories
CO 2: Learnt about the quantitative and qualitative analyses by separation
CO 3: Learnt the preparation of inorganic compounds
CO 4: Preparation and purification of different inorganic compounds
CO 5: To teach the synthesis of inorganic compounds and their characterization with instrumental techniques
CO 6: Safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents

PART-I (90 Hours)

1. Qualitative analysis:
Qualitative analysis employing semi-micro methods and spot tests of mixtures of common cations and ions of the following less familiar elements. Molybdenum, tungsten, selenium, tellurium, cerium, thorium, titanium, zirconium, vanadium, uranium and lithium

2. Colorimetry:
Colorimetric estimations of copper, nickel, iron and chromium using photoelectric colorimeter

3. Industrial analysis:
(i) Analysis of two of the following alloys: brass, bronze, stainless steel, solder type metal.
(ii) Analysis of any one of the following: cement, glass, ultramarine

4. Titrimetry:
Complexometric titrations involving estimations of calcium, magnesium, nickel, zinc and hardness of water

5. Quantitative analysis:
Quantitative analysis involving volumetric and gravimetric estimations of at least four mixtures of cations

6. Preparation of inorganic complexes:
About six preparations involving different techniques selected from the following.
(i) Potassium tris(oxalato)aluminate
(ii) Nickel ammonium sulphate
(iii) Tris(thiourea)copper(I) chloride
(iv) Potassium tris(oxalato)ferrate
(v) Hexamminecobalt(III) chloride
(vi) Ammonium hexachloro stannate(IV)
(vii) Tetrammine copper(II) sulphate
(viii) Cis and trans bis(glycinate) copper

Reference Books:

1. J. Mendham, R.C. Denney, J.D. Barnes, and M. J.K. Thomas, **Vogel's Textbook of Quantitative Analysis**, Pearson Education, 3rd Edition,2007.
2. V.V. Ramanujam, **Inorganic Semi-micro Qualitative Analysis**, National Publishing Company, Madras, 3rd Edition, l990.
3. G. Svehla and B. Sivasankar, **Vogel's Qualitative Inorganic Analysis** (revised), Pearson, 7th Edition, 1996.
4. A. I. Vogel, **Text Book of Quantitative Inorganic Analysis**, Longman, New Delhi, 6th Edition, 2000.

ELECTIVE II (A) – APPLIED ELECTROCHEMISTRY
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 5**
Subject Code: GMCHE2A **Credits: 5**

CO 1: To impart the knowledge on the chemistry of green inhibitors and their crucial applications
CO 2: To teach the importance of various types of battery and their applications
CO 3: Detailed knowledge about the electrochemical energy storage
CO 4: To create awareness on conversion and storage of electrochemical energy.
CO 5: To teach the chemistry of coulometry
CO 6: To teach methodologies involved in voltammetry

UNIT I **(15 Hours)**

Conversion and Storage of Electrochemical Energy: Pollution problem, History of fuel cells, Direct energy conversion by electrochemical means, Electrochemical Generators (Fuel Cells) – Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkaline fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells

UNIT II **(15 Hours)**

Electrochemical Energy Storage: Properties of Electrochemical energy storers – Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density, Classical Batteries – (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide. Modern Batteries– (i) Zinc-Air (iii) Lithium Battery

UNIT III **(15 Hours)**

Corrosion and Stability of Metals: Civilization and Surface mechanism of the corrosion of the metals–Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diaphragms, uses and abuses, Corrosion current and corrosion potential -Evans diagrams, Measurement of corrosion rate – (i) Weight Loss method, (ii) Electrochemical Method. Inhibiting Corrosion– Cathodic and Anodic Protection, (i) Inhibition by addition of substrates to the electrolyte environment, (ii) by charging the corroding method from external source, anodic Protection, Organic inhibitors, Passivation – Structure of Passivation films, Mechanism of Passivation

UNIT IV **(15 Hours)**

Kinetic of Electrode Process: Methods of determining kinetic parameters for quasi-reversible and irreversible waves – Koutecky's methods, Meits Israel Method, Gellings

method, Electrocatalysis – Chemical catalysts and Electrochemical catalysts with special reference to porphyrin oxides of rare earths, Electrocatalysis in simple redox reactions, in reaction involving adsorbed species. Influence of various parameters

UNIT V **(15 Hours)**

Potential Sweep Methods: Cyclic Voltammetry, theory and applications. Diagnostic criteria of cyclivoltammetry, controlled potentials methods, chronopotentiometry, theory ad applications, Bulk Electrolysis Methods – Controlled potential coulometry, Controlled Coulometry, Stripping analysis – anodic and cathodic modes, Bioelectrochemistry – bioelectrodics, Membrane Potentials, Simplistic theory and Modern theory

Text Book:

1. J'OM Bockris and A.K.N. Reddy, **Modern Electrochemistry,** Plenum Publication, New York, Vol. I, IIA, Vol. IIB, 2005.

ReferenceBooks :

2. Samuel Glasstone, **An Introduction to Electrochemistry**, Litton Educational Publishing, Inc., New York, 2008.
3. D. Pletcher and F.C. Walsh, **Industrial Electrochemistry**, Chapman and Hall, 2nd Edition, 1984.
4. F. C. Walsh and D. Pletcher, **Industrial Electrochemistry**, Kluwer Academic Pub, 2nd Edition, 1990.
5. L. Antropov, **Theoretical Electrochemistry**, University Press of the Pacific, USA, 2001.
6. J. O'M Bockris and A. K. N. Reddy, **Modern Electrochemistry**, Plenum Press, New York, 2nd Edition, Vol. 1 and 2, 1998.
7. Basil H. Vessor & W. Galen, **Electroaalytical Chemistry**, Wiley Interscience.
8. S. K. Rangrajan, **Topics in pure and Applied Chemistry,** SAEST Publication, Karaikudi (India).

ELECTIVE II (B) – POLYMER CHEMISTRY
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 5**
Subject Code: GMCHE2B **Credits: 5**

CO 1: To teach the students the essential role of polymer in industries and to preserve the same
CO 2: To teach the importance of various types of polymers and their applications
CO 3: To create awareness on polymer processing
CO 4: Different mechanisms of polymerization
CO 5: To impart the knowledge on the chemistry of polymers and their crucial applications
CO 6: Number, weight and viscosity average molecular weights with various techniques

UNIT I **(15 Hours)**

Introduction: History of macromolecular science, Concept of macromolecules, Nomenclature of polymers. Different ways in classification of polymers depending on – a) The origin (natural, Semisynthetic, synthetic etc.) b) The structure (linear, branched, network, hyper branched, dendrimer) c) The type of atom in the main chain (homochain, heterochain) d) The formation (condensation, addition), Homopolymers, copolymers. Monomer structure and polymerizability

UNIT II **(15 Hours)**

Kinetics and mechanism of Chain polymerization processes: Chain reaction (Addition) polymerization, Free radical addition polymerization mechanism of vinyl polymerization, generation of free radicals, initiation, propagation, termination, chain transfer inhibition of retardation, configuration of monomer units in vinyl polymer chains, Kinetics of free radical addition polymerization. Ionic and coordination chain (addition) polymerization common features of two types of ionic polymerization, Mechanism of cationic polymerization

UNIT III **(15 Hours)**

Condensation polymerization: Step reaction (condensation) polymerization – Mechanism of step reaction polymerization, Kinetics of step reaction polymerization, reactivity and molecular size. Kinetic expressions for polymerization in absence and in presence of a catalyst, Hyper-branched polymers, dandled with highlighting their methods of synthesis and properties, Preparation, properties and application of the following – polyamides , Nylon 6, Nylon 66, Nylon 610 etc., polyesters

UNIT IV **(15 Hours)**

Analytical Chemistry of polymers: Instruments and specimen reparation, Elucidation of structure – Proton NMR and C^{13} NMR phenomenon, Line broadening by local fields, broad line spectra, Analysis of molecular structure of simple polymers, Differential thermal analysis – physical transitions, melting thermograms, Thermo gravimetric analysis – Introduction, instrumentation, Determination of kinetic parameters, Thermal degradation, behaviour of some polymer by TGA methods

UNIT V **(15 Hours)**

Polymer processing: Plastics technology, Plastics technology raw materials–types of forms, products, applications consumption pattern, Tailoring of material, Molding – compression molding, transfer molding, injection molding, Extrusion Fiber Technology, Textile and fabric properties – Definition of textile terms, properties of textile fibers – electric, mechanical and fabric properties. Spinning – melt spinning, dry spinning, and wet spinning. Fiber after treatments scouring, lubrication, sizing, dyeing, finishing, Elastomers technology – Compounding and elastomers properties, Vulcanization – chemistry of vulcanization

Text Book:

1. Fred W. Billmayer, **Textbook of Polymer Science**, John Wiley & Sons Pvt. Ltd., Singapore, Indian Edition, 3rd Edition, 2007.

Reference Books:

2. C. E. Carraher, **Polymer chemistry**, Marcel Dekker, New York, 6th Edition, 2003.
3. P.J. Flory, **Principles of Polymer Chemistry,** Asian Book Private Ltd., 1st edition, 2006.
4. V.K. Ahluwalia and Anuradha Mishra, **Polymer Science – A Textbook**, Ane Books India, Noida, 2008.
5. V.R. Gowariker, N.V. Viswanathan and Jayadev Sreedhar, **Polymer Science**, 5th Edition, New Age International Publishers, New Delhi, 2005.
6. Malcolm P. Stevans, **Polymer Chemistry,** Oxford University Press, New York, First Indian Edition, 2008.

7. P. Bahadur and N.V. Sastry, Principles **of polymer science**, 2nd edition, Narosa Publishing house, Chennai, 2005.
8. T. R. Crompton**, Analysis of polymers- an introduction**, pergaman pres, 1989.
9. E.A. Turi, **Thermal characterization of polymeric materials**, Academic press Inc.
10. W. J., D. Bavaporwala, **Plastic technology**, Bombay.
11. L.M. Dekkar Naturaman, **Polymer plastics technology and Engineering,** 1979.

EXTRA CREDIT II – CHROMATOGRAPHIC TECHNIQUES

(For those who joined from since 2018-19)

Semester: II **Credits: 2**

Subject Code: GMCHX2

CO 1: Chromatographic separation and identification of organic compounds
CO 2: Chromatographic Techniques and applications
CO 3: Data handling/ statistical treatment of data.
CO 4: HPLC and gas Chromatography methods of analysis

UNIT I

Partition Chromatography: Paper chromatography– Thin Layer Chromatography, Rf value, chromatogram, Ascending and descending chromatography, Applications of partition chromatography

UNIT II

Adsorption Chromatography: Principle, classification of column chromatography, column efficiency, preparation of column

UNIT III

Ion Exchange Chromatography: Structure of ion exchanger, types of cation and anion exchanger, mechanism of ion exchange chromatography, Ion exchange resins, ion exchange capacity, Factors affecting separations, applications of IEC

UNIT IV

Exclusion Or Gel Chromatography: Technique in Gel Chromatography, Gel preparation, packing of column, theory and application of gel chromatography

UNIT V

Gas Chromatography and H.P.L.C: Principle, instrumentation, advantages of HPLC, Effect of temperature in HPLC and HPTLC

Gas Chromatography– Principle, G.C. columns, Instrumentation, Methodology, GC-MS, Applications of GC

Text Book:

1. D.A. Skoog, F.J. Holler, and S.R. Crouch, **Principles of Instrumental Analysis, Thomson Learning**, 2007.

Reference Books:

2. H.H. Willard, Jr. L. Merritt, J.A. Dean and F.A. Settle, **Instrumental Methods of Analysis,** CBS Publishers, 7th Edition, 2007.
3. G.D. Christian, **Analytical Chemistry,** Wiley 6th Edition, 2007.

4. J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, **Vogel's Textbook of Quantitative Chemical Analysis**, Pearson Education, 2007.
5. D.A. Skoog, D.M. West, F.J. Holler, and S.R. Crouch, **Fundamentals of Analytical Chemistry**, Brooks/Cole, 8th Edition,2003.
6. A. Braithwaite and J. F. Smith, **Chromatographic Methods**, Springer, Germany, 5th Edition, 1995.
7. V. K. Srivastava and K. K. Srivastava, **Introduction to Chromatography,** 2nd Edition Holden Day, New York, 1985.
8. V.K. Srivatsan and K.K. Srivatsan, **Introduction to Chromatography- Theory and Practice,** S. Chand Company Ltd., 4th Edition, 1991.
9. Lloyd R. Snyder and Joseph J. Kirkland, **Introduction to Modern Liquid Chromatography Hardcover**, Wiley, 3rd Edition, 2009

CORE IX – ORGANIC CHEMISTRY-III
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GMCHC31 **Credits: 5**

CO 1: Learnt about the various principles involved in terepenoids, alkaloids, flavonoids, steroids, porphyrins and prostaglandins
CO 2: To make the student to understand about the organometallic compounds
CO 3: Learnt the principles involved in small ring heterocycles
CO 4: IR range for functional groups, λ_{max} for polyenes and α, β-unsaturated carbonyl compounds
CO 5: Cotton effect curves for obtaining absolute configuration of chiral molecules with chromophores
CO 6: Solve structural problems based on UV-Vis, IR, ^{1}HNMR, ^{13}CNMR and mass spectral data

UNIT I **(18 Hours)**

Ultraviolet and Visible Spectroscopy: Introduction, Ultraviolet Bands for Carbonyl Compounds, Unsaturated Carbonyl Compounds, Dienes, Conjugated Polyenes, Fieser – Woodward Rules for Conjugated Dienes and Carbonyl Compounds, Ultraviolet Spectra of Aromatic and Heterocyclic compounds, Steric effect in Biphenyls (problem to be discuss).
Infrared Spectroscopy: Introduction, Characteristic Vibrational Frequencies of alkanes, Alkenes, Alkynes, Aromatic compounds, Alcohols, Ethers, Phenols and amines. Detailed Study of Vibrational Frequencies of Carbonyl Compounds (Ketones, Aldehydes, Esters, Amides, Acids, Anhydrides, Lactones, Lactams and Conjugated Carbonyl Compounds). Effect of Hydrogen Bonding and Solvent Effect on Vibrational Frequencies, FT-IR
Optical Rotatory Dispersion and Circular Dichroism: Definition, Deduction of Absolute Configuration, Octant Rule for Ketones

UNIT II **(18 Hours)**

Nuclear Magnetic Resonance Spectroscopy: General Introduction and Definition, Resonance of Other Nuclei – F and P, Chemical shift, Spin-spin Interaction, Shielding Mechanism, Chemical Shift Values and Correlation for Protons Bonded to Carbon (Aliphatic, Olefinic, Aldehydic and Aromatic) and Other Nuclei (Alcohols, Phenols, Enols, Carboxylic acids, Amines, Amides & Mercapto), Chemical Exchange, Effect of Deuteration, First Order

Spectra, Simplification of Complex Spectra, Nuclear Magnetic Double Resonance, Continuous Wave and FT-NMR

UNIT III **(18 Hours)**

Mass Spectrometry: Introduction, Mass spectral fragmentation of organic compounds, Common functional groups, Molecular ion peak, and McLafferty rearrangement. Nitrogen Rule, High Resolution Mass Spectrometery. Examples of Mass Spectral Fragmentation of Organic Compounds with respect to their Structure Determination. Ion Production - EI, CI, FD and FAB, Factors Affecting Fragmentation

Structure Elucidation of some model organic molecules by UV-Vis, IR, 1H NMR, 13C NMR and MS

UNIT IV **(18 Hours)**

SMALL RING HETEROCYCLES: Three-Membered and Four-Membered Heterocycles-Synthesis and Reactions of Azirodines, Oxiranes, Thiranes, Azetidines, Oxetanes and Thietanes Benzo-Fused Five-Membered Heterocycles Synthesis and Reactions including Medicinal Applications of Benzopyrroles, Bezofurans and Benzothiophenes

UNIT V **(18 Hours)**

Chemistry of Natural Products: Stereochemistry, Reaction and Synthesis of Terpenoids and Carotenoids: Zingiberine, Abietic acid and α- Cadinene

Stereochemistry, Reactions and Synthesis of Alkaloids: Quinine, Morphine, Camptothecin. Structure, Synthesis and Reacations of Flavonoids and Coumarins

Reaction and Synthesis of Steroids: Cholesterol (without synthesis), Bile acid, Testosterone, Estrone, Progesterone

Structure and Synthesis of Prostaglandins: PGE_2

Text Book:

1. P. M. Silverstein and F. X. Western, **Spectroscopic Identification of Organic Compounds**, John Wiley, New York, 8th Edition, 2014.

Reference Books:

2. I. L. Finar, **Organic Chemistry**, Pearson Education Pvt. Ltd, Vol 2, 6th Edition,2002.
3. C. N. Banwell and E. M. McCash, **Fundamentals of Molecular Spectroscopy,** Tata McGraw Hill, 1994.
4. S. Chandra, **Molecular Spectroscopy**, Narosa Pvt. Ltd, 2009.
5. William Kemp, **Organic Spectroscopy**, Palgrave, New York, USA, 3rd Edition, 2004.
6. J. R. Dyer, **Applications of Absorption Spectroscopy of Organic Compounds,** PHI Learning, New Delhi, 2009.
7. Y. R. Sharma, **Elementary Organic Spectroscopy – Principles and Chemical applications,** S. Chand, New Delhi, 1992.
8. P. S. Kalsi, **Spectroscopy of Organic Compounds**, 6th Edition, New Age International Publishers, New Delhi, 2004.
9. Silverstein, **Spectrometric Identification of Organic Compounds**, Tata McGraw Hill, 7th Edition,2005.
10. J.A. Joule and K. Mills, **Heterocyclic Chemistry,** Blackwell Publishing, Wiley India Pvt. Ltd., New Delhi, 4th Edition, 2009.

11. O.P. Agarwal, **Organic Chemistry – Natural Products,** GOEL Publishing House, Meerut, India, Vol. I, 2003.
12. O.P. Agarwal, **Organic Chemistry – Natural Products,** GOEL Publishing House, Meerut, India, Vol. II,2004.
10. Raj K, Bansal, **Heterocyclic Chemistry**, New Age International Publishers, New Delhi, India, 4th Edition, 2009.

COREX– INORGANIC CHEMISTRY-III
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GMCHC32 **Credits: 5**

CO 1: To enable the student to learn the theories of metalloporphyrins and metalloenzyme.
CO 2: To teach the students the essential role of chemotherapy
CO 3: Theories of medicinal bioinorganic Chemistry
CO 4: Detailed knowledge about the advanced organometallic Chemistry
CO 5: Learnt about the various principles involved in organometallic Chemistry
CO 6 : Learnt the principles involved in molecular Bioinorganic Chemistry

UNIT I **(18 Hours)**

Organometallic Chemistry: The 18- electron rule for organometallic compounds of transition metals, Classification based on 18-electron rule, Complexes of two, three, four, five six, seven, eight-electron pi-ligands, Nomenclature, Exceptions to 18 electron rule, the 16-electron rule, Isolobal and isoelectronic relationship of complexes, Agostic interaction Metal-carbon-bonded compounds (compounds of the sigma electron ligands), Metal-alkyl, -Allyl, -Carbene, -Carbonyl, -Carbide and Cyclopentadienyl complexes structure and bonding inη2-Ethylene and η3- Allylic compounds with typical examples, structure and bonding. Elementary idea about Homoleptic and Non-Homoleptic compounds – synthesis, reactivity, oxidative addition and reductive elimination reaction – insertion reactions and elimination, electrophilic and nucleophilic reactions; instability (decomposition pathway) and stabilization, Metallacycles

UNIT II **(18 Hours)**

Advanced Organometallic Chemistry: Stereochemical non rigidity and fluxional behavior of organometallic compounds with typical examples, Reactions in fluxional organometallic compounds, Catalysis by organometallic compounds Hydrogenation, Wilkinson Catalyst, Tolman Catalytic loop, Syntehses gas, Water gas shift reaction, Hydroformylation (Oxo process), Monsantro Acetic Acid process, Walcker process, Synthetic gasoline – Fischer Tropsch process and mobile process. Polymerization, Oligomerization, and metatheses reaction of alkenes and alkynes, Zieggler Natta catalysis, Photodehydrogenation catalyst (Platinum POP)

UNIT III **(18 Hours)**

Metalloporphyrins: Porphyrins and their salient features, Characteristic absorption spectrum of Porphyrins, Chlorophyll (structure and its role in photosynthesis) Transport of

Iron in microorganisms (sidrophores), Types of siderophores (Catecholate and Hydroxamato Siderophores)

Metalloenzyme – Definitions, Apoenzyme, Coenzyme, Metalloenzyme, Structure and functions of carbonic anhydrase A & B, carboxy peptidases.

Cobalamines – Reactions of the alkyl cobalamins, One-electron Reduction and Oxidation, Co-C Bond Cleavage, Coenzyme B_{12}, Alkylation reactions of methylcobalamin

Copper Containing Proteins – Classification and examples, Electron transfer, Oxygen transport, Oxygenation, oxidases and reductases, Cytochrome oxidase, Superoxide dismutase (Cu, Zn)

UNIT IV (18 Hours)

Medicinal Bioinorganic Chemistry: Bioinorganic Chemistry of quint essentially toxic metals. Lead, Cadmium, Mercury, Aluminium, Chromium, Iron, Copper, Plutonium. Detoxification by metal chelation, Drugs that act by binding at the metal sites of Metalloenzymes

Chemotherapy – Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy, Cisplatin and its mode of action, Cytotoxic compounds of other metals, Gold containing drugs as anti-rheumatic agents and their mode of action, Lithium in Pschycopharmocological drugs, Radiopharmaceuticals Technetium

UNIT V (18 Hours)

Supramolecular Chemistry : Definition, Nature of supra molecular interactions, Supra molecular host-guest compounds, Supramolecular devices and sensors, various types of supramolecular devices – supramolecular photochemistry, molecular and supramolecular photonic devices – light conversion and energy transfer devices, Molecular and supramolecular electronic devices – electronic conducting devices – molecular wires, modified and switchable molecular wires, Molecular and supramolecular ionic devices – tubular mesophases, molecular protonics, Switching devices – electro-photo switch – ion and molecule sensors, Role of supramolecular chemistry in the development of nanoscience and technology

Text Book:

1. J.E. Huheey, E.A. Keiter and R.L. Keiter, **Inorganic Chemistry Principles of Structure and Reactivity,** Harper Collins College Publishers, 4th Edition,2006.

Reference Books:

2. John F. Hartwig, **Organotransition Metal Chemistry: From Bonding to Catalysis**, University Science Books, 2009.
3. Ch. Elshebroicn and A. Salzer, **Organometallics: A concise Introduction,** VCH, 2006.
4. B.E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry, Wiley-India, 3rd Edition,2007.
5. B.D. Guptha and A.J Elias, Basic Organometallic Chemistry, Universities Press, 2010.
6. H.J. Schneider and A.Yatsimirsky, **Principles and Methods in Supramolecular Chemistry,** Wiley, New York, 2000.
7. J.W. Steed and J.L. Atwood, **Supramolecular Chemistry,** John Wiley &Sons, Chichester, 2009.
8. R. H. Crabtree, **The Organometallic Chemistry of the Transition Metals**, 3rd Edition, John Wiley and Sons, New York, 2001.

9. Stephen J. Lippard and Jeremy Berg, **Principles of Bioinorganic Chemistry**, Panima Publishing Corporation, New Delhi, India, 2005.
10. Bertini, Gray, Lippard and Valentine**, Bioinorganic Chemistry,** Viva Books, Pvt., Ltd. 2004.
11. Asim K. Das, **Bioinorganic Chemistry**, Books and Allied (P) Ltd, Kolkota, 2010
12. W. Kaim and B. Schewederski, **Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life**, John Wiley and Sons, New York, USA, 2nd Edition, 2013.

CORE XI – PHYSICAL CHEMISTRY-III
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GMCHC33 **Credits: 5**

CO 1: Learnt about the various principles involved in group theory
CO 2: Learnt the principles involved in molecular spectroscopy
CO 3: Characterization by physical and spectroscopic techniques
CO 4: To teach the students to understand the basic principles group theory and molecular spectroscopy
CO 5: Learnt the knowledge of electrochemistry
CO 6: Versatile knowledge about the photoelectron spectroscopy, photo acoustic spectroscopy and electron spin resonance spectroscopy

UNIT I **(18 Hours)**

Group Theory: Symmetry elements and symmetry operation, Definitions of group, Subgroup, Relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group, Schonflies symbols, Representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh), Character of a representation

Character Table and their Uses – The great orthogonality theorem and its importance. Construction of character tables, Reducible and irreducible representations, Group theory and quantum mechanics, Projection operator, Using projection operator to construct symmetry adopted linear combinations (SALCs)

UNIT II **(18 Hours)**

Electrochemistry-I: Mean ion activity and activity coefficient of electrolytes in solution, ion association, ionic strength, Debye-Hückel theory and Debye-Hückel limiting law - its validity and limitations, strong and weak electrolytes, Debye theory of electrolytic conductance. Debye-Hückel-Onsager equation - verification and limitations, electrochemical cells and applications of standard redox potentials

UNIT III **(18 Hours)**

Electrochemistry-II: The electrical double layer, polarizable and non-polarizable interfaces, structure of electrical double layer, double layer models, Helmholtz, Guoy-Chapman and Stern models. Kinetics of electrode processes, current-potential curve, Butler-Volmer relation and its approximations, symmetry factor and transfer coefficient, Tafel equation, charge transfer resistance, Nernst equation from Butler-Volmer equation, primary and secondary batteries , fuel cells, corrosion and its prevention methods

UNIT IV **(18 Hours)**

Nuclear Magnetic Resonance Spectroscopy: Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin- spin interactions, factors including coupling constant 'J'. Classification (ABX, AMX, ABC, A_2B_2, etc), spin decoupling. Basic ideas about instruments, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics

Carbon-13 NMR Spectroscopy: General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic, hetero aromatic and carbonyl carbon), coupling constants. Two dimension NMR Spectroscopy, COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techiniques

UNIT V **(18 Hours)**

Nuclear Quadruple Resonance Spectroscopy: Quadruple nuclei, Quadruple moments, electric field gradient, coupling constant, splitting, applications

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin

Text Book:

1. Peter Atkins, **Atkins' Physical Chemistry**, Oxford University Press, New York, 8th Edition, 2010.

Reference Books:

2. Colin N. Banwell and Elaine M. McCash, **Fundamentals of Molecular Spectroscopy**, Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2008.
3. Samuel Glasstone, **An Introduction to Electrochemistry**, Litton Educational Publishing, Inc., New York, 2008.
4. B.K. Sharma, **Electrochemistry,** Krishna Prakashan Media (p) Ltd, 1998.
5. D.R. Crow, Principle and applications of electrochemistry, Campmann & Hall.
6. K. Veera Reddy, **Symmetry and spectroscopy of molecules,** 2nd Edition, NewAge International Publication, 2009.
7. F. A. Cotton, **Chemical Applications of Group Theory**, 3rd Edition, John Wiley and Sons, Singapore, 2003.
8. R. L. Flurry, **Symmetry Groups: Theory and Chemical Applications**, Prentice Hall, New Jersy, 1980.
9. S. F. A. Kettle, **Symmetry and Structure,** 2nd Edition, John Wiley and Sons, Chichester, 1995.
10. J. H. Simpson, **Organic Structure Determination using 2D NMR Spectroscopy**, Academic Press, Elsevier, 2008.
11. D.L. Pavia, G. M. Lampman and G.S. Kriz, **Introduction to Spectroscopy**, Brooks/Cole Cengage Learning 4th Edition,2008.
12. R.M. Silverstein and F.X. Webster, **Spectrometric Identification of Organic Compounds,** John Wiley & Sons, Inc., 7th Edition,2005.
13. M.L. Martin, J.J. Delpeuch and G.J. Mirtin, **Practical NMR Spectroscopy**, Heyden 1980.

14. R.V. Parish, **NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry**, Ellis Harwood, 1991.
15. H. Windawi, and F.L.H. Floyd, **Applied Electron Spectroscopy** for Chemical Analysis (Chemical Analysis Vol. 63), John Wiley 1982.
16. Raman K.V., **Group Theory and Its Applications to Chemistry**, Tata McGraw-Hill, 1990.
17. N.N. Dass, **Symmetry and Group Theory for Chemists**, Asian Books Pvt. Ltd 2004.
18. M.S. Gopinathan, and V. Ramakrishnan, **Group Theory in Chemistry**, Vishal Publishers, 2006.
19. K.L. Kapoor, **A Text Book of Physical Chemistry,** Macmillan, India, 2nd Edition, Vol. 3, 2005.
20. K.J. Laidler, **Chemical Kinetics,** Dorling Kingsley, 2007.
21. J., Rajaraman, and J., Kuriacose, **Kinetics and Mechanism of Chemical Transformations**, McMillan, 2008.

CORE XII – PHYSICAL CHEMISTRY PRACTICAL
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GMCHC34P **Credits: 5**

CO 1: The students to understand the basic principles of lab techniques adopted in physical laboratories
CO 2: Experimental techniques for controlling the chemical reactions.
CO 3: Measurement of various physical and chemical properties.
CO 4: Applying related experiments for their research work.
CO 5: Learnt the potentiometric and conductometric titrations
CO 6: Safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents.

PART-I **(90 Hours)**

1. Conductometry
(i) Determination of cell constant
(ii) NaOH vs. HCl titration.
(iii) NaOH vs. Oxalic acid titration
(iv) NaOH vs. CH3COOH titration.
(v) $AgNO_3$ vs. KCl titration.
(vi) $Ba(NO_3)_2$ vs. Na_2SO_4 titration.

2. Potentiometry
(i) NaOH vs. HCl titration.
(ii) NaOH vs. Oxalic acid titration.
(iii) NaOH vs. CH_3COOH titration
(iv) $AgNO_3$ vs. Kcl titration.
(v) $KMnO_4$ vs. Mohr's Salt/ FeSO4 titrations.

3. pH metry
(i) NaOH vs. HCl titration.
(ii) NaOH vs. Oxalic acid titration.
(iii) NaOH vs. CH_3COOH titration.

4. Thermochemistry
(a). Determination of heat of neutralisation
(i) NaOH vs. HCl
(ii) NaOH vs. CH_3COOH
(iii) NaOH vs. Oxalic acid.
(b) Determination of Heat of solution and Heat of hydration of $BaCl_2$ and $CuSO_4$
5. Chemical Kinetics
(i) To study kinetics of hydrolysis of an ester in the presence of acid
(ii) To compare the relative strength of acids (HCl and H_2SO_4)
(iii) To determine the temperature coefficient for the Ist order reaction.
6. Refractometry
(i) Determin Ahluwalia, V. K., and Kidwai, M., New Trends in Green Chemistry, Anamaya Publishers (2004)ation of molar refractivity of the given liquid.
(ii) To determine percentage composition of liquids in the given binary mixture.
7. Surface tension
To determine interfacial tension of two immiscible liquids.
8. Adsorption
To study the adsorption of Oxalic acid and Acetic acid on charcoal.
9. Distribution Law
(i) To determine partition coefficient of benzoic acid between benzene and water.
(ii) To determine partition coefficient of Iodine between Carbon tetrachloride and water.
(iii) Determination of Equilibrium constant for $I_2 + I^- = I_3$

Reference Books:

1. B.D. Khosla, V.C. Garg, and A.R. Gulati **Senior Practical Physical Chemistry**, S. Chand, 2007.
2. J.B. Yadav, **Advanced Practical Physical Chemistry**, Krishna Prakasan Media, 2008.
3. D. P. Shoemaker, **Experimental Physical Chemistry,** Mc. Growhill, 7th Edition, 2003.
4. B.P. Levitt, **Findlay's Practical Physical Chemistry**, Longman Group Ltd., 9th Edition, 1973.
5. Matthews, G. Peter, **Experimental Physical Chemistry,** Oxford University Press, 1st Edition, 1985.
6. R.C. Das, and B. Behra, **Experimental Physical Chemistry**, Tata McGraw, 1983.
7. B.P. Levitt, **Findlay's "Practical Physical Chemistry"** Longman, London, 9th Edition,1985.

ELECTIVE I (A) – NANOSCIENCE AND NANOTECHNOLOGY
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 5**
Subject Code: GMCHE3A **Credits: 5**

CO 1: To understand the concept of self-assembly and its applications to various Nano structures
CO 2: To understand synthesis of Nano materials
CO 3: To learn characterization of Nano materials
CO 4: Learnt about the various theories of Nanoscience and Nanotechnology

CO 5: Studied the recent development in Nanomedicine
CO 6: To understand the role of various methods of preparation of Nanomaterials

UNIT I **(15 Hours)**

Introduction to Nanoscience and Nanotechnology: Background to Nanotechnology Scientific revolution, Types of Nanostructures, Definition of a Nano system, Types of Nanocrystals – One Dimensional (1D), Two Dimensional (2D), Three Dimensional (3D) Nanostructured materials, Quantum dots, Quantum wire- Core/Shell structures. Nanomaterials and properties –Carbon Nanotubes (CNT), Metals (Au, Ag), Metal oxides (TiO_2, CeO_2, ZnO), Semiconductors (Si, Ge, CdS, ZnSe), Applications of Nanomaterials

UNIT II **(15 Hours)**

Synthesis of Nanomaterials: Bulk synthesis of bulk Nanostructured materials, Sol-gel processing, Mechanical alloying and milling, inert gas condensation technique, bulk and Nano composite materials, grinding, high energy ball milling physical and chemical approaches self-assembly–self-assembled monolayers (SAM), vapour liquid solid (VLS) approach- chemical vapour deposition (CVD), Introduction to vacuum technology, physical vapour deposition techniques

UNIT III **(15 Hours)**

Characterization Techniques for Nanomaterials: Diffraction analyses X-ray diffraction, powder diffraction, single crystal XRD, thin film analyses Imaging techniques Scanning Electron Microscope (SEM), Field Emission scanning Electron microscope (FESEM), Atomic force microscopy (AFM), scanning tunneling microscopy (STM), scanning near field optical microscopy (SNOM), Transmission Electron Microscopy (TEM). Magnetic and mechanical properties Magnetic measurements using vibrating sample magnetometer (VSM), Electrical properties**,** I-V/C-V - Hall - Quantum Hall effects

UNIT IV **(15 Hours)**

Fabrication Techniques: Introduction to microelectronics fabrication and Moore`s empirical law, Limitations, Si processing methods Top-down Lithography techniques Necessity of clean a room, different types of clean rooms, maintenance, Importance of Lithography techniques, Photolithography, Electron Beam lithography, Etching Techniques Types of etching, Bottom - up approach, Chemical vapour deposition of Nanostructures, Bottom - up approach, Patterned growth Nano imprint lithography (NIL), soft polymer photo-resistive

UNIT V **(15 Hours)**

Nanomedicine: Current medical practice, treatment methodology, Principles of Nanomedicine, Nanomedical perspective and the medical applications, Ethical, safety and regulatory issues of Nano medicine, Molecular Nanotechnology, MEMS, NEMS, Nano fluidics and micro fluidics, self-assembly of Nanoparticles for biomedical applications, Nanomolecular diagnostics and Biosensor Nanodiagnostics, detection of single DNA

Text Book:

1. G.Cao, **Naostructures and Nanomaterials: Synthesis, Properties and Applications,** Imperical College Press, 2004.

Reference Books:

2. M. Wilson, K. Kannangara, G Smith, M. Simmons and B. Raguse, **Nanotechnology: Basic Science and Emerging Technologies,** Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.

3. C. N R. Rao, A. Muller and A. K. Cheetham (Eds), **The Chemistry of Nanomaterials: Synthesis, Properties and Applications,** Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
4. Kenneth J. Klabunde (Eds), **Nanoscale Materials Science**, John Wiley & Sons, Inc, 2001.
5. C. S. S. R. Kumar, J. Hormes and C. Leuschner, **Nanofabrication towards biomedical applications,** Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
6. W. Rainer, **Nano Electronics and information Technology**, Wiley, 2003.
7. K. E. Drexler, Nano systems, Wiley, 1992.
8. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds), **The Chemistry of Nanomaterials,** Wiley-VCH, Germany, Weinheim, Vol. 1 and 2, 2004.
9. C. P. Poole and F. J. Owens, **Introduction to Nanotechnology**, Wiley Interscience, New Jersey, 2003.
10. K. J. Klabunde (Ed), **Nanoscale Materials in Chemistry**, Wiley-Interscience, New York, 2nd Edition, 2009.
11. T. Pradeep, **Nano: The Essentials in Understanding Nanoscience and Nanotechnology**, 1st Edition, Tata McGraw Hill, New York, 2007.
12. H. Fujita (Ed.), **Micromachines as Tools in Nanotechnology**, Springer-Verlag, Berlin, 2003.
13. T. Tang and P. Sheng (Eds), **Nanoscience and Technology, Novel Structures and Phenomena**, Taylor and Francis, New York, 2003.
14. A. Nabok, **Organic and Inorganic Nanostructures**, Artech House, Boston, 2005.
15. E. A. Rietman, **Molecular Engineering of Nanosystems**, Springer-Verlag, New York, 2001.

ELECTIVE III (B) – MATERIAL CHEMISTRY
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 5**
Subject Code: GMCHE3B **Credits: 5**

CO 1: To understand the basic concept of Structure of matter and their various properties
CO 2: Experimental techniques for controlling the chemical reactions
CO 3: Measurement of various physical and chemical properties
CO 4: Applying related experiments for their research work
CO 5: Mechanism for chemical reactions for optimizing the experimental conditions
CO 6: Physical and chemical characterization of catalysts and catalytic reaction

UNIT I **(15 Hours)**

Structure of Matter: Atomic structure: Wave mechanical model, electronic configurations, ionic, covalent, metallic and secondary bond. Space lattices and crystalographic systems. influence of radius ratio on coronation, structure of common metallic, semi conducting, ionic, polymeric and ceramic materials

Use of X-ray diffraction for determination of simple structures, point, line and surface defects; geometry of edge and screw dislocations. Burger's vector; grain and twin boundaries.

UNIT II **(15 Hours)**

Diffusion Behaviour: Mechanism of diffusion Fick's laws, solution to Fick's second law, surface and grain boundary diffusion, experimental determination of diffusion coefficient.

Phase behavior **–** Solid Solutions: Intermediate phases and intermetallic compounds, phase rule, binary phase diagrams like Cu-Ni, Pb-Sn, Cu-Zn and Fe-C, transformation in steels

Nucleation and growth phenomena, solidification including directional solidification, crystal growth, zone melting and purification

Mechanical properties **–** Elastic, anelastic and viscoelastic behaviours of materials, atomic model of elastic behaviours, rubber – like elasticity, relaxation processes, displacement model for viscoelasticity, plastic deformation, slip systems in crystals, critical resolved shear stress, work hardening, strengthening mechamism, ductile and brittle fracture, Griffith's criterion, failure of materials due to creep and fatigues, deformation behaviours of polymers and ceramics

UNIT III (15 Hours)

Electrical Properties: Electrical / Electronic behaviours of materials, electronic and ionic conductivity, free electron and band theory of solids, intrinsic and extrinsic semiconductors, conduction mechanisms, junctions and devices, viz-diodes, rectifiers, transistors and solar cells; super conductivity

Dielectric behaviours of materials – Polarization phenomena, polarizability, frequency and temperature dependence of dielectric constant

UNIT IV (15 Hours)

Magnetic properties: Magnetic behaviours of materials– dia, para, ferro and ferri magnetisms, soft and hard magnetic materials including ceramic magnets

Optical Properties **–** Optical properties of materials, elementary ideas about absorption, transmissions and reflection refractive index, lasers and their application, optoelectronic devices

Thermal properties **–** Thermal properties of materials, specific heat, thermal conductivity and thermal expansions

Unit V

Thin film deposition techniques: Introduction – CVD, PVD, Spray pyrolysis, Sputtering, Molecular beam epitaxy Electroplating and Electroless plates methods

Materials characterization techniques – Materials characterization techniques such as XRD, ESC A, XPS, AES, FTIR and Laser Raman spectroscopy. Microscopic techniques – SEM, AFM and TEM. Thermal analysis – TG/DTA and DSC

Text Book:

1. V. Raghavan, **A First course in Materials science and Engineering**, Prentice-Hall of India Private Ltd., New Delhi.

Reference Books:

2. A**.** G. Guy, **Elements of Materials Science**, Mc Graw Hill.
3. A. L. Ruoff, **Introduction to Materials Science**, Prentice-Hall.
4. M. F. Ashby and D. R. H, Jones, **Engineering Materials**, Pregamon
5. O. P. Khana, **A Text book of Material Science and Metallurgy**, Damphat Rai &Sons, New Delhi.
6. C. M. Srivastava & C. S rinivasan, **Science of Engineering Materials**, New Age International (P) Ltd., New Delhi.
7. C. Kittd, **Solid State Physics**, Wiley Eastern Ltd., 1995.
8. B. S. Saxena R. C. Gupta and P. M. Saxena, **Fundamentals of Solid State Physics**, Pragati Prakasham Educational Publishers, Meerat
9. K.L Chopra and I.Kaur, **Thin Film Devices and Their Applications**, Plenum Press, New York, 1983.

10. K. S. V. Santhanam and M. Sharon, **Photoelectrochemical solar cell**, Elsevier Science Publishers, New York, 1988.
11. A. F. Fahrenbruch and R.H. Bube, **Fundamentals of solar cells**. Academic Press. London.

EXTRA CREDIT III – AGRICULTURAL AND DRUGS CHEMISTRY

(For those who joined from since 2018-19)

Semester: III **Credits: 2**
Subject Code: GMCHX3

CO 1: Concepts and applications of agricultural and drugs Chemistry
CO 2: The students will acquire the knowledge of insecticides, fungicides and herbicides.
CO 3: Mode of action of different drugs
CO 4: Role of drugs to inhibit the particular enzymes and treatment of disease

UNIT I

Soil Chemistry: Introduction, Soil classification & survey, Properties of Soil, Soil Texture, Soil Water, Soil Temperature, Soil Colloids, Soil Minerals, Soil P^H acidity and alkalinity, Buffering Soil, Soil Fertility, Soil formation

UNIT II

Insecticides, Fungicides and Herbicides: Introduction, Methods of Pest Controls, Methods of using Pest Controls, insecticides, the arsenic compounds, Fluorine compounds, Boron compounds, Mercury compounds, Copper compounds, Sulphur compounds, Modern Insecticides, Some Important Herbicides

UNIT III

Fertilizers: Classification of Fertilizers, Important example of Fertilizers, Nitrogeneous fertilizers, Phosphate fertilizers, Potash fertilizers, Effects of fertilizers

UNIT IV

Manures, compost and saw dust: Formyarde Manure, Compose, Reinforcing Manure, Green Manure Crops, Saw dust, Night soil, sevage and sludge, Bio gas production and Manure

UNIT V

Acquired Immuno Deficiency Syndrome (AIDS): Introduction; Prevention, Treatment, Heterocyclic compounds as (eg. Quinoline, Carbazole, Coumarin and Naphthyridines), HIV Integrase Inhibitors – Anti-HIV natural products, Synthesis

Awareness through chickun-guinea – Chicken-guinea, Causes, Virus, mosquito, Emergent in drug discovery, Comparative studies with malaria

Text Book:

1. Conard L. Stanitski, Luey Pyrde Eubenks, Catherine H. Middle Camp and Wilmer J. Stratton **Chemistry in Context: Applying Chemistry to Society**, Mc Graw Hil, third edition, 2000.

Reference Books:

2. Bailey, Clark, Ferris, Isrause and Strong, **Chemistry of the environment**, Elsevier publications, second edition, 2001.
3. V. K. Prabhakar, **Energy resources and the environment**, 2001.

4. Jayashree Ghosh, **Fundamental Concepts of Applied Chemistry,** S.Chand, 2005.
5. I. P. Singh, S. B. Bharate and K. K. Bhutani, **Current Science,** Vol. 89, NO. 2, 25, 2005.
6. L. Zhuang et al., **J. Med. Chem**. 46, 453-456, 2003.
7. D. Sriram et al., **J Pharm Phaemaceut Sci** (www.cspsCanada) 8(3): 565-577, 2005.

CORE XIII– PROJECT
(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 30**
Subject Code: GMCHC41PW **Credits: 15**

CO 1: To enable students to understand the basic concepts in Chemistry project
CO 2: Experimental techniques for controlling the chemical reactions
CO 3: Measurement of various physical and chemical properties
CO 4: Applying related experiments for their research work
CO 5: To gain the hands on experience of different instruments and will give the exposure of research potential
CO 6: To learn principles and procedures employed in thesis writing of chemistry and develop practical

The program encourages the students to experience the research in the field of chemistry. A Project work to be done individually by the students either in the department laboratory or in a chemical industry or in institutions like CECRI, Agricultural Research Station, Water testing centres, Pharmaceutical laboratories etc. The Project work should help the students to create research attitude and apply theory they have learnt throughout the course.
Project internal is evaluated on the basis of presentation of the project such as, for review 45 marks, background knowledge 25 marks, field work 25 marks and 5marks for attendance. The external 100 marks is distributed as follows, for dissertation 60 marks, for presentation 30 marks and for viva- voce10 marks.

B. Sc CHEMISTRY
(Three Years Regular Programme)
(For those who joined since 2018-19)

PSO 1: To developed ability and to acquire the knowledge of terms, facts, concept, processes, techniques and principles of Chemistry
PSO 2: To develop problem solving skills in students
PSO **3:** To develop skills required in Chemistry such as the proper handling of apparatus chemicals

Programme Structure – 2018-19 onwards

Sem	Part	Subject Code	Course	Subject Title	Hrs/ wk	Credit	CIA	ESE	Total
I	I	GBLT11/ GBLA11/ GBLIA11/ GBLH11	Language I	Tamil I / Basic Arabic I /Intermediate Arabic I /Hindi I	6	6	40	60	100
	II	GBLG12/ GBLF12	Language –II	English-I-General / English-I-Functional	6	6	40	60	100
	III	GBCHC11	Core Course –I	General Chemistry	4	4	40	60	100
		GBCHC12	Core Course –II	Inorganic Chemistry – I	4	4	40	60	100
			Core Course –III	Inorganic Qualitative Analysis	2	-	-	-	-

				and Volumetric Analysis (LAB)					
		GBCHA13 / GBCHA14	First Allied –I	Mathematics-I/ Biochemistry-I	6	5	40	60	100
	IV	GBCHE15 P	Skill Based Elective –I	Preparation of Consumer Products (LAB)	2	2	-	50	50
				Total	**30**	**27**	**200**	**350**	**550**
II	I	GBLT21/ GBLA21/ GBLIA21/ GBLH21	Language –I	Tamil II / Basic Arabic II /Intermediate Arabic II /Hindi II	6	6	40	60	100
	II	GBLG22/ GBLF22	Language –II	English-II-General / English-II-Functional	6	6	40	60	100
	III	GBCHC21 P	Core Course –III	Inorganic Qualitative Analysis and Volumetric Analysis (LAB)	3	3	40	60	100
		GBCHC22	Core Course –IV	Physical Chemistry – I	5	3	40	60	100
		GBCHA23 / GBCHA24	First Allied –II	Mathematics – II/ Biochemistry-II	6	5	40	60	100
	IV	GBCHE25	Skill Based Elective –II	Fundamentals of Applied Chemistry	2	2	-	50	50
		GBES2	General Interest Course-I	Environmental Studies	2	2	-	50	50
		GBCHX2/ GBCHX2O	Extra Credit	Food Chemistry/Online course	-	2	-	100	100
				Total	**30**	**27 + 2**	**200**	**400 + 100**	**600 + 100**
III	III	GBCHC31	Core Course –V	Organic Chemistry – I	6	4	40	60	100
		GBCHC32 P	Core Course –VI	Organic Analysis & Organic Estimation(LAB)	6	4	40	60	100
		GBCHA33	Second Allied –I	Pharmaceutical Chemistry-I	6	5	40	60	100
	IV	GBCHE34	Skill Based Elective –III	Introduction to Marine Chemistry	3	2	-	50	50
			Non- Major Elective-I		4	2	-	50	50
		GBHR3	General Interest Course-II	Human Rights	3	2	-	50	50
	V	GBXTN3	Extension Activities	NSS/CSS	2	2	100	-	100
		GBCHX3/ GBCHX3O	Extra Credit	Chemistry of Consumer Products/Online course	-	2	-	100	100
				Total	**30**	**21 + 2**	**220**	**330 + 100**	**550 + 100**
IV	III	GBCHC41	Core Course –VII	Inorganic Chemistry – II	5	4	40	60	100
		GBCHC42	Core Course –VIII	Organic Chemistry – II	5	4	40	60	100
		GBCHC43 P	Core Course –IX	Gravimetric Analysis and Organic Preparation Practical(LAB)	5	4	40	60	100
		GBCHA44	Second Allied –II	Pharmaceutical Chemistry-II	6	5	40	60	100
	IV	GBCHE45	Skill Based Elective –IV	Selected Topics in Applied Chemistry	3	2	-	50	50

		GBVE4	General Interest Course-III	Value Education	2	2	-	50	50
			Non Major Elective-II		4	2	-	50	50
		GBCHX4/ GBCHX4O	Extra credit	Dairy Chemistry/Online course	-	2	-	100	100
				Total	**30**	**23 + 2**	**160**	**390 + 100**	**550 + 100**
V	III	GBCHC51	Core Course –X	Physical Chemistry – II	5	3	40	60	100
		GBCHC52	Core Course –XI	Organic Chemistry-III	4	3	40	60	100
		GBCHC53 P	Core Course –XII	Physical Chemistry Practical(LAB)	4	4	40	60	100
		GBCHE5A / GBCHE5B	Elective – I	a. Industrial Chemistry/ b. Biological Chemistry	5	5	40	60	100
		GBCHE5C / GBCHE5D	Elective –II	a. Textile Chemistry/ b. Analytical Methods	5	5	40	60	100
	IV	GBCHE54 P	Skill Based Elective –V	Practical Course in Applied Chemistry (LAB)	3	2	-	50	50
		GBWS5	General Interest Course-IV	Women Studies	3	2	-	50	50
		GBCHX5/ GBCHX5O	Extra Credit	Industrial Training Report/Online course	-	2	-	100	100
				Library/ Browsing	1	-	-	-	-
				Total	**30**	**24 + 2**	**200**	**400 + 100**	**600 + 100**
VI	III	GBCHC61 PW	Core Course –XIII	Project	6	4	40	60	100
		GBCHC62	Core Course –XIV	Inorganic Chemistry-III	5	4	40	60	100
		GBCHC63	Core Course –XV	Physical Chemistry - III	5	4	40	60	100
		GBCHC64 P	Core Course –XVI	Industrial and Inorganic Preparation Practicals (LAB)	4	4	40	60	100
		GBCHE6A / GBCHE6B	Elective-III	a. Introduction to Green Chemistry & Nano Chemistry/ b. Polymer Chemistry	5	5	40	60	100
	IV	GBCHE65 P	Skill Based Elective-VI	Practical Industrial Chemistry (LAB)	3	2	-	50	50
				Library/ Browsing	2	-	-	-	-
		GBSED6	Extra credit	Skills for Employability Development	-	2	100		100
				Total	**30**	**23 + 2**	**200 + 100**	**350**	**550 + 100**
				Grand Total	**180**	**145 + 10**	**1180 + 100**	**2220 + 400**	**3400 + 500**

∗Hrs/wk– Hours/Week, CIA– Continuous Internal Assessment and ESE – End Semester Examination

∗For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from spoken tutorial, EDX, NPTEL or Coursera.

CORE I - GENERAL CHEMISTRY
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 4**
Subject Code: GBCHC11/FBCHC111/ FBCHC11 **Credits: 4**

CO 1: To enable students to understand the basic concepts in Chemistry
CO 2: To widen the knowledge in atomic structure & basic concepts of organic Chemistry
CO 3: To widen the knowledge in nuclear Chemistry & thermodynamic
CO 4: To widen the knowledge in acid-base reactions and computer applications in Chemistry

UNIT I **[12 Hours]**

Atomic Structure: Historical Development, Dalton's atomic theory, Limitation of Dalton's atomic theory. Electron **–** its discovery and properties, e/m ratio of electron by Thomson's method, Charge on electron by Millikens oil drop method

Proton **–** its discovery and properties, Thomson's Atomic model and its drawbacks, Rutherford's alpha particles scattering experiments, Rutherford's atomic model and its drawbacks, Prouty's hypothesis, Moseley experiment and its importance

Neutron **–** its discovery and properties, Atomic spectra, Ritz- combination principle

Bohr's model of Hydrogen atom**–**Postulates, Derivation for its radius and energy, Application of Bohr's theory, Spectra and ionization potential of hydrogen, Limitations of Bohr's theory, Spectra and ionization potential of hydrogen, Quantum number, Pauling's Exclusion principle, Hund's principles of maximum multiplicity and Aufbau's principle

UNIT II **[12 Hours]**

Basic Concepts of Organic Chemistry: IUPAC**–** Nomenclature of organic compounds; Molecular weight determination of organic acids and bases – Silver salt and Platonic chloride methods; Problems arriving empirical and molecular formula using percentage composition of elements and molecular weight

Fundamental Concepts**–**Homolytic fission and Heterolytic fission of carbon-carbon bonds

Reaction intermediates – Formation and stability of Free radicals, Carbonium ions, Carbanions, Nucleophilic and Electrophilic reagents

Types of reactions–Substitution, Addition, Elimination, Rearrangement and Polymerization with suitable examples

Inductive effect and Electromeric effect–Explanation with suitable examples

UNIT III **[12 Hours]**

Nuclear Chemistry: Constitution of nuclei, Stability of nuclei and (n-p) ratio, Magic number, Mass defect and Binding energy, Mass-Energy relationship

Radioactivity– Natural radioactivity, Soddy's group displacement law, Radioactivity equilibrium, Rate of radioactive disintegration, Half-life period and Average life period, Radioactive disintegration series

Nuclear fission – Theory, Applications, Principle of atom bomb

Nuclear fusion – Theory, Solar and Stellar energy, Principle of Hydrogen bomb

Applications of radioactivity–Medicine, Agriculture, Industry, Rock dating and Carbon dating

Particle accelerators– Linear accelerator and Cyclotron

UNIT IV [12 Hours]

Thermodynamics: Definition of thermodynamics term, system, surroundings, Types of systems, Intensive and extensive properties, State and path functions and their differential, Thermodynamic processes, Concept of heat and work

First Law of Thermodynamics – Statement and Mathematical form, Definition of internal energy and enthalpy, Calculation of w, q, ΔE and ΔH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Bond dissociation energy and its calculation from thermochemical data, Work obtained during adiabatic and isothermal change; Heat capacity – Heat capacities at constant volume and pressure and their relationship $C_p - C_v = R$; Joule's law– Joule Thomson coefficient and inversion temperature (only definition)

Zeroth Law of Thermodynamics–Mathematical treatment of Zeroth law and its limitation and various statements of law

UNIT V [12 Hours]

Acid-Base Reactions and Computer Applications in Chemistry: Acid-Base Concept – Arrhenius concept, Theory of solvent system (in H_2O, NH_3,SO_2 and HF), Bronsted-Lowry's concept, Relative strength of acids, Pauling rules, Amphoterism, Lux-Flood concept, Lewis concept, Superacids, HSAB principle, Acid base equilibria in aqueous solution and pH

Acid-base neutralisation curves–Indicator, Choice of indicators

Introduction to computers–Definition, Classification of computers, Components of computer, Input unit, CPU and Output unit

High level languages– Importance, BASIC, Structure, Constants and variables, Control statements, Application of BASIC in the computation of some simple programmes for Half-life period, Normality and Molarity of a solution and Root mean square velocity

Text Books:

1. B.S. Bahl, G.D. Tuli & Arun Bahl, **Essentials of Physical Chemistry**, S. Chand & Company Ltd., New Delhi, 1st Edition, 2009. [Chapter 1, 2, 4, 7, 8 & 27]
2. P.L. Soni & H.M. Chalwa, **Text book of Organic Chemistry,** Sultan Chand & Sons, New Delhi, 29th Edition, 2007. [Chapter 4, 8, 9 & 10]

Reference Books:

3. Robert Thorhton Morrison Robert & Robert Neilson Boyd, **Organic Chemistry,** Prentice Hall of India Private Limited., New Delhi, 2004.
4. R.D. Madan, **Modern Inorganic Chemistry,** S. Chand & Company Private Limited, New Delhi, 1987.
5. Peter Atkins & Julio de Paula, **Atkins Physical Chemistry**, Oxford University Press YMCA Library Building, New Delhi, 2006.
6. U.N. Dash, **Nuclear Chemistry**, Sultan Chand & Sons, New Delhi, 2005.
7. K.V. Raman, **Computers in Chemistry,** Tata McGraw-Hill Ltd., New Delhi, 1993.
8. L. R. Sharma, B.R. Puri & M. S. Pathania, **Elements of Physical Chemistry**, Vishal Publishing Co., New Delhi, 2014.
9. B.R. Puri, L.R. Sharma & M.S. Pathania, **Principles of Physical Chemistry,** Vishal Publishing, Co., New Delhi, 1962.
10. P.L. Soni, & Mohan Katyal, **Text Book of Inorganic Chemistry**, Sultan Chand & Sons, New Delhi, 2006.

CORE II - INORGANIC CHEMISTRY–I
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 4**
Subject Code: GBCHC12 /FBCHC121/FBCHC12 **Credits: 4**

CO 1: To enable students to understand the basic concepts in Chemistry
CO 2: To widen the knowledge in periodic properties & chemical bonding
CO 3: To widen the knowledge in hydrogen, metallurgy & IA group elements
CO 4: To widen the knowledge in volumetric and qualitative analysis

UNIT I **[12 Hours]**

Periodic Properties: Atomic and ionic radii, Determination of covalent radii, ionic radii, Determination of Crystal Coordination number, Radius ratio, Factors influencing the magnitude of ionic radii, Periodic variation of atomic and ionic radii, Ionisation potential and its periodic variations, Applications to the concept of ionization potential; Electron affinity– Factors influencing the magnitude of electron affinity, Periodic variation of electron affinity, Impact of electron affinity on chemical behaviour; Electro negativity–Scales of electronegativity, Pauling's bond energy scale, Mulliken scale, Allred Rochow electrostatic approach, Correlation of ionization potential and electron affinity with electronegativity, Relation between oxidation state of the element and its electronegativity, Applications of Electronegativity Concept

UNIT II **[12 Hours]**

Chemical Bonding: Ionic bond–Lattice energy and its determination using Born-Haber Cycle

Covalent bond– Fajan's rule and its applications

Theories of covalent bonding– Heitler-London theory and Pauling theory, Types of overlapping, Sigma and Pi bonds, Formation of simple molecules like H_2, HF, F_2, N_2 and O_2

Geometry of Molecules and Hybridization- Hybridisation of orbitals. sp, sp^2, sp^3, sp^3d, sp^3d^2- Hybridisation with examples- Shapes of hybridized molecule

VSEPR theory– VSEPR theory, Geometry of H_2O and NH_3

Molecular orbital theory–M.O diagram of H_2, O_2, N_2, F_2, CO and HF

Metallic bond – Introduction, Properties of Metallic bond

Weak interactions– Elementary ideas of Hydrogen bonding, Vanderwaal's forces, Keesom forces, Debye and London forces

UNIT III **[12 Hours]**

Hydrogen, H_2O_2, H_2O, O_2& O_3: Hydrogen– Hydrides - Ionic, Covalent, Metallic and Polynuclear hydrides, $LiAlH_4$ and $NaBH_4$.

Hydrogen Peroxide – Preparation, Reactions, Structure and Estimation

Water – Hardness of water, Water softening processes, Ion-exchange & Reverse osmosis process, Preparation, properties & uses of heavy water

Oxygen – Oxides, Classification of Oxide

Ozone – Preparation, properties and structure of Ozone

UNIT IV **[12 Hours]**

Metallurgy & IA Group Elements: Metallurgy–Definition of Metallurgy, Minerals and Ores, Grinding, Pulverizing, Ore Dressing- Gravity separation, Hydraulic washing, Froth

floatation, Magnetic separation and Chemical separation, Roasting and Calcinations, Reduction of minerals to metal – Carbon, Hydrogen, Magnesium, Aluminium reduction, Self-reduction, Electrolytic reduction, Amalgamation process, Hydro metallurgy process, Pyrometallurgy process, Chemical reduction and Auto reduction, Refining of metals – Electrolytic refining, Electrowinning, Vapour phase refining, Chromatography, Ion exchange method and Zone refining methods

I A Group– General properties, Diagonal relationship of Li with Mg, Comparison with other members of family,

Extraction, properties and uses of Li

UNIT V **[12 Hours]**

Principles of Volumetric and Qualitative Analysis: Principles of Volumetric Analysis– Definition of Molarity, Molality, Normality and Mole fraction; Definition and examples for Primary and Secondary standards, Theories of Acid-Base, Redox, Iodometric and Iodimetric Titrations

Principles of Qualitative Analysis–Basic Principles of Inorganic Semi Micro Analysis, Semi Micro Techniques, Principles involved in Sodium Carbonate Extract preparation, Common Ion Effect and Solubility Product and their applications in Qualitative Analysis

Text Book:

1. R.D. Madan, **Sathya Prakash's Modern Inorganic Chemistry,** S. Chand and Company Private Limited., New Delhi, 1st Edition, 2008. [Chapter 4, 7, 15, 17,18 & 40]

Reference Books:

2. B.R. Puri, L.R. Sharma & K.C. Kalia, **Principle of Inorganic Chemistry,** Milestone Publishers & Distributors, New Delhi, 2013.
3. Sathya Prakash, G.D. Tuli, S.K. Basu & R.D. Madan, **Advanced Inorganic Chemistry (Volume 1),** S. Chand & Company Ltd., New Delhi, 1997.
4. P.L. Soni & Mohan Katyal, **Text Book of Inorganic Chemistry,** Sultan Chand & Sons, New Delhi, 2006.
5. A.I. Vogel, **Text Book of Qualitative Inorganic Analysis,** ELBS Lonman, London, 2012.
6. F. Albert Cotton, Geoffrey Wilkinson, A. Murillo Carlos & Manfred Bochmann, **Advanced Inorganic Chemistry**, A Wiley Interscience Publication, New York, 1999.
7. James E. Huheey, Ellen A. Keiter, L. Keiter Richard & K. Medhi Okhil, **Inorganic Chemistry,** Dorling Kindersley Pvt. Ltd., South Asia, 2006.

CORE III - INORGANIC QUALITATIVE ANALYSIS AND VOLUMETRIC ANALYSIS
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 5**
Subject Code: GBCHC21P/FBCHC211P/FBCHC21P **Credits: 3**

CO 1: To learn principles and procedures employed in inorganic qualitative analysis
CO 2: To learn principles and procedures employed in inorganic volumetric analysis
CO 3: To develop skill in testing and analysing two cations of inorganic compounds
CO 4: To develop skill in testing and analysing two anions of inorganic compounds

CO 5: To develop skills required in chemistry such as the proper handling of apparatus and chemicals

CO 6: To provide knowledge on analyses of inorganic compounds

PART – I

Inorganic Qualitative Analysis (3 Hrs): [45 Hours]

Duration of Examination - 6 Hrs

Analysis of mixtures containing two cations and two anions of which one is an interfering ion.

Cations: Lead, Bismuth, Copper, Cadmium, Arsenic, Antimony, Iron (II and III), Aluminium, Chromium, Zinc, Manganese, Cobalt, Nickel, Barium, Strontium, Calcium, Magnesium and Ammonium.

Anions: Carbonate, Sulphide, Nitrate, Sulphate, Fluoride, Bromide, Iodide, Oxalate, Borate, Phosphate, Arsenite and Chromate.

PART–II [30 Hours]

Volumetric Analysis (2 Hrs):

A double titration involved in the making of the solution to be estimated.

List of Experiments:

1. Estimation of Sodium Hydroxide or Potassium Hydroxide (Standard AR Sodium Carbonate)
2. Estimation of Hydrochloric acid or Sulphuric acid (standard AR Oxalic acid)
3. Estimation of a mixture of Sodium Hydroxide and Sodium Carbonate

Permanganometry:

4. Estimation of Ferrous ion
5. Estimation of Calcium (direct Method)
6. Estimation of Hydrogen Peroxide

Dichrometry:

7. Estimation of Ferrous ion
8. Estimation of Ferric ion using external indicator (demonstration only)

Iodometry and Iodimetry:

9. Estimation of Potassium dichromate
10. Estimation of Potassium permanganate
11. Estimation of Copper
12. Estimation of Arsenous oxide

Argentimetry:

13. Estimation of Potassium Chloride (standard AR Sodium Chloride) - demonstration only

Evaluation Scheme: 3 hrs for volumetric analysis and 3hrs for qualitative analysis for 60 marks each.

Reference Books:

1. V. Venkateswaran, R. Veeraswamy & A. R. Kulandaivelu, **Basic Principles of Practical Chemistry,** Sulthan Chand & Sons Publications, **N**ew Delhi, 1999.
2. A.O. Thomas, **Practical Chemistry for B.Sc. Main Students**, Scientific Book Centre, Kerala, 1995.
3. G. Suehla, **Vogel's Qualitative Inorganic Analysis.** Dorling Kindersely PVT. Ltd., South Asia, 2011.
4. J. Bassett, **Text Book of Quantitative Chemical Analysis.** Longmann, U.K. 1989.

5. V.V. Ramanujam, **Inorganic Semi micro Qualitative Analysis**, The National Publishing Co., Chennai, 1974.

SKILL BASED ELECTIVE I - PREPARATION OF CONSUMER PRODUCTS
(For those who joined from since 2018-19)

Semester: I **Hours/Week: 2**
Subject Code: GBCHE15P /FBCHE151P/FBCHE15P **Credits: 2**

CO 1: To learn principles and procedures employed in consumer products in the cottage industry level
CO 2: To develop practical skill
CO 3: To develop skill in preparation of Consumer products
CO 4: To develop skills required in chemistry such as the proper handling of apparatus and chemicals

[30 Hours]

A Practical Course on the preparation of the following Consumer Products in the Cottage Industry level.

1. Preparation of White Phenyl
2. Preparation of Black Phenyl
3. Preparation of Detergent Powder
4. Preparation of Detergent Cake
5. Preparation of Vessel Cleaning powder
6. Preparation of Candles
7. Preparation of Ink
8. Preparation of Talcum Powder
9. Preparation of Chalk.
10. Preparation of Nail Polish

At the end of the semester, a practical examination for three hours will be conducted for 50 marks.

Reference Books:

1. **Modern Technology of Cosmetics**. Asia Pacific Business Press Inc., New Delhi, 2004.
2. Andre O. Barel, Marce Paye & Harward I. Maibach**, Handbook of Cosmetic Science and Technology,** Marcel Dekker Inc., New York, 2001.
3. Arza Seidal, Michalina Bickfork, Shirley Thomas & Kirk-Othmer Kellsee Chu **Chemical technology of Cosmetics**, A John Wiley & Sons, Inc., Canada, Publications, 2013.
4. Andre O. Barel, Marce Paye & Harward I. Maibach, **Handbook of Cosmetic Science and Technology**, Taylor & Francis, New York, 2nd Edition, 2006.
5. Andre O. Barel, Marce Paye & Maibach, Harward I. (2009). **Handbook of Cosmetic Science and Technology,** Informa Healthcare, USA, 3rd Edition.

CORE IV - PHYSICAL CHEMISTRY–I
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 5**
Subject Code: GBCHC22 /FBCHC221/FBCHC22 **Credits: 3**

CO1: To enable the students understand concepts in quantum chemistry
CO 2: To enable the students understand concepts in thermodynamics & liquid Crystals
CO 3: To enable the students understand concepts in gaseous state
CO 4: To gain knowledge about colligative properties
CO 5: To gain knowledge about adsorption
CO 6: To gain knowledge about phase rule

UNIT I [15 Hours]

Quantum Chemistry & Gaseous State: Quantum Chemistry – Quantum theory of Radiation, The Sommerfield extension of Bohr theory, Planck's theory, Photoelectric effect, Compton effect, Wave Mechanical Concept of the Atom, De-Broglie's Relationship, Davisson and Germer Experiment, Wave Nature of Electron, Heisenberg's Uncertainty Principle; Schrodinger Wave Equation (Without Derivation), Significance of Wave Functions, ψ^1 and ψ^2, Probability Distribution of Electrons, Radial Probability Distribution Curves

Gaseous state– Kinetic Gas Equation, Derivation, Gas Laws from the Kinetic Gas Equation, Kinds of Velocities - Mean, RMS, Most Probable Velocities, Calculation of Molecular Velocities, Maxwell's Distribution of Molecular Velocities (no derivation), Effect of Temperature on Velocity Distribution, Equipartition of energy , Heat Capacity and Molecular Basis, Virial Equation of State, Boyle Temperature, Coefficient of Compressibility and Thermal Expansion

UNIT II [15 Hours]

Second Law of Thermodynamics: Second Law of Thermodynamics – Need for the II Law, Spontaneous Process, Criteria of Spontaneity, Different Forms of Statements of the Second Law, Cyclic process, Heat Engines, Carnot's cycle, Efficiency - Carnot's theorem (statement only); Concept of entropy- Definition and mathematical statement, Randomness and entropy; Standard entropy -Derivation of entropy from Carnot cycle, entropy change of an ideal gas during isothermal process, Entropy changes in cyclic - reversible and irreversible processes, Entropy changes in physical transformations , Calculation of entropy changes with changes in T, V and P, Entropy of mixing of ideal gases; Free energy and Work Function, Gibbs Free Energy, Helmholtz Work Function-their Variations with Temperature, Pressure and Volume ,Criteria for Spontaneity, Gibbs-Helmholtz Equations - Derivation and Applications, Clausius- Clapeyron Equation - Derivation and Application

UNIT III [15 Hours]

Third Law of Thermodynamics & Liquid Crystals: Third Law of Thermodynamics – Entropy at Absolute Zero, Planck's Formulation of Third Law, Nernst Heat Theorem, Statement of III Law of Thermodynamics, Evaluation of Absolute Entropy from Heat Capacity Measurements, Exceptions to III law, Application of III law; Partial Molar Properties, Chemical Potential, Gibbs-Duhem Equation, Effect of Temperature and Pressure on Chemical Potential

Liquid Crystals – Classification and Molecular Arrangements, Liquid state, Density, Diffusion, Viscosity, Evaporation; Surface Tension, Effect of temperature on Surface Tension, Parachor - Definition and Applications only, Coefficient of Viscosity-Effect of Temperature and Effect of Pressure

UNIT IV **[15 Hours]**

Colligative Properties & Adsorption: Colligative Properties – Lowering of Vapour Pressure, Osmosis and Osmotic Pressure, Relation between Osmotic Pressure and Vapour Pressure of an Ideal Solution, Reverse Osmosis; Elevation of Boiling Point and Depression of Freezing Point - Derivations and Determinations, Vant Hoff Factor

Adsorption – Distinction between Chemical and Physical Adsorption, Adsorption isotherms, Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm - Derivation, Brunauer Emmett Teller (BET) – Measurement of Surface Area

UNIT V **[15 Hours]**

Phase Rule: Definition – Phase, Number of Components and Number of Degrees of Freedom, Gibbs phase rule (derivation)

One Component System – Water system and Carbon dioxide System.

Two Component System – Reduced phase rule, Simple eutectic systems - Pb-Ag system and KI-H_2O System

Systems involving Compound Formation – Congruent and Incongruent Melting Points– Zn-Mg system, $FeCl_3$-H_2O system and Dehydration of $CuSO_4.5H_2O$

Distribution Law – Statement, Conditions for the Validity of Distribution Law, Thermodynamic derivation, Applications of the Distribution Law

Text Book:

1. B.R. Puri, L.R. Sharma & S. Pathania, **Principles of Physical Chemistry**, Vishal Publishing Co., New Delhi, 2005. [Chapter 1, 9, 11, 16, 17, 23, 24 & 30]

Reference Books:

2. L.R. Sharma, B.R. Puri & Madan S. Pathania, **Elements of Physical Chemistry,** Vishal Publishing Co., New Delhi, 2014.
3. B.S. Bahl, G.D. Tuli & Arun Bahl, **Essentials of Physical Chemistry,** 12th Edition, S. Chand & Company Ltd., New Delhi, 2011.
4. P.L. Soni, **Text Book of Physical Chemistry**, Sultan Chand & Co. New Delhi, 2014.
5. S.H. Maron & J.B. Lando, **Fundamentals of Physical Chemistry,** Macmillan Limited., New Delhi, 1966.
6. Peter Atkins & Julio de Paula, **Atkins Physical Chemistry,** Oxford University Press YMCA Library Building, New Delhi, 2006.
7. A. S. Nagi & S.C. Anand, **A Text Book of Physical Chemistry,** Wiley Eastern Ltd, New Delhi, 2008.
8. R. Anantha Raman, **Fundamentals of Quantum Chemistry**, Mc Millan India Ltd., New Delhi, 2000.
9. R.K. Prasad, **Quantum Chemistry,** New Age International Publishers, New Delhi, 2006.
10. J. Rajaram & J.C. Kuriacose, **Thermodynamics,** Shobanlal Nagin Chand and CO. New Delhi, 1986.
11. K. L. Kapoor, **A Textbook of Physical Chemistry,** Macmillan, India Ltd., New Delhi, 1994.

SKILL BASED ELECTIVE I - FUNDAMENTALS OF APPLIED CHEMISTRY
(For those who joined from since 2018-19)

Semester: II **Hours/Week: 2**
Subject Code: GBCHE25/FBCHE251/FBCHE25 **Credits: 2**

CO 1: Acquire knowledge of fuels, alloys, paints & pigments and their applications
CO 2: To conceptualize the mode of action of industrial materials and their applications
CO 3: To understand the corrosion caused in air, water and soil and control measures to be taken
CO 4: Acquire knowledge of cement & petroleum and their applications

UNIT I **[6 Hours]**
Fuels: Definition, Types fuels, Characteristics, Properties, Solid fuels (Wood and Coal) Liquid fuels, Disadvantages of Solid Fuels over Liquid and Gaseous Fuels, Nuclear Fuels, Difference between Nuclear & Chemical Fuels

UNIT II **[6 Hours]**
Alloys: Introduction, Physical and Chemical properties of alloys, Purpose of Making Alloys, Types of Alloys, Ferrous Alloys, Copper Alloys, Nickel Alloys, Nickel Iron Alloys, Super Alloys, Hard Alloys, Preparation of Alloys

UNIT III **[6 Hours]**
Paints & Pigments: Introduction, White Pigments, Manufacture Characteristic of Pigments, Lithopone, Physical Properties of Pigments, Uses
Paints – Classification, Constitution and its Manufacture Method

UNIT IV **[6 Hours]**
Cement and Petroleum: Cement – Manufacture - Wet Process and Dry process, Types, Analysis of Major Constituents, Setting of Cement, Reinforced Concrete. Cement Industries in India
Petroleum – Origin, refining, Cracking, reforming, knocking and octane number, LPG, synthetic gas, synthetic petrol

UNIT V **[6 Hours]**
Corrosion: Introduction, Consequences of Corrosion, Types of Corrosion – Galvanic Corrosion, Pitting Corrosion, Stress Corrosion, Erosion Corrosion; Corrosion Fatigue, Corrosive Agents, Prevention of Corrosion and Corrosion rate measurement – Polarization Techniques

Text Books:
1. P.C. Jain & Monica Jain, **Engineering Chemistry**, Dhanpat Rai Publishing Company Ltd., New Delhi, 15th Edition, 2010. [Chapter 2,7,11, 30 & 36]
2. B.K. Sharma, **Industrial Chemistry**, *Goel* publishing. New Delhi, 15th Edition, 2006. [Chapter 43]

Reference Books:

3. B.N. Chakrabarty, **Industrial Chemistry**, Oxford & IBH Publishing Co., New Delhi, 1981.
4. P.P. Singh, T.M. Joesph, & R.G. Dhavale, **College Industrial Chemistry**, Himalaya Publishing House, Bombay, 1983.
5. M.G. Fontana & N.D. Greene, **Corrosion Engineering,** McGraw-Hill Book Company, New Delhi, 1978.
6. A. Ravikrishnan, **Engineering chemistry**, Sir Krishna Hitech publication, Chennai, 2008.
7. D. Pletcher & F. C. Walsh, **Industrial Electrochemistry**, Blakrid Academic Professional, London. 1993.
8. D. Jones, **Principles and prevention of corrosion**, Macmillan Publications. New York, 1992.
9. J. J. Meketta, **Cathodic Protection Theory and practice,** Marcel Dekker Publication, New York, 1993.

EXTRA CREDIT - FOOD CHEMISTRY

(For those who joined from since 2018-19)

Semester: II
Subject Code: GBCHX2 /FBCHX21/FBCHX2 Credits: 2

CO 1: Enable students to use the theoretical knowledge in various applications and food preparation
CO 2: To provide knowledge on analyses of constituents of food samples
CO 3: Acquire knowledge of food texture, food Adulteration & food Chemistry and their application
CO 4: Acquire knowledge of food spoilage & natural and artificial colouring and their application

UNIT I

Introduction to Food Chemistry: Introduction, Terminology used in Food Chemistry–Bio-Synthetic Reaction, Oxidation Reaction, Elimination Reaction, Reduction, Condensation, Photosynthesis- General Chemical Reaction involved in Photosynthesis

UNIT II

Food Texture: Texture–Nutritive Value, Pigments, Carotenoids, Chlorophylls, Flavonoids, Pectic Substance, Changes in Cooking and Processing, Browning Reaction, Fruits Preservation

UNIT III

Food Adulteration: Food Adulteration – Contamination, List of Food Items and their Contaminants, Detection of Adulteration–by Simple Techniques, Prevention of Food Adulteration

UNIT IV

Food Spoilage: Food Spoilage –Preservation Method, Low Temperature Method, High Temperature Method; Asepsis– Filtration, Centrifugation; Wood Smoking and Antibiotics– Use of Chemical Preservatives

UNIT V

Natural and Artificial Agents: Natural and Artificial Colouring, Role in Cookery, Sweetening Agents, Artificial Sweeteners, Legal Safeguards, Adulteration in Food (Adulterence) Chemistry of Cooking.

Text Book:

1. H.K. Chopra & P.S. Panesar, **Food Chemistry**, Narosa Publishing House, New Delhi, 2010. [Chapter 1, 2, 7, 8, 9 & 10]

Reference Books:

2. Sumathi R. Mudambi, & Shalini M. Rao, **Food Science**, Wiley Eastern Ltd. New Delhi, **1990**.
3. Seemayadav, **Food Chemistry,** Anmol Publication Private Limited, New Delhi, 1997.
4. Lilian Hoagland Meyer, **Food Chemistry**, CBS Publishers & Distributors, New Delhi, 2004.
5. B. Sri Lakshmi, **Food Science,** New Age International Publisher, New Delhi, 2005.

CORE V - ORGANIC CHEMISTRY–I
(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GBCHC31 /FBCHC311/FBCHC31 **Credits: 4**

CO 1: To enable students to gain knowledge in mechanistic reactions of alkyl halides, aliphatic hydrocarbon, alcohol, phenol, ethers and epoxides
CO 2: To know the chemistry of other functional derivatives of organic compounds
CO 3: To know the significance of organic synthesis and its applications
CO 4: To enable students to gain knowledge in optical isomerism, geometrical isomerism and organometallic compounds

UNIT I **[18 Hours]**

Optical and Geometrical isomerism: Definition – Classification, Optical and Geometrical isomerism

Optical isomerism – Optical activity, Optical and Specific rotations, Conditions for optical activity, Asymmetric centre, Chirality, Achiral molecules-Meaning of (+) and (-) and D and L notations; Elements of symmetry –Projection formulae, Fischer, and Newmann projection formulae, Notation of Optical isomers, Cahn- Ingold - Prelog rules, R-S; Notations for Optical Isomers with one and two Asymmetric Carbon atoms, Erythro and Threo representations; Meso compounds, Racemic Mixtures and Resolution, Optical isomerism of compounds without Asymmetric Carbon atoms, Allenes and biphenyls, Asymmetric Synthesis

Geometrical Isomerism–Cis-Trans, Syn-Anti and E-Z Notations, Geometrical Isomerism in Maleic and Fumaric acids and Unsymmetrical Ketoximes, Methods of Distinguishing Geometrical Isomers using Melting point, Dipole moment, Dehydration, Cyclisation and Heat of Hydrogenation

UNIT II **[18 Hours]**

Aliphatic Hydrocarbons: Aliphatic Saturated Hydrocarbons – General methods of preparation, Properties and Reactions of Alkanes, Methane and Ethane; Free radical substitution, Halogenation of Methane and Ethane, Petroleum Products, Cracking, Octane number and Flash point

Aliphatic Unsaturated Hydrocarbons–General methods of preparation, properties and reactions of Alkenes – Ethylene and Propene, Markovnikov's rules and Peroxide effect, Mechanism of addition to carbon, carbon double bond; Alkynes –preparation, properties and reactions of Acetylene

Alkadienes – Isolated, Conjugated and Cumulated double bond systems with examples - Thiele's theory of partial
valency

UNIT III **[18 Hours]**

Halogen Compounds: Nomenclature of Alkyl and Aryl Halides, Preparation of Alkyl Halides, from Alcohols and Alkenes, Radical Halogenation, Alkylic Bromination of Alkenes, Preparation of Aryl Halides

Reactions of Alkyl Halides–Substitution reactions, SN^1& SN^2, Mechanism, Kinetics, and Energy profile diagram & Stereochemistry

Reactions of Vinyl and Allyl halides–Elimination of Alkyl halides, E_1 & E_2 mechanism, Saytzeff rule

Reactions of Aryl halides–Nucleophilic Aromatic Substitution Reaction with mechanism, Bimolecular Displacement mechanism, Elimination-Addition mechanism and Addition-Elimination mechanism, Benzyne Intermediate; Electrophilic Addition reaction -Mechanism of addition of Hydrogen Halides and Halogen to Alkenes, Markownikoff's rule, Peroxide effect mechanisms

Halogen derivatives of Unsaturated Hydrocarbons-Vinyl chloride, Allyl chloride, Allyl Iodide and Chloroprene – Preparation and Uses

UNITIV **[18 Hours]**

Organometallic Compounds and Alcohols: Organometallic Compounds – Preparation of Grignard reagent, Organolithium compounds, Organozinc compounds, Organocopper compounds- Reformatsky reaction, Synthesis of organic compounds using Grignard reagent and Alkyl lithium

Alcohols – Nomenclature, Preparation of alcohols, by reduction of carbonyl compounds, Reaction of carbonyl compounds with Grignard reagent, Properties of Alcohol, Hydrogen bonding, Reactions of Alcohols, Dehydration, Conversion to Tosylates-Oxidation.

Aliphatic Alcohol – General methods of preparation, properties and reactions of Monohydric Alcohol

Unsaturated Alcohol – Allyl alcohol

Polyhydric Alcohol – Glycol, Glycerol and Nitroglycerin, Estimation of Hydroxy Groups

UNIT V **[18 Hours]**

Phenols, Ethers and Epoxides: Phenols – Preparation (from Cumene, Aromatic Sulphonic Acid, Chlorobenzene), Properties - Acidity of phenol, Uses, Reactions (oxidation) to Quinines, Riemer-Tiemann reaction, Bromination, Nitration, Liebermann's Nitroso reaction, Preparation of phenolphthalein, Kolbe's reaction, Pinacol-Pinacolone rearrangement

Ethers– Nomenclature, Preparation (from Williamsons Synthesis and Alkoxy Mercuration of

Alkenes), Reactions of ethers, Acidic cleavage, Claisen rearrangement, Zeisel's Method of Estimation of Methoxy groups, Crown ether structure and importance in Organic Synthesis.
Epoxides – Nomenclature, Preparation from Alkenes and Halohydrins, Reactions, ring Opening reactions, Acid Catalyzed and Base Catalysed reactions

Text Book:

1. M. K. Jain, & S.C. Sharma, **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi, 4th Edition, 2014. [Chapter 6, 7, 8, 10, 11, 18, 19, 33, 20 & 21]

Reference Books:

2. P.L. Soni & H. M. Chalwa, **Text Book of Organic Chemistry**, Sultan Chand & Sons, New Delhi, 2006.
3. Arun Bahl & B.S. Bahl, **Advanced Organic Chemistry,** S. Chand & Company Ltd., New Delhi, 2010.
4. M. K. Jain & S.C. Sharma, **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi, 2014.
5. Robert Thorhton, Morrison Robert & Robert Neilson Boyd, **Organic Chemistry**, Prentice Hall of India Private Limited. New Delhi, 2004.
6. K.S. Tewari, N.K. Vishoi & S.N. Mehrotra, A Text Book of Organic Chemistry, Vikas Publishing House Pvt., Ltd., New Delhi, 2004.
7. Jerry March, **Advanced Organic Chemistry (Reactions, Mechanisms and Structure)** Wiley Eastern Limited, New Delhi, 1987.
8. William H. Reusch, **An Introduction to Organic Chemistry,** New Delhi, CBS Publishers & Distributors, 1986.
9. Raj K. Bansal, **A Text book of Organic Chemistry,** New Age International Publishers, New Delhi, 1997.

CORE VI - ORGANIC ANALYSIS AND ORGANIC ESTIMATION

(For those who joined from since 2018-19)

Semester: III **Hours/Week: 6**
Subject Code: GBCHC32P /FBCHC321P/FBCHC32P **Credits: 4**

CO 1: To learn principles and procedure involved in organic estimation of organic compounds
CO 2: To develop skill in testing and analysing of organic compounds
CO 3: To learn principles and procedure involved in organic analysis of organic compounds
CO 4: To develop skills required in chemistry such as the proper handling of apparatus and chemicals of organic compounds

PART – I [45 Hours]

Organic Analysis:

Analysis of following functional groups (any one) organic substance (Aliphatic or Aromatic) starting saturation or unsaturation and confirmation by the preparation of a solid derivation. Acids, Phenols, Aldehydes, Ketones, Esters, Nitro Compounds, Amines, (Primary, Secondary and tertiary), Amides, Anilides and Halogenated Hydrocarbons (side chain and nuclear). Determination of Melting point (using Melting point instrument) and Boiling points.

PART – II [45 Hours]

Organic Estimation:

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Glucose (Bertrands Method)

Evaluation Scheme: 3hrs for Organic Analysis and 3hrs for Organic Estimation for 60 marks each

Reference Books:

1. V. Venkateswaran, R. Veeraswamy & A. R. Kulandaivelu, **Basic Principles of Practical Chemistry,** New Delhi, Sulthan Chand & Sons Publications, 1999.
2. A.O. Thomas, **Practical Chemistry for B. Sc. Main Students**, Kerala, Scientific Book Centre. 1995.
3. A. I. Vogel, **Text Book of Practical Organic Chemistry,** ELBS, London, 5th Edition, 2010.

SECOND ALLIED I - PHARMACEUTICAL CHEMISTRY – I

(For those who joined from since 2018-19)

Semester: III Hours/Week: 6
Subject Code: GBCHA33/FBCHA331/FBCHA33 Credits: 5

CO 1: To enable the students understand concepts in pharmaceutical Chemistry and drugs
CO 2: To gain knowledge about assay of drugs and metabolism of drugs
CO 3: To widen the knowledge in analytical separation methods and drug design
CO 4: To widen the knowledge in quantitative structure relation chemical structure and Pharmacological activity
CO 5: To widen the knowledge in achievements and limitations of QSAR

UNIT I [18 Hours]

Introduction to Pharmaceutical Chemistry, Classification and Nomenclature of Drugs:

Pharmaceutical Chemistry – Definition, Important aspects of Pharmaceutical Chemistry, Role of Chemistry in Pharmacy, Pharmacopoeia; Terms used in Chemistry of Drugs–Classification of Drugs based on Chemical Structure and Therapeutic Actions, Nomenclature, IUPAC Naming of Simple Heterocyclics, Stereo Chemical Notations

UNIT II [18 Hours]

Theories of Drug Action and Factors Affecting Drug Action: Biological Defenses, Chemical Defenses, Isosterism in Drugs; Drug Receptors – Nature, Isolation, Modification and Localization of Receptors; Theories of Drug Action – Nature of Pharmacological Action, Occupancy Theory, Rate Theory, Induced Fit Theory; Mechanism of Drug Action, Action of Drugs on Enzymes, Drugs Acting on Biological Membranes, Nonspecific Action of Drugs and Pharmacogenomics – Personalized Medicine

UNIT III [18 Hours]

Assay of Drugs and Metabolism of Drugs: Chemical Assay, Biological Assay, Immunological Assay; Metabolism of Drugs– Factors Affecting Metabolism, Phases of

Metabolism, Phase-I Reactions– Microsomal Reductions, Non Microsomal Metabolism, Hydrolysis, Phase-II Reactions–Major Path Way of Metabolism

UNIT IV [18 Hours]

Quantitative Structure Activity Relationship: Quantitative Structure Activity Relationship between Chemical Structure and Pharmacological Activity, Effects of Unsaturation, Chain length, Isomerism, Halogens, Amino group Nitro and Nitrite Compound, Nitrile group, Acidic group, Hydroxyl group, Alkyl groups, Hansh Equation, Craig plot, Topliss scheme, Achievements of QSAR-Limitations of QSAR

UNIT V [18 Hours]

Analytical Separation Methods & Drug Design: Analytical Separation Methods **–** Liquid-Liquid Extraction, Distribution Co-Efficient and Distribution Ratio, Factors Influenzing Solvent Extraction, Elementary idea on Chromatography – TLC, HPLC, and GC and Applications

Drug Design **–** Introduction, Methods of Lead Discovery, Application of Biosterism in drug Design, Prodrug Design, Computer Aided Drug Design

Text Books:

1. Jaya Shree Ghosh, **Fundamental Concepts of Pharmaceutical Chemistry,** New Delhi, S. Chand Publication, 2008. [Chapter 1, 2 &3]
2. V.K. Ahluwalia, & Madhu Chopra, **Text book of Medicinal Chemistry**, 1st Edition, Anne Book's Pvt. Ltd., New Delhi, 2008. [Chapter 1, 2 & 3]

Reference Books:

3. R.P. Budhiraja, **Separation Chemistry**, Newage international Ltd., New Delhi, 2004.
4. G.R. Chatwal, **Organic Pharmaceutical Chemistry,** New Delhi, Himalaya publishing house, 2002.
5. V. M. Kulkarni & Dr. K. G. Bothara, **Drug Design**, Nirali Prakasam publication, New Delhi, 2003.
6. R.S. Satoskar, S.D. Bhandarkar, & Popular Prakasan, **Pharmacology and Pharamtherapeutics,** Volume 1& 2, 2005.
7. K. D. Tripathi & J.B. Brother, **Essentials of Medical pharmacology,** 2006.
8. G.R. Chatwal, ***Pharmaceutical Chemistry Organic Volume II***, Himalaya Publishing House, New Delhi, 1991.

SKILL BASED ELECTIVE III - INTRODUCTION TO MARINE CHEMISTRY

(For those who joined from since 2018-19)

Semester: III **Hours/Week: 3**
Subject Code: GBCHE34/ FBCHE341/FBCHE34 **Credits: 2**

CO 1: To gain knowledge about Marine Science
CO 2: To have an understanding of salinity, sea water battery and sea weeds
CO 3: To widen the knowledge in Marine Chemistry
CO 4: To widen the knowledge in Marine Sediments

UNIT I **[9 Hours]**

Introduction: Introduction– Chemical Oceanography, Ocean basins; Properties of Fresh Water and Seawater, Temperature, Salinity, Density, Micro & Macro Nutrient Analysis of Sea Water, Life in the Oceans and the Chemical Connection

UNIT II **[9 Hours]**

Chemical Equilibrium: Chemical Equilibrium – Ion Complexes, Acid-Base Reactions, Carbonate Chemistry (Alkalinity, DIC), REDOX Chemistry, Seawater Composition Changes, Marine Sediments, Radioactive Tracers and Stable Isotopes

UNIT III **[9 Hours]**

Salinity: The Salts –The Ocean Salinity and Dissolved Salts, Sources of Salts & Salt Balance, Resistance Time, The Gases-Types, Depth Distribution, CO_2 as Buffer, Carbon Cycle and Other Substances

UNIT IV **[9 Hours]**

Heavy Metals in Sea Water and Sea Water Battery: Heavy Metals Contribution in Seawater and Sediments and their intoxication Oil Slick, Suitable Adsorbents for Oil Slick; Sea Water Battery –Types of Battery, Marine Corrosion and Anti-Corrosion Coating Material

UNIT V **[9 Hours]**

Sea Weeds: Sea Weeds – Classification, Uses of sea weeds in Various Fields, Bio fuels, Nutritional and Medicinal Value of Sea Weeds, Humans and the Sea and the Impacts of Humans on the Marine Environment

Text Book:

1. R.E. Hester & R.M. Harrison, **Chemistry in the Marine Environment,** The Royal Society of Chemistry, UK, 13th Edition, 2000. [Chapter 1, 2, 3, 4 & 5]

Reference Books:

2. D. Satyanarayana, **Marine Chemistry,** Daya Publishing House, New Delhi, 2007.

EXTRA CREDIT - CHEMISRY OF CONSUMER PRODUCTS

(For those who joined from since 2018-19)

Semester: III
Subject Code: GBCHX3/FBCHX31/FBCHX3 **Credits: 2**

CO 1: Be acquainted with current development in the field of industrial chemistry
CO 2: To acquire knowledge of energy sources and significance of renewable sources of energy
CO 3: To learn about various industrial processes and appreciate the chemistry behind them
CO 4: To widen the knowledge in glass, ceramic industry, alkali and chlorine, petroleum and petroleum product and cottage industry

UNIT I

Glass: Introduction, Characteristics, Physical and Chemical properties of Glass, Raw materials of Glass Industry–Formation of the Batch Material, Furnaces of Glass Industry – Chemical Reaction in Furnace, Shaping and Forming, Annealing, Finishing, Special Glasses – Optical Glass, Borosilicate Glass, Soda Lime Glass, Coloured Glass, Optical Glass, Opal

Glass, Fiber Glass, Bullet Resistant Glass, Glass Wool, Photosensitive Glass, Photochromic Glasses and Insulating Glasses

UNIT II

Ceramic Industry: Introduction, Subdivisions of Ceramics, General Properties of Ceramics – Porous and Non-Porous Wares (Distinction Between the Two), Classification Based on Reduction in Porosity, Basic Raw Materials and the Ingredients, Manufacturing process – Firing, Glazing, Frits and Decoration, Application of Color to Pottery, Porcelain and China – Raw Materials and Manufacture of Earthern Wares and Stone Wares

UNIT III

Alkali and Chlorine: Introduction, Common Salt – Manufacture, Caustic Soda – Manufacture of Caustic Soda and Chlorine using Diaphragm Cells, Costner killer Cell, Lime Soda Process for the Manufacture of Caustic Soda, Soda Ash, Leblanc Process, Solvay's Ammonia Soda Process, Sodium Hypochlorite and Manufacture by Electrolysis of NaCl. Baking Powder and Baking Soda – Preparation and Uses

UNIT IV

Petroleum and Petroleum Products: **Petroleum –** Preparation of Petroleum for Processing, Distillation of Crude Petroleum, Various Fraction of Composition and Uses, Treatment of the Residual Liquid, Processing of Liquid Fuels such as Petroleum and Petroleum Products

Petroleum products – Introduction, Natural Gas, Liquified Hydrocarbon Gases and Fuels, Fuels for Carburet or Engines, Aviation Gasoline, Motor Gasoline, Fuels for Jet, Lubricants, Paraffins, Petroleum, Bitumens, Solvents, Domestic Kerosene, Coke and Carbon Black, Lacquers and Solvents

UNIT V

Cottage Industry: Methods of Preparation of the following in the Cottage Industry – Soap, Detergent, Detergent Powder, Tooth Paste, Shampoo, Tooth Powder, Phenol, Fountain Pen Ink, Shoe Polish, Wax Candle and Chalk Crayons, Gum Paste and Naphthalene Ball

Practical Work – (No external examination)

Preparation of Phenol and Wax Candle

Text Book:

1. B.K. Sharma, **Industrial Chemistry,** Goel publishing, New Delhi, 15th Edition, 2006. [Chapter 5, 6, 20, 21, 28, 39 & 40]

References Books:

2. B. N. Chakrabarty, **Industrial Chemistry,** Oxford & IBH Publishing Co., New Delhi, 1981.
3. P.P. Singh, T.M. Joesph & R.G. Dhavale, **College Industrial Chemistry**, Himalaya Publishing House, Bombay, 1983.
4. Jayashree Ghosh, **Fundamental concepts of Applied Chemistry**, New Delhi S. Chand & Co Ltd. 2008.
5. P.C. Jain & Monica Jain, **Engineering Chemistry**, Dhanphatrai and Sons, New Delhi, 2006.
6. Shrive George & T. Austin, **Chemical Process Industries,** McGraw Hill Book Co., New Delhi, 1984.
7. B. K. Sharma, **Industrial chemistry including chemical engineering,** Krishnaprakasam media, Meerut, 2002.

8. A. Ravikrishnan, **Engineering Chemistry,** Sir Krishna publication, Chennai, 2008.

CORE VII - INORGANIC CHEMISTRY–II

(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 5**
Subject Code: GBCHC41 /FBCHC411/FBCHC41 **Credits: 4**

CO 1: To enable students to gain knowledge in principles and process of metals
CO 2: To enable students to gain knowledge in principles and process of non-metals
CO 3: To enable students to gain knowledge in principles and process of noble gases
CO 4: To acquaint the students with the importance and uses of transition elements

UNIT I **[15 Hours]**

IB, IIA & IIIA Group Elements: I B Group– Group Discussion, Extraction, Properties and Uses of Cu, Alloys of Cu and their Application

II A Group – Diagonal Relationship of Be with Al, Comparison of Be with Mg, Extraction, Properties and Uses of Be

IIIA Group **–** General Characteristics, Extraction of Aluminium, Anhydrous Aluminium trichloride, Boranes, Diborane - Preparation, Properties and Structure

UNIT II **[15 Hours]**

Dipole Moment & Magneto Chemistry: Dipole Moment – Definition, Experimental Determination, Calculation of Percentage Ionic character of HF and HCl, Dipole Moment and Molecular structure - CO_2, H_2O, NH_3 and CH_4

Magneto Chemistry – Introduction (Magnetic field, Magnetic pole, Intensity of magnetization). Magnetic Induction, Permeability, Intensity of Magnetism, Magnetic Susceptibility, Molar Magnetic Susceptibility. Magnetic Behaviour - Diamagnetism, Paramagnetism, Ferromagnetism and Antiferromagnetism, Effect of temperature on Magnetic Behaviour of Substances, Derivation of Equation for Total Angular Magnetic Momentum and Diamagnetic Momentum. Determination of Magnetic Susceptibility by Gouy Method

Applications of Magnetic Susceptibilities **–** Number of Unpaired Electrons in a Molecule, Structure of Co-Ordination compounds, Formation of Free Radicals

UNIT III **[15 Hours]**

IV, V & VI Group Elements:

Group IV – Metallurgy of Lead, Allotropy of Carbon, Carbides, Silicates, Silicones, Permonocarbonic acid, Perdicarbonic acid

Group VA – Nitrogen, Active Nitrogen, Hydrides of Nitrogen, Ammonia - Manufacture, Properties and Uses, Oxides of Nitrogen, Fixation of Nitrogen, Manufacture of Nitric and Arsenic acid, Distinction between Arsenite and Arsenate, Antimony trioxide, tarter emetic and sodium bismuthate

Group VI – Oxides, Oxyacids and Oxyhalides of Sulphur, Permonosulphuric acid, Perdisulphuric acid & Potassium Persulphate

UNIT IV **[15 Hours]**

Halogens & Noble Gas:

Halogens – Isolation of Fluorine, Moissan's method and Denis method, Distinction of Fluorine from other Elements, Manufacture & Properties of Chlorine, Bromine and Iodine, Manufacture of Bleaching Powder by Bachmann Method, Structure & Properties of Bleaching Powder

Interhalogen Compounds – Naming of the compounds, Types, Preparation, Properties, Structure and Uses of ICl, BrF_3, IF_5, IF_7. Basic Properties of Iodine

Pseudohalogens – Definition, Similarities and Dissimilarities between Halogen and Pseudohalogen, Cyanogen. Thiocyanogen-Preparation, Properties and Uses

Noble Gases – Isolation, General properties, Clathrates, Fluorides, Oxides and Oxifluorides of Xenon

UNIT V **[15 Hours]**

Transition Elements and Group Study: Transition elements– Position in the Periodic Table, General Characteristics of d-block Elements, Occurrence, Extraction and Uses of Titanium, Vanadium, Molybdenum and Tungsten, Chemistry of Titanium Dioxide, Titanium Tetrachloride, Vanadium Pentaoxide, Ammonium Molybdate, Zirconium Halide, Molybdenum Blue, Tungstic Oxide, Tungsten Bronze and Chloroplatnic Acid, Group study of Ti, V, Cr groups, Comparative study of Fe, Co, Ni, Preparation, Properties and Uses of Potassium Ferricyanide, Potassium Ferrocyanide, Cobaltous Nitrate and Nickel (II) Chloride

Text Book:

1. R.D. Madan, **Sathya Prakash's Modern Inorganic Chemistry**, New Delhi, S. Chand and Company Private Limited, 1rd Edition, 2008. [Chapter 19, 20, 22, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 43, 44, 45,46, 47, 48, 50, 51, 52 & 53]

Reference Books:

2. B.R. Puri, L.R. Sharma & K.C. Kalia, **Principle of Inorganic Chemistry,** Milestone Publishers & Distributors, New Delhi, 2013.
3. Sathya Prakash, G.D. Tuli, S.K. Basu & R.D. Madan, **Advanced Inorganic Chemistry,** S. Chand & Company Ltd., New Delhi, Vol. 1, 1997.
4. P. L. Soni & Mohan Katyal, **Text Book of Inorganic Chemistry**, Sultan Chand & Sons, New Delhi, 2006.
5. V.V. Ramanujam, **Inorganic Semi Micro Qualitative Analysis**, The National Publishing Co., Chennai, 1974.
6. F. Albert Cotton, Geoffrey Wilkinson, A. Murillo Carlos & Manfred Bochmann, **Advanced Inorganic Chemistry**, A Wiley Interscience Publication, Newyork, 1999.
7. James E. Huheey, Ellen A. Keiter, L. Keiter Richard & Okhil K. Medhi, **Inorganic Chemistry**, Dorling Kindersely Pvt. Ltd., South Asia, 2006.
8. J.D. Lee, **Concise Inorganic Chemistry**, Chapmen & Hall, London, 1992.

CORE VIII - ORGANIC CHEMISTRY –II

(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 5**
Subject Code: GBCHC42/FBCHC421/FBCHC51 **Credits: 4**

CO 1: To enable students to gain understanding of cycloalkanes and aromatic hydrocarbon

CO 2: To enable students to gain understanding of aldehydes and ketones and carboxylic acid

CO 3: To gather knowledge of pericyclic reactions and organic photochemistry of organic compounds

CO 4: To enable students to know the chemistry of heterocyclic compounds and significance of reactive methylene compounds

UNIT I [15 Hours]

Cycloalkanes and Aromatic Hydrocarbons: Conformational Analysis – Introduction of terms, Conformers, Dihedral angle, Torsional strain, Conformational analysis of Ethane and n-Butane including energy diagrams, Conformers of Cyclohexane (Chair, Boat and Skew boat forms), Axial and Equatorial bonds, Ring flipping showing axial equatorial interconversions

Cycloalkanes – Nomenclature, General methods of preparation and reactions of Cycloalkanes, Baeyers strain theory and its modifications, Conformational analysis of Cyclohexane

Aromatic hydrocarbons **–** Isolation of aromatic hydrocarbons from coal tar, Benzene – Preparation, Reactions and Structure of Benzene; Aromaticity and Huckels (4n+2) rule

Aromatic substitution **–** Orientation in Benzene ring, Relative and Absolute method, Mechanism of aromatic electrophilic mono-substitution and di-substitutions such as i) Halogenation ii) Friedal Crafts reaction iii) Nitration iv) Sulphonation

Aromatic Nucleophilic substitution - Unimolecular and Bimolecular substitution

UNIT II [15 Hours]

Aldehydes and Ketones: Nomenclature, Nature of carbonyl group, Preparation – Oxidation of alcohols, Ozonolysis, Reactions- Oxidation (with CrO_3, Ag_2O and $KMnO_4$), Reduction - Wolf Kisner, Clemmenson reduction, Metal Hydride Reduction, Nucleophilic addition (Hydration, bisulphite addition, HCN addition) Hemiacetal and Acetal formation, Carbonyl Alpha Substitution Reaction – Keto-Enol Tautomerism , Enolate ion formation , Haloform reaction, Carbonyl Condensation Reaction, Perkin reaction, Clavin Schmidth Reaction, Stobbe Condensation, Study of name reactions with mechanisms – Aldol Condensation, Cannizaro Reaction, Claisen Condensation Benzoin, and Beckmann rearrangement, Synthesis of Caprolactum, Preparation of Vanillin and Acrolein, General methods of preparation, properties and reactions of Formaldehyde and Acetone. Distinction between Aldehydes and Ketones

UNITIII [15 Hours]

Carboxylic Acids and Acids Derivatives: Nomenclature, Effect of Substituent on Acidity of Aliphatic and Aromatic Carboxylic Acids, Preparation of Monocarboxylic Acids - Oxidative Cleavage of Alkenes Hydrolysis of Nitriles, Carboxylation with Grignard Reagent, Side Chain Oxidation of Alkyl Benzenes, and Reaction of Carboxylic Acids, Preparation and Reactions of Acid Derivatives – Acid Chlorides, Esters, Amides and Anhydrides, Dicarboxylic acids – Preparation and Reactions of Malonic acid, Adipic acid, Phthalic acid and Citric acid

UNITIV [15 Hours]

Heterocyclic compounds & Aromatic Nitro Compounds: Heterocyclic Compounds – General Classification, Aromatic and non-Aromatic Heterocylics, preparation, properties and uses of Furan, Pyrrole & Thiophene, Synthesis and reactions of Pyridine, Comparative study of basicity of Pyrrole, Pyridine with Amines. Preparation of Indole, Quinoline, Isoquinoline & Indigotin

Relative basic character of Aromatic Amines – Derivatives of Aniline, Preparation and uses of Acetanilide, Sulphanilic acid and Sulphanilamide

Benzene diazonium chloride –Synthetic and applications of benzene diazonium chloride.

Aromatic nitro compounds – Conversion of nitrobenzene into o-, p- and m-dinitro benzenes, Reduction reactions of nitrobenzene in neutral, acidic and basic media, Preparation and uses of TNT and Amatol

UNIT V [15 Hours]

Pericyclic Reactions and Organic Photochemistry: Pericyclic Reactions – Features, MOs of conjugated π systems, FMOS, Electrocyclic reaction, Mode of rotations, Analysis of odd and even number of electron pair(s) systems with FMO method, Cycloaddition reaction, Modes of addition, Diels-Alder reaction, Analysis with FMO method, Sigmatropic rearrangement, [1,3] and [1,5] rearrangements, Cope and Claisen rearrangements– Mechanisms

Organic Photochemistry –Types of Photochemical reactions, Photo dissociation, Gas phase photolysis, Isomerisation, Cyclisation, Dimerisation and Oxetane formation. Norrish-I and II reactions. Barton reaction, Photo Fries rearrangement, Photochemical formation of smog, Photochemistry of vision

Text Book:

1. M. K. Jain, & S.C. Sharma, **Modern Organic Chemistry,** Vishal Publishing Co., New Dehli, 4th Edition, 2014. [Chapter 9, 14, 22, 23, 24, 25, 28, 29, 3034, 35, 47 & 48]

Reference Books:

2. P.L. Soni & H.M. Chalwa, **Text Book of Organic Chemistry,** Sultan Chand & Sons., New Dehli**,** 2006.
3. Arun Bahl, & B.S. Bahl, **Advanced Organic Chemistry**, S. Chand & Company Ltd., New Delhi, 2010.
4. Robert Thorhton Morrison Robert & Robert Neilson Boyd, **Organic Chemistry**, Prentice Hall of India Private Limited., New Delhi, 2004.
5. Jerry March, **Advanced Organic Chemistry (Reactions, Mechanisms and Structure),** Wiley Eastern Limited., New Delhi, 1987.
6. K.S. Tewari, N.K. Vishoi & S.N. Mehrotra, **A Text Book of Organic Chemistry,** Vikas Publishing House Pvt., Ltd., New Delhi, 2004.
7. Thomas L. Gilchrist, **Heterocyclic Chemistry**, Sai Pronto Pvt. Ltd., New Delhi, 2005.
8. Raj K. Banal, **Heterocyclic Chemistry,** New Age International Publishers, New Delhi, 2005.
9. Jagdamba Singh & L.D.S. Yadav, **Advanced Organic Chemistry**, Pragati Prakashan, Meerut, 1988.

CORE IX - GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATION

(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 5**
Subject Code: GBCHC43P /FBCHC431P/FBCHC53P **Credits: 4**

CO 1: To learn principles and procedure involved in inorganic estimation of inorganic compounds

CO 2: To develop skill in testing and analysing of organic compounds and inorganic compounds
CO 3: To learn principles and procedure involved in organic analysis of organic compounds

CO 4: To develop skills required in chemistry such as the proper handling of apparatus and chemicals of organic compounds
CO 5: To learn methods and principles of gravimetric analysis
CO 6: To gain skills relating to the preparation of organic compounds

PART– I

Gravimetric Analysis: **[45 Hours]**

1. Estimation of Lead as Lead Chromate
2. Estimation of Barium as Barium Chromate
3. Estimation of Calcium as Calcium Oxalate Mono Hydrate
4. Estimation of Copper as Cuprous Thiocynate
5. Estimation of Nickel as DMG Complex
6. Estimation of Chloride as Silver Chloride (demonstration only)

PART – II

OrganicPreparation:
[**30 Hours]**
Nitration**:**
1. Meta Dinitrobenzene from Nitrobenzene
2. Picric Acid from Phenol
Bromination**:**
3.Para Bromo Acetanilide from Acetanilide
Hydrolysis**:**
4. Salicylic Acid from Methyl Salicylate
5. Benzoic Acid from Benzamide
Oxidation**:**
6. Benzoic Acid from Benzaldehyde
Condensation**:**
7. Glucosone from Glucose
Benzoylation**:**
8. Benzoylation of Amines
9. Benzoylation of Phenols
10. Benzoylation of β-Naphthol
Evaluation Scheme: 3 hrs for Gravimetric Analysis and 3hrs for Organic Preparation for 60 mark each.

Reference Books:

1. V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu, **Basic Principles of Practical Chemistry**, New Delhi, Sulthan Chand and Sons Publications, 1999.
2. A.O. Thomas, **Practical Chemistry for B.Sc. Main Student**, Scientific Book Centre, Kerala, 1995.
3. O.P. Pandey, D.N. Bajpai & S. Giri, **Practical Chemistry**, Sulthan Chand and Sons Publication, New Delhi, 2006.
4. F.G. Mann & B.C. Saunders, **Practical Organic Chemistry,** Orient Longman Pvt. Ltd. Publications, New Delhi,

SECOND ALLIED II - PHARMACEUTICAL CHEMISTRY– II

(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 6**
Subject Code: GBCHA44/FBCHA441/ FBCHA42 **Credits: 5**

CO 1: To learn the basic idea of drugs and name of common drugs
CO 2: To effectively impart knowledge about various diseases and their treatment
CO 3: To learn about the importance of Indian medicinal plants
CO 4: To widen the knowledge in organic pharmaceutical aids and organic diagnostic agents
CO 5: To widen the knowledge in analgesics, antipyretics, anti-inflammatory agents and anaesthetics
CO 6: To widen the knowledge in antiseptics, disinfectants, cancer, antineoplastic and antibiotics

UNIT I **[18 Hours]**

Organic Pharmaceutical Aids and Organic Diagnostic Agents: Organic pharmaceutical aids– Preservatives, Anti-oxidants, Sesquistrants, Emulsifying Agents, Colouring, Flavouring, Sweetening, Stabilizing and Suspending Agents, Ointment Bases and Related Agents

Organic diagnostic agents**–**Drugs Used as X-ray Contrast Media, Drugs Used to Organ Function, Drugs Used to Determine Blood Volume and Hemopoietic Function, Drugs Used for Miscellaneous Diagnostic Tests

UNIT II **[18 Hours]**

Analgesics, Antipyretics, Anti-inflammatory Agents and Anaesthetics: Analgesics, Antipyretics and Anti-inflammatory agents **–** Narcotic Analgesics– Methadone and Morphine, Non-Narcotic Analgesics–Salicylic Acid Derivatives, Para Amino Phenol Derivatives, Pyrazole Derivative, Indolyl and Aryl Acetic Derivatives

Anaesthetics **–** General Anaesthetics – Ether Chloroform, Halothane, Trichloroethylene, Ethyl Chloride, Nitrous Oxide and Cyclopropane, Intravenous Anaesthetics– Thiopental Sodium Methohexitone, Local Anaesthetics– Esters, Amides

UNIT III **[18 Hours]**

Antiseptics, Disinfectants and Antibiotics: Antiseptics and Disinfectants **–** Distinction between Antiseptics and Disinfectants, Standardizations of Disinfectants and Antiseptics– Examples of Phenol, Halogen Compounds, Dyes, Organic Mercurial, Formaldehyde and its Derivatives and Cationic Surface Active Agents

Antibiotics **–** Classification, Structure, Properties and Uses of Chloramphenicol, Penicillin, Streptomycin, Tetracycline and Erythromycin.

UNIT IV **[18 Hours]**

Cancer, Antineoplastic and Cardiovascular Drugs: Cancer and antineoplastic drugs **–** Malignant and Non-Malignant Tumour– Causes, Treatment, Antineoplastic Drugs– Alkylating or Cytotoxic Agents, Antimetabolites – Plant Products, Harmones, Adrenocorticosteroids

Diabetes and hypoglycemic Drugs–Diabetes, Types, Insulin, Hypoglycemic Agents

Cardiovascular drugs **–** Cardiac Glycosides, Antiarrhythmic Drugs, Quinidine, Procainamide, Propranol Hydrochloride, Cholinergic Drugs, Antihypertensive Agents, Alpha Methyldopa and Reserpine

UNIT V [18 Hours]

Aids, Anticonvulsant Drugs and Medicinally Inorganic Compounds: AIDS–HIV, Symptoms and Treatment of AIDS

Anticonvulsant drugs **–** Barbiturates, Hydantoin, Oxazolidine Diones, Acetyl Urea Derivative and Succinimides

Medicinally important inorganic compounds **–** Compounds of Aluminium– Alum, Aluminium Hydroxide Gel, Bentonite and Aluminium Monosterate; Compounds of Phosphorus – Phosphoric Acid and Hypophosphoric Acid; Compounds of Iron–Ferrous Fumerate, Ferrous Gluconate, Ferrous Sulphate and Ferric Ammonium Citrate; Compounds of Mercury– Mercuric Oxide, Oleated Mercury, Mercurous Chloride, Mercury Amido Chloride and Mercury with Chalk

Text Book:

1. Jeyashree Gosh, **Text Book of Pharmaceutical Chemistry**, S. Chand and company, New Delhi, 2003. [Chapter 7, 10, 16, 17, 18, 19, 20, 23 & 26]

Reference Books:

2. R. Chatwal, **Organic Pharmaceutical Chemistry,** Himalaya Publishing House, New Delhi, 2002.
3. Jaya Shree Ghosh, **Fundamental Concepts of Pharmaceutical Chemistry**, S. Chand publication, New Delhi, 2005.
4. David Plummer, **Practical Biochemistry**, Tata McGraw-Hills Publishing Company, New Delhi, 2005.
5. Jeyashree Gosh, **Text Book of Pharmaceutical Chemistry**, New Delhi, S. Chand and company, New Delhi. 2003.
6. G.R. Chatwal, **Medicinal Chemistry**, New Delhi, Himalaya Publishing House, 2002.
7. G.R. Chatwal, **Pharmaceutical Chemistry Organic Volume II**, Himalaya Publishing House, New Delhi.

SKILL BASED ELECTIVE IV - SELECTED TOPICS IN APPLIED CHEMISTRY

(For those who joined from since 2018-19)

Semester: IV Hours/Week: 3
Subject Code: GBCHE45/FBCHE451/ FBCHE43 Credits: 2

CO1: To impart knowledge on dairy Chemistry
CO2: To widen the knowledge in leather and fertilizer Chemistry
CO3: To widen the knowledge in polymer and insecticides Chemistry
CO4: To widen the knowledge in herbicides & fungicides Chemistry

UNITI [9 Hours]

Leather Chemistry: Introduction, Chief Processes Used in Leather Manufacture– Before Tannage, Tannage, After Tannage, Composition of a Hide, Preparing Skins and Hides –Cleaning and Soaking, Liming and Degreasing and Fleshing and Shaving. Tanning Process –Tannage Materials, Vegetable Tanning

UNIT II [9 Hours]

Dairy Chemistry: Milk **–** Composition of Milk, Physical Properties of milk, Effect of Heat on Milk, Coagulation by Heat, Effect of Heat on Fat, Sugar Protein Mixture, Acidity, Viscosity,

Minerals, Colour, Flavour & Digestibility, Microorganism, Screen Formation and Scorching of Milk, Pasteurization, Homogenization

UNIT III [9 Hours]

Polymer Chemistry: Introduction, Classification of Polymer –Natural & Synthetic, Thermoplastic & Thermosetting, Plastics, Elastomers, Fibers & Liquid resins, Homopolymer & Co-Polymers (Definition & Examples only)

Polymerization: Definition, Types of Polymerization, Addition & Condensation Polymerization, Examples –Polyethylene, Polyvinyl Chloride, Terylene and Nylon 6, 6. Natural Rubber– Synthetic Rubber, Buna N and Buna S Rubber

UNIT IV [9 Hours]

Fertilizer Industry: Introduction, Requisites of a Good Fertilizer and Classification of Fertilizer, Nitrogen Fertilizers – Ammonium Sulphate, Calcium Ammonium Nitrate, Calcium Cyanamide and Urea; Phosphate Fertilizers –Super Phosphate of Lime, Double and triple Super Phosphate and Phosphate slag; Potash Fertilizers: Potassium Chloride, Potassium Sulphate and Potassium Nitrate (Preliminary Studies Only- Manufacturing Methods are Not Needed), Ill Effects of Fertilizers

UNITV [9 Hours]

Insecticides, Herbicides and Fungicides: Pesticides – Classification of Insecticides, Fungicides, Herbicides as Organic and Inorganic – General Methods of Application and Toxicity. Safety Measures when using Pesticides Insecticides – Plant Products - Nicotine, Pyrethrin, Inorganic pesticides – Borates and Organic pesticides – D.D.T. and BHC

Fungicide – Sulphur Compounds, Copper Compounds, Bordeaux Mixture

Herbicides – Acaricides – Rodenticides. Attractants – Repellants. Preservation of seeds

Text Book:

1. Jayashree Ghosh, **Fundamental Concepts of Applied Chemistry,** S. Chand and Company Limited, New Delhi, 2006. [Chapter 24, 25, 26, 28 & 29]

Reference Books:

2. K. Bagavathi Sundari, **Applied Chemistry,** MJP publications. New Delhi, 2006.
3. B.K. Sharma, **Industrial Chemistry,** Goel publishing, New Delhi, 2006.
4. B.N. Chakrabarty, **Industrial Chemistry,** Oxford & IBH Publishing Co., New Delhi, 1981.
5. P.P. Singh, T.M. Joesph & R.G. Dhavale, **College Industrial Chemistry**, Himalaya Publishing House, Bombay, 1983.
6. A. Ravikrishnan, **Engineering Chemistry, Chennai**, Sir Krishna publication, 2008.
7. F.W. Billmeyer, **Text Book of Polymer Science,** John Wiley and sons, New York, 1984.
8. P. Bahadur & N.V. Sastry, **Principles of Polymer Science,** Narosa Pub. House Pvt. Ltd., New Delhi, 2005.

EXTRA CREDIT - DAIRY CHEMISTRY

(For those who joined from since 2018-19)

Semester: IV

Subject Code: GBCHX4/FBCHX41/FBCHX4 Credits: 2

CO 1: To know the basics of Chemistry in our life

CO 2: To know about the proteins of milk, enzymes, lactose, vitamins and mineral of milk
CO 3: To widen the knowledge in processing of milk, milk products
CO 4: To widen the knowledge in manufacture of milk

UNIT I
Milk: Milk, Composition of Milk – Water and Dry Matters, Milk Fat, Milk Proteins, Casein, Whey Proteins, Milk Sugars, Ash or Mineral Matters; Minor Constituents of Milk –Phospholipids, Cholesterol, Pigments Enzymes, Vitamins, Gases and Non Protein Nitrogenous Substances of Flavour and Aroma of Milk, Physical Properties of Milk. (Short Note Only)

UNIT II
Proteins of Milk: Fractionation of Milk Proteins – Caseins, Alpha Caseins, Beta Casein and k Casein, Factors Influencing Stability of Casein Micelle, Casein Micelle Aggregation – Enzyme Coagulation, Acid Coagulation, Heat, Age-Gelation, Proteolytic Breakdown of Casein, whey Proteins, Beta Lacto Globulins and Alpha Lactalbumins (Short Note Only)

UNIT III
Enzymes, Lactose, Vitamins and Mineral of Milk: Enzymes – Lipoprotein Lipase – Plasmin, Alkaline Phosphatase. Lactose. Vitamins and Minerals. Density of milk –Experiment to Measure the Density of Milk, Properties of Milk – Viscosity & freezing point (Short Note Only)

UNIT IV
Processing of Milk: Effect of Heat on Milk, Milk Processing – Clarification and Pasteurization; The Holding or Batch System, High Temperature Short Time Method or the Continuous System, Ultra High Temperature System, Role of Phosphates in Pasteurization, Effects of Pasteurization, Homogenization (Short Note Only)

UNIT V
Milk Products: Introduction, Cream, butter, Ghee, Ice Cream, Various Ingredients Used in the Manufacture of Ice Creams – Milk Fat, Milk Solids-Not-Fat, Lactose Crystallization, Sweeteners, Stabilizers and Emulsifiers; Dairy Milk as Milk Powder – Types and Uses of Dry Milk (Short Notes Only)

Text Book:
1. K. Bagavathi Sundari, **Applied Chemistry**. MJP Publications, New Delhi, 2008. [Chapter 17]

Reference Books:
2. Jayashree Ghosh, F**undamental Concepts of Applied Chemistry,** S. Chand and Company Ltd publication, New Delhi, **2006**.
3. B.K. Sharma, **Industrial Chemistry,** New Delhi, Goel publishing, 2006.

CORE X - PHYSICAL CHEMISTRY–II
(For those who joined from since 2018-19)

Semester: V **Hours/Week: 5**
Subject Code: GBCHC51/FBCHC511/FBCHC52 **Credits: 3**

CO 1: To enable the students understand concepts in solution and group theory

CO 2: To enable the students understand concepts in chemical equilibrium
CO 3: To gain knowledge about chemical kinetics
CO 4: To gain knowledge about electrochemistry

UNIT I [15 Hours]

Chemical Equilibrium: Chemical Equilibrium – Law of Mass Action, Law of Chemical Equilibrium, Thermodynamic Derivation of Law of Chemical Equilibrium, Vant Hoff Reaction Isotherm, Standard Free Energy Change, Temperature Dependence of Equilibrium Constant, Vant Hoff Isochore, Le Chatelier Principle and its Applications

Enzyme Catalysis – Mechanism and Kinetics of Enzyme Catalysis, Michaelis Menton Equation, Effect of Temperature on Enzyme Catalysis

UNIT II [15 Hours]

Solutions: Solutions – Raoult's Law, Ideal Solution, Henry's Law, Temperature Composition Diagrams, Ideal Liquid Mixture (Toluene - Benzene), Non Ideal Mixture (Water- Ethanol and Water - Hydrogen Chloride), Azeotropic Mixtures, Distillation of Immiscible Liquids; Partially Miscible Liquids – Phenol - Water, Triethylamine - Water systems; Nernst Distribution Law, Thermodynamic Derivation, Limitations, Applications of Nernst Distribution Law, Solvent Extraction and Determination of Hydrolysis Constant

UNIT III [15 Hours]

Group Theory: Group Theory –Molecular Symmetry Elements and Symmetry Operations, Products of Symmetry Operations, Properties of a Group, Classes and Sub Groups, Group Multiplication Table (C_2V Table only), Point Groups, Classification of Molecules into Point Groups, Vector and Matrix Algebra, Symmetry Operations and Transformation Matrices, Inverse Matrices

Solid State– Crystal Lattices, Laws of Crystallography, Elements of symmetry, Crystal Systems, Unit cell, Space Lattice, Bravais' Lattices, Structure of NaCl, Structure of CsCl, Miller's Indices

UNIT IV [15 Hours]

Chemical Kinetics: Rate of Reactions – Rate Constant, Order and Molecularity of Reactions, First Order and Pseudo Unimolecular Reactions (Definition and Examples), Derivation of Rate Constant for the Inversion of Cane Sugar

Second Order Reactions – Definition and examples, Derivation of Rate Constant (Same Concentration and Different Concentration) and Half Life Period, Application to Saponification of Ester

Third Order Reactions – Definition and examples, Application to the Reaction between $FeCl_3$ and $SnCl_2$, Methods of Determination of Order of Reactions

Zero Order Reactions – Definition and examples, Derivation of Rate Constant

Theory of Reaction Rates – Collision Theory of Bimolecular Reactions, Unimolecular Reactions, Lindemann's Hypothesis, Theory of Absolute Reaction Rates

UNIT V [15 Hours]

Electrochemistry – I: Conduction in Metals and in Electrolyte Solutions, Specific Conductance and Equivalent Conductance, Measurement of Equivalent Conductance, Variation of Equivalent and Specific Conductance with Dilution, Ostwalds Dilution Law, Debye Huckel Theory of Strong Electrolytes, Onsagar Equation (no derivation) Significance and Limitations, Kohlrausch Law and its Applications, Migration of Ions, Ionic Mobility,

Transport Number and its Determination, Hittorff Method and Moving Boundary Method, Abnormal Transport Number, Applications of Conductometric Measurements, Determination of Degree of Dissociation of Weak Electrolytes, Ionic Product of Water, Solubility Product of a Sparingly Soluble Salt, Conductometric Titrations, pH Concept, Buffer Solutions, Buffer Activity-Henderson Equation, Applications of Buffer Solutions

Text Book:

1. B.R. Puri, L.R. Sharma & S. Pathania, **Principles of Physical Chemistry**, New Delhi, Vishal Publishing Co., 2005. [Chapter 5, 18, 20, 22, & 26]

Reference Books:

2. L.R. Sharma, B.R. Puri & M. S. Pathania, **Elements of Physical Chemistry**, New Delhi, Vishal Publishing Co., 2014.
3. B.S. Bahl, G.D. Tuli & Arun Bahl, **Essentials of Physical Chemistry,** S.Chand & Company Ltd., New Delhi, 12th Edition, 2011.
4. P. L. Soni, **Text Book of Physical Chemistry,** New Delhi, Sultan Chand & Co., 2014.
5. S.H. Maron & J.B. Lando, **Fundamentals of Physical Chemistry**, Macmillan Limited, New Delhi, 1966.
6. B. R. Puri, L. R. Sharma & M.S. Pathania, **Principles of Physical Chemistry**, New Delhi, Shobanlal Nagin Chand and Co., 2001.
7. Peter Atkins, & Julio de Paula, Atkins **Physical Chemistry,** Oxford University Press YMCA Library Building. New Delhi, 2006.
8. A.S. Nagi & S.C. Anand, **A Text Book of Physical Chemistry**, New Delhi, Wiley Eastern Ltd., 2008.
9. K. L. Kapoor, **A Textbook of Physical Chemistry,** New Delhi, Macmillan, India Ltd., 1994.
10. Fritz Helmet, **Symmetry and Group Theory**, Salup & Sons. New Delhi, 2005.
11. Samuel Glasstone, **Text Book of Physical Chemistry,** Macmillan Indian Limited., Madras, 1986.
12. Ira. N. Levine, **Physical Chemistry,** New Delhi: Tata McGraw Hill Publishing Company Limited. 2002.
13. F.A. Cotton, **Chemical Applications of Group Theory,** John Wiley & Sons, New York, 1999.
14. K.V. Raman, **Group Theory and its Applications to Chemistry,** Tata McGraw-Hill., New Delhi, 1990.

CORE XI - ORGANIC CHEMISTRY–III

(For those who joined from since 2018-19)

Semester: V **Hours/Week: 4**
Subject Code: GBCHC52/FBCHC521/FBCHC63 **Credits: 3**

CO1: To understand how complex natural products are assembled in the laboratory through synthetic organic chemistry
CO2: To enable the students understand concepts in chemistry of carbohydrates and aminoacids
CO3: To enable the students understand concepts in proteins, terpenes, and alkaloids
CO4: To enable students to gain understanding of molecular rearrangement and tautomerism

UNIT I **[12 Hours]**

Polynuclear Hydrocarbons, Oils, Fats and Dyes: Polynuclear Hydrocarbons – Preparation, Properties and Uses of Naphthalene, Anthracene and Phenanthrene, Structure of Naphthalene. Preparation and Uses of Naphthylamine, Naphthols, Naphthaquinone and Anthraquinone, Preparation of Biphenyl, Benzidine and Stilbene

Oils and Fats– Definition, Determination and Application, Saponification value, iodine value, Reichert, Meissel value, Acid value

Dyes – Definition, Otto-Witt theory of colour and constitution, Bathochromic shift Hypsochromic shift, Classification of dyes with examples according to structure and applications, Preparation and uses of following dyes - Methyl orange, Malachite green, Phenolphthalein, Indigo and Alizarin

UNIT II **[12 Hours]**

Amino Acids, Proteins, Ureides and Nucleic Acids: Amino Acids –Definition, Classification, Essential and Non-Essential Amino Acids, Preparation of Alpha Amino Acids – Glycine, Alanine and Tryptophan, General Properties of Amino Acids – Zwitter ions, Isoelectric Point, Peptides – Synthesis, Bergmann Method, Structure Determination of Polypeptides, End Group Analysis

Proteins – Definition, Classification Based on Physical and Chemical Properties and on Physiological Functions, Primary and Secondary structure of Proteins - Helical and Sheet Structures (Elementary Treatment Only), Denaturation of Proteins

Ureides - Classification, Pyrimidines, Thymine, Uracil and Cytosine, Purines, Adenine and Guanine, Synthesis (Structural Elucidation Not Necessary)

Nucleic acid – Nucleoside, Nucleotide, R.N.A and D.N.A. (General Structure)

UNIT III **[12 Hours]**

Carbohydrates, Vitamins, Antibiotics and Aromatic Sulphonic Acids: Carbohydrates – Classification, Monosaccharides, Reactions of Glucose and Fructose-Osazone formation, Constitution of Glucose and Fructose – Open Chain Structure, Configuration and Ring Structure, Mutarotation, Determination of Ring size, Haworth's Projection Formulae and Conformation of Monosaccharides, Interconversions of Monosaccharides, Epimerisation – Conversion of Pentose to Hexose and vice versa, Aldose to Ketose and Vice Versa; Disaccharides – Structural Elucidation of Sucrose; Polysaccharides–Structure of Starch and Cellulose (no Structural Elucidation), Derivatives of Cellulose

Vitamins – Occurrence and Biological Importance of Vitamin A, Thiamine, Riboflavin, Pyridoxine and Ascorbic acid, Synthesis and Structural Elucidation of Ascorbic Acid

Aromatic Sulphonic Acids - Preparation, Properties and Uses of Benzene Sulphonic Acid, Preparation and Uses of Saccharin, Chloramine-T and Dichloramine-T

UNIT IV **[12 Hours]**

Molecular Rearrangements and Tautomerism: Molecular Rearrangements – Classification as Anionotropic, Cationotropic, Intermolecular and Intramolecular, Mechanisms – Pinacol - Pinacolone, Beckmann, Benzidine, Hofmann, Curtius, Lossen, Schmidt

Tautomerism **–** Definition, Prototropy and Anionotropy, Detailed Study of the Following– Types of Tautomerism, Keto-Enol Tautomeris, Nitro – Aci-Nitro Tautomerism, Lactam-Lactim Tautomerism

UNIT V [12 Hours]

Chemistry of Natural Products: Alkaloids – Classification, Isolation, General Methods of Determination of Structure of Alkaloids, Synthesis and Structural Elucidation of Piperine, Atropine and Nicotine

Terpenoids – Classification, Isolation, Isoprene rule, Synthesis and Structural Elucidation of Citral, Geraniol, and Alpha-Pinene

Text Book:

1. M. K. Jain, and S.C. Sharma, **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi, 4th Edition, 2014. [Chapter 16, 31, 32, 37, 38, 39,41, 43, 44, 46 & 51]

Reference Books:

2. Robert Thorhton Morrison Robert & Robert Neilson Boyd, **Organic Chemistry**, New Delhi, Prentice Hall of India Private Limited., 2004.
3. Arun Bahl & B.S. Bahl, **Advanced Organic Chemistry,** New Delhi, S. Chand & Company Ltd., 2010.
4. P. L. Soni, & H. M. Chawla, **Text Book of Organic Chemistry**, New Delhi, Sultan Chand and Sons, 2007.
5. Gurdeep R. Chatwal, & M. Arora, **Reaction Mechanism and Reagents in Organic Chemistry,** Himalaya Publishing House. New Delhi, 1987.
6. I.L. Finer, **Organic Chemistry Volume 2: Stereochemistry and the Chemistry of Natural Products,** Longman Singapore Publishers Ltd., Singapore, 1986.
7. Jerry March, **Advanced Organic Chemistry (Reactions, Mechanisms and Structure),** Wiley Eastern Limited., New Delhi, 1987.
8. K.S. Tewari, N.K. Vishoi & S.N. Mehrotra, **A Text Book of Organic Chemistry,** Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
9. K.S. Mukherjee, **Mechanism of Organic Reactions**, Books and Allied PVT. Ltd., New Delhi, 2010.
10. O.P. Agarwal, **Chemistry of Organic Natural Products (Volume II),** Krishna Prakashan media Pvt. Ltd, India, 2002.
11. V.K. Ahluwalia, & R.K. Parashar, **Organic Reaction Mechanism**, Narosa Publishing House, New Delhi, 2003.
12. M. K. Jain & S.C. Sharma, **Modern Organic Chemistry,** Vishal Publishing Co., New Delhi, 2014.

CORE XII - PHYSICAL CHEMISTRY PRACTICALS

(For those who joined from since 2018-19)

Semester: V Hours/Week: 4
Subject Code: GBCHC53P /FBCHC531P/FBCHC65P Credits: 4

CO 1: To develop skills required in chemistry such as the proper handling of apparatus and chemicals
CO 2: To gain practical skill in carrying out experiments related to kinetics, electrochemistry and ionic equilibria
CO 3: To gain hands on experience in the use of colorimeter, potentiometer and conductivity meter
CO 4: To gain hands on experience in the use of viscosity

PART –I

Physical Chemistry Experiments: **[60 Hours]**

1. Determination of molecular weight by
   (a) Transition Temperature Methods – Sodium Thiosulphate Pentahydrate, Strontium Chloride Hexahydrate and Sodium Acetate Trihydrate
   (b) Cryoscopic Method –Rast Method –Camphor and Naphthalene
2. Phase diagram involving
   (a) Simple Eutectic
   (b) Compound Formation
3. Critical Solution Temperature – Estimation of Sodium Chloride by Studying the CST of Phenol and Water System
4. Thermochemistry – Heat of Solution – Potassium dichromate and Ammonium Oxalate
5. Viscosity – Determination of the composition of unknown mixture
6. Partition Coefficient Experiments
   (a) Study of Equilibria $KI + I_2 \longrightarrow KI_3$ by Studying the partition Coefficient of Iodine between Water and Carbon tetrachloride
   (b) Determination of Association Factor of Benzoic Acid in Benzene
7. Kinetics – Determination of relative strength of acids by
   (a) Acid Catalyses Hydrolysis of Ester
   (b) Inversion of Cane Sugar
8. Electrochemistry
   (a) Conductivity Titration between an Acid and a Base (HCl Vs NaOH)
   (b) Potentiometric Titration between an Acid and a Base (HCl Vs NaOH)

Reference Books:

1. A.O. Thomas, **Practical Chemistry for B.Sc. Main Students**, Kerala, Scientific Book Centre. 1995.
2. V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu, **Basic Principles of Practical Chemistry,** Sultan Chand and Sons, New Delhi, 2012.
3. B. Viswanathan, & P.S. Raghavan, **Practical Physical Chemistry**, New Delhi, Viva Book Private Limited, 2014.
4. J.B. Yadav, **Advanced Practical Physical Chemistry,** Goel Publications, Meerut, 1986.
5. O. P. Pandey, D.N. Bajpai & S. Giri, **Practical Chemistry,** Sulthan Chand and Sons Publications, New Delhi.
6. F.M. Mann & B.C. Saunders, **Practical Organic Chemistry**, Orient Longman Pvt. Ltd. Publications, New Delhi.

ELECTIVE I (A) - INDUSTRIAL CHEMISTRY
(For those who joined from since 2018-19)

Semester: V **Hours/Week: 5**
Subject Code: GBCHE5A/ FBCHE51A/FBCHE5A **Credits: 5**

CO1: Be acquainted with current development in the field of industrial Chemistry

CO2: To acquire knowledge of energy sources and significance of renewable sources of energy
CO3: To learn about various industrial processes and appreciate the Chemistry behind them
CO4: To enable the students understand concepts in pulp, paper and fermentation industries
CO5: To enable the students understand concepts in silicate and rubber industry
CO6: To enable the students understand concepts in fertilizers and detergents

UNIT I **[15 Hours]**

Pulp & Paper Industry: Raw materials for Pulp & Paper (Fibrous &Non-Fibrous raw materials)

Pulping – Definition, Uses of Pulp, Pulping Methods for Paper Manufacture: (1) Mechanical or Ground Wood Process – Chemical Nature of Wood - Wood Pulping - Object and Use - Ground Wood Process – Improvements, (2) Chemical Processes – (a) Kraft or Alkaline Sulphate Process in detail including Recovery of Chemicals, (b)Acid Sulphite Process in detail, (3) Semi-Chemical Process – Short Time (NSSC) Process Comparison of Kraft, Sulphite & NSSC Pulping Processes, Stock Preparation, Furnishing, Beating, Bleaching, Sizing, Fillers and Colouring ; Paper Making Processes – Fourdrinier Machine in detail with flow chart - Cylinder Machine – Short account with advantages & disadvantages

UNIT II **[15 Hours]**

Fermentation Industries: Introduction, Definition, Factors Influencing Fermentation Reactions, Types of Fermentation Process – Aerobic and Anaerobic processes (Microorganisms), Microbial Nutrients, Merits of Fermentation Process and Fermentation Products; Fermentation Industries: Manufacture of Ethyl Alcohol with flow sheet - Manufacture of Butyl Alcohol - Manufacture of Vinegar - Manufacture of Lactic acid - Manufacture of Citric Acid

UNIT III **[15 Hours]**

Silicate and Rubber Industry: Cement –Manufacture of Cement, Setting & Curing, RCC and Cement Industries in India; Glass – Types of Glasses, Manufacture of Optical Glass, Borosilicate Glass, Coloured Glass, Glass Wool & Applications; Rubber – Natural and Synthetic rubber, Manufacture and Applications of SBR, Neoprene, PUF and Silicone rubber

UNIT IV **[15 Hours]**

Fertilizers: Introduction, Requisites of a Good Fertilizer, Role of Various Elements in Plant Growth, Natural and Chemical Fertilizers, Manufacture of Ammonium Sulphate, Calcium Cyanamide, Urea, Calcium Super Phosphate, DAP and Potassium Nitrate, Mixed Fertilizers, Fertilizer Industry in India

UNIT V **[15 Hours]**

Soaps and Detergents: Introduction, Classification of Soaps, Raw Materials Required, Manufacture of Soaps, Cleansing Action of Soaps; Detergents – Principal Groups of Synthetic Detergents, Classification of Detergents, Anionic Surfactants, Cationic and Ampholytic Surfactants, Non-Ionic Surfactants, Detergent Builders & Additives-Sludge Regulators, Principle of Cleansing Action of Detergents or Detergency, Comparison of Soaps and Detergents

Text Book:

1. B.K. Sharma, **Industrial Chemistry,** Goel publishing, New Delhi, 15th Edition, 2006. [Chapter 20, 23, 26. 34, 36, 37, 39 & 40]

Reference books

2. Jayashree Ghosh, **Fundamental Concepts of Applied Chemistry**, S. Chand & Company Ltd. New Delhi, 2006.
3. B.N. Chakravarty, **Industrial chemistry,** Oxford IBH publishing co., New Delhi, 1981.
4. M. G. Arora & M. Singh, **Industrial Chemistry**, Anmol Publications, New Delhi, 1998.
5. K. Bagavathi Sundari, **Applied Chemistry,** MJP Publications, New Delhi**,** 2006.
6. O.P. Veromani & A.K. Narula, **Industrial chemistry,** New Delhi, Galgotia publications, 2004.
7. B.K. Sharma, **Industrial chemistry including chemical engineering**. Krishnprakasam Media, Meerut, 2002.
8. P.C. Jain, & Monica Jain. **Engineering Chemistry,** Dhanphatrai and Sons, New Delhi, 2006.
9. S.S. Dara, **A Text Book of Engineering Chemistry**, S. Chand & Co., New Delhi, 2006.

ELECTIVE I (B) - BIOLOGICAL CHEMISTRY

(For those who joined from since 2018-19)

Semester: V **Hours/Week: 5**
Subject Code: GBCHE5B/ FBCHE51B/FBCHE5B **Credits: 5**

CO 1: To learn about various methods of treatment and analysis of blood
CO 2: To learn about various methods of treatment and analysis of hormones
CO 3: To learn about various methods of treatment and analysis of enzymes
CO 4: To acquire knowledge of nutrients digestion and absorption
CO 5: To acquire knowledge of micro nutritents and their biological role
CO 6: To acquire knowledge of enzymes

UNIT I **[15 Hours]**

Blood: Blood – Composition, Plasma Proteins, RBCs, Blood Groups, The Rh Factors, Blood Transfusions, Blood Pressure, Hypertension, Hypotension

UNIT II **[15 Hours]**

Nutrients Digestion and Absorption: Introduction, Digestion, Absorption, Process of Digestion, Digestion in the Oral Cavity, Digestion in the Stomach, Digestion in the Small Intestine, Absorption and Digestion of Carbohydrates, Fatty acids, Amino acids and Proteins

UNIT III **[15 Hours]**

Hormones and their Physiological Effects: Introduction, Preparation and Functions of Harmones, Chemical Nature of Harmones, Structure an Physiological Functions of Some Harmones, Adrenaline, Thyroxine, Oxytocin, Insulin, The Sex Harmones (Androgens and Oestrogens)

UNIT IV **[15 Hours]**

Micro Nutrients and their Biological Role: Introduction, Biological Function of Some Micro Minerals, Iron, Copper, Fluorine and Zinc and Iodine etc.; Vitamins – Water Soluble Vitamins, Lipid Soluble Vitamins - a detailed study

UNIT V **[15 Hours]**

Enzymes: Introduction, Properties, Nomenclature, Classification, Chemical Nature of Enzyme, Co-Factors and Co-Enzymes, Mechanism of Enzyme Catalysis, Factors Affecting – Enzyme Activity, Enzyme Action, Regulation of Enzyme Activity, Inhibitors -Reversible and Irreversible Inhibitors

Text Book:

1. Jayashree Ghosh, **Fundamental Concepts of Applied Chemistry,** S. Chand and Company Limited, New Delhi, 2006. [Chapter 16, 20, 21, 22 & 23]

Reference Books:

2. P.D. Mayne, **Clinical chemistry in Diagnosis & Treatment,** ELBS/ Arnold., New Delhi, 1995.
3. W. J. Marshall & S.K. Bangert, **Clinical chemistry**, ELBS/ Arnold., New Delhi,1995
4. K.V. Krishnedas, **Textbooks of medicine,** Jaypee Brothes Publication, New Delhi, 1996.
5. B.S. Bahl, G.D. Tuli, & Arun Bahl, **Essentials of Physical Chemistry**, S. Chand & Company Ltd., New Delhi, 2011.
6. J.D. Lee, **Concise Inorganic Chemistry,** Chapmen & Hall, London, 1992.
7. R.T. Morrison & R.N. Boyd, **Organic Chemistry,** New Delhi, Prentice Hall of India Pvt. Ltd., 2011.

ELECTIVE II (A) - TEXTILE CHEMISTRY

(For those who joined from since 2018-19)

Semester: V **Hours/Week: 5**
Subject Code: GBCHE5C /FBCHE51C/FBCHE5C **Credits: 5**

CO1: To acquire knowledge of dyes and their applications
CO2: To acquire knowledge of textile fibres and their applications
CO3: To acquire knowledge of jute and their applications
CO4: To acquire knowledge of printing of synthetic fibres and their applications
CO5: To acquire knowledge of silk and their applications
CO6: To acquire knowledge of wool and their application

UNIT I **[15 Hours]**

Textile Fibres: Definition and Classification of Textile Fibres according to their Nature &Origin, Essential and Desirable Properties of Textile Fibres; Cotton Fibres– Chemical Composition and Morphology; Bast Fibres – Jute, Hemp, Ramie and Linin (Flax); Regenerated Fibres – Viscose Rayon; Protein Fibres – Silk and Wool, Sericulture and Reeling of Silk, Grading of Wool, Morphology of Wool Fibre, Regenerated Protein Fibres – Soyabean, Ardile, Casein, Vicara and Mineral Fibres (Asbestos)

UNIT II **[15 Hours]**

Operation of Singeing: Study of the Operation of Singeing, Various Method of Singeing Such as Plate, Gas and Rotary Cylinder Machines, Precautionary Measures to be taken during Singeing Operation, Study of Operations of Desizing using Hydrolytic and Oxidative Method (Any Two Methods) Scouring Method using Vertical Kier, General methods of Bleaching using Sodium Chlorite, Bromite, Hypochlorites and Hydrogen Peroxide

UNIT III **[15 Hours]**

Dyes: Colour and Chemical Constitution, Chromosphere, Auxochrome Theories, History of Natural and Synthetic Dye, Classification of Dyes based on Chemical Constitution and Method of Application. Application of Direct, Reactive, Acid, Basic and Vat Dyes on Cotton and Protein Fibres

UNIT IV **[15 Hours]**

Dyeing and Printing: Definition, Difference between Dyeing and Printing, Block Printing, Batik Printing, Screen Printing, Roller Printing, Direct Printing Styles, Printing with Vat Dyes, Azoic dyes and Modernt colours; Finishing Processes – Purpose, Classification, Brief Details of Finishing Operations, Straightening, Sanforizing, Stiffening, Mercerizing in Detail, Calendering , Water Proofing, Mildew Proofing, Fire Proofing and Moth Proofing

UNIT V **[15 Hours]**

Printing of Synthetic Fibres: Development in Printing of Synthetic Fibres and their Blends. Bubble Dyeing, Foam Technology, Transfer Printing, Capsule / Speckle Printing; Aqueous Pigment Printing-Dybln and Cellestren Dyes; Foam – Discharge Style, Burnt –Out Style etc.

Text Book:

1. Tyronel L. Vigo, **Textile Processing & Properties,** Elsevier Publishing Company, Netherland, 2002. [Chapter 1.2, 1.3, 2.2, 2.5 & 2.7]

Reference books:

2. V.A. Shenai, **Textile Fibres**, Bombay, Sevak Publication, 1991.
3. K. Hunger, **Industrial Dyes: Chemistry, Properties, Applications**, Wiley-VCH. New Delhi, 2003.
4. R. Nietzki, **Chemistry of Organic Dyestuffs**. Gurney & Jackson, University of Michigan. 2007.
5. J.T. Marsh, **Textile Science**. B.I. Publication, Madras, 1941.
6. E.R. Trotman, **Textile Scouring and Bleaching.** Charles Griffin and Co. Ltd. London, 1968.
7. R.S. Prayag, **Bleaching, Mercerization and Dyeing of Cotton Material**, Weavers Service Centre, Bombay.
8. V.A. Shenai, **Introduction to the Chemistry of Dyestuffs**, Sevak Publications Mumbai, 1995.
9. H.L. Needles, **Textile Fibers, Dyes, Finishes, and Processes,** A Concise Guide, Noyes Publications, New Delhi, 1986.

ELECTIVE II (B) - ANALYTICAL METHODS

(For those who joined from since 2018-19)

Semester: V **Hours/Week: 5**
Subject Code: GBCHE5D/ FBCHE51D/ FBCHE5D **Credits: 5**

CO 1: To understand the significance of errors in analysis
CO 2: To acquire knowledge of analytical techniques including spectral techniques
CO 3: To enable the students understand concepts in thermal techniques
CO 4: To enable the students understand concepts in atomic spectrometry
CO 5: To enable the students understand concepts in ultraviolet and visible spectrometry
CO 6: To enable the students understand concepts in infrared techniques

UNIT I **[15 Hours]**

Introduction of Analytical Chemistry: The Scope of Analytical Chemistry, Functions and Applications of Analytical Chemistry, Definition and Basic Concepts of Mean, Median, Degree of Freedom, Deviation, Standard Deviation Variance, Q Test, T Test, Accuracy, Absolute Method and Comparative Method, Precision, Errors, Classification of Errors – Methods of Minimizing Errors, Significant Figures and Computative Rules

UNIT II **[15 Hours]**

Thermal Techniques: Thermogravimetry **–** Principle, Instrumentation, Application of TGA, Differential Thermal Analysis (DTA)– Principle, Instrumentation and application of DTA

Differential Scanning Calorimetry**–**Principle, Instrumentation, Applications of DSC, Thermo Mechanical Analysis (TMA) and Dynamic Mechanical Analysis (DMA), Principle, Instrumentation and Applications of TMA and DMA; Pyrolysis-gas chromatography, Principle, Instrumentation

UNIT III **[15 Hours]**

Atomic Spectrometry: Atomic absorption spectrometry **–**Absorption of Characteristic Radiation Instrumentation, Sample Vapourisation, Quantitative Measurements and Interferences and Applications

Flame emission spectrometry **–** Principle, Instrumentation, Flame characteristics Flame Process, Emission Spectra, Quantitative Measurements and Interferences and Applications.

X – Ray Emission Spectrometry **–** X- Ray Process, Instrumentation and Applications

UNIT IV **[15 Hours]**

Ultraviolet and Visible Spectroscopy: Introduction, Absorption laws, Formation of Absorption bands, Theory of Electronic Spectroscopy, Types of Electronic Transitions, Transition Probability, Chromophore, Auxochrome, Absorption and Intensity Shifts, Types of Absorption Bands, Solvent Effects, Conjugated Diene, Woodward-Fieser rules for Calculating Wavelength Maxima in Diene, Distortion of the Chromophore– Polyenes and Polyynes, Benzene and its Derivatives, Absorption Spectra of Condensed Ring Systems, Steric Hindrance and Coplanarity, Fluorescence and Phosphorescence – applications

UNIT V **[15 Hours]**

Infrared Spectroscopy: Introduction, Theory of Molecular Vibrations, Vibrational Frequency, Number of Fundamental Vibrations, Factors Influencing Vibrational Frequencies, Finger Print Region, Application of IR Spectroscopy, Detection of Alkanes, Alkenes, Alkynes, Cycloalkanes, Aromatic Hydrocarbon, Phenols and Alcohols, Ethers, Carbonyl Compounds, Aldehydes and Ketones, Esters Lactones, Carboxylic Acid, Acid Halides, Acid Anhydrides, Amides, Amino Acid, Amines and Nitro Compounds

Text Book:

1. F.W. Fifield, and D. Kealey, **Principle and Practice of Analytical Chemistry,** Blackwell Science Ltd., New Delhi, 5th Edition, 2004. [Chapter 1, 2, 8, 9 & 11]

Reference books:

2. D.A. Skoog, D.M. West and F.J. Hollar**, Fundamentals of Analytical Chemistry,** Harcourt College Publishers, New Delhi, 1996.
3. H.H. Williard, L.L. Merritt, and J.A. Dean, **Instrumental Methods of Analysis,** East-West press, New Delhi, 1988.
4. J.G. Dick, **Analytical Chemistry**, Tata – Mc-Graw Hill, New Delhi, l973.

5. R. Gopalan, P.S. Subramanian & K. Rengarajan, **Elements of Analytical Chemistry,** S. Chand and Sons, New Delhi,1997.
6. D.A. Skoog and D.M. West, **Fundamentals of Analytical Chemistry,** Holt Reinhard and Winston Publication, New Delhi, 1982.
7. D.A. Skoog, **Principles of Instrumental Methods of Analysis,** Saunders College Publications, New Delhi, 1985.
8. Chatwal Anand, **Instrumental Methods of Chemical Analysis,** New Delhi, Himalaya Publishing House, 2000.
9. H.W. Willard, L.I. Merrit, J.A. Dean, and P.A. Settle, **Instrumental Methods of Analysis,** New Delhi, CBS Publishers, 1996.
10. B.K. Sharma, **Instrumental Methods of Analysis**, Goel Publishers, New Delhi, 1993.

SKILL BASED ELECTIVE V- PRACTICAL COURSE IN APPLIED CHEMISTRY

(For those who joined from since 2018-19)

Semester: V **Hours/Week: 3**
Subject Code: GBCHE54P /FBCHE541P/FBCHE54P **Credits: 2**

CO 1: To develop skill in testing and analyzing organic compounds
CO 2: To learn about various methods of treatment and analysis of water
CO 3: To develop skills required in chemistry such as the proper handling of apparatus and chemicals
CO 4: To learn principles and procedure involved in estimation of glucose, acetone &hardness of water

PART –I **(45 hours)**

1. Estimation of Glucose (Lane and Eynon Method)
2. Determination of Iodine Value of Oil (Hanus Method)
3. Determination of Saponification Value
4. Determination of Free Fatty Acid
5. Estimation of Total Dissolved Soilds in Water
6. Estimation of Chloride in Water
7. Estimation of Fluoride in Water
8. Alloy Analysis
9. Estimation of Hardness of Water (EDTA Method)
10. Estimation of Ascorbic Acid (Vitamin C)
11. Estimation of Acetone

Reference books:

1. G. Suehla, **Vogel's Qualitative Inorganic Analysis,** Dorling Kindersely PVT. Ltd., South Asia, 2011.
2. N.S. Gnanapragasam, & Prof. G. Ramamurthy, *Organic Chemistry Lab Manual*. S.Viswanath PVT. Ltd., Chennai, 2008.
3. A. P. Bhargava, V. P. Lavania & K.G. Ojha, **Practical Chemistry,** Ramesh Book Depot., New Delhi, 2010.
4. O.P. Pandey, D.N. Bajpal & S. Giri, **Practical Chemistry,** S.Chand and Company Ltd., New Delhi, 2006.
5. V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu, **Basic Principles of Practical Chemistry,** New Delhi, Sultan Chand and Sons, 2012.
6. J. Bassett, **Text Book of Quantitative Chemical Analysis,** LBS, Longmann U.K. 1989.

7. V.V. Ramanujam, **Inorganic Semi Micro Qualitative Analysis**, The National Publishing Co., Chennai, 1974.

EXTRA CREDIT - INDUSTRIAL TRAINING REPORT

(For those who joined from since 2018-19)

Semester: V
Subject Code: GBCHX5/FBCHX51/FBCHX5 Credits: 2

CO 1: To learn principles and procedures employed in industrial training of various industry
CO 2: To develop practical skill and application of various industry
CO 3: To develop skills required in chemistry such as the proper handling of machine
CO 4: To enable students to understand the raw materials and product yield

The students should undergo an industrial training in any chemical, textile or pharmaceutical industry for a period of ten days. They have to prepare the report with the guidance of the course teacher. Necessary documents and the evidence are to be enclosed in the report. The report is to be submitted by the end of October. 75 marks will be given for the documentation of the report and 15 marks for the presentation and 10 marks for the viva voce.

CORE COURSE–XIII: PROJECT

(For those who joined from since 2018-19)

Semester: VI Hours/Week: 6
Subject Code: GPCHC61PW/ FBCHC611PW /FPCHC61PW Credits: 4

CO 1: To enable students to understand the basic concepts in Chemistry project
CO 2: To learn principles and procedures employed in thesis writing of Chemistry
CO 3: To develop practical skill
CO 4: To develop skills required in chemistry such as the proper handling of apparatus and chemicals

(75 Hours)

A Project work to be done by a group of five students either in the laboratory or in a chemical industry or in institutions like CECRI, Agricultural Research Station, Water testing centers, Pharmaceutical laboratories etc. The Project work should help the students to create research attitude and apply theory they have learnt throught out the course. Project internal is evaluated on the basis of presentation of the project such as, for review 15 marks, background knowledge 20 marks and 5marks for attendance. The external 60 marks is distributed as follows, for dissertation 35 marks, for presentation 15 marks and for viva- voce10 marks

CORE XIV - INORGANIC CHEMISTRY–III

(For those who joined from since 2018-19)

Semester: VI Hours/Week: 5
Subject Code: GBCHC62/ FBCHC621/FBCHC62 Credits: 4

CO 1: To enable students to understand the concept of co-ordination chemistry
CO 2: To acquaint the students with the importance and uses of inner transition elements
CO 3: To enable the students to develop an understanding of organometallic compounds and solids
CO 4: To understand the chemistry of bio-inorganic compounds and inorganic polymers

UNIT I **[15 Hours]**

Lanthanides and Actinides: Lanthanides – Position in the Periodic Table, General Characteristic of Lanthanides, Lanthanide Contraction and its Consequences, Isolation of Lanthanides from Monazite (including the Ion Exchange Resin Method)

Actinides – Position in the Periodic Table, General Characteristic of Actinides, Occurrence, Separation of Actinide, Synthesis of Trans uranium elements

Comparison of Lanthanides and Actinides, Comparison of d- and f- block elements

UNIT II **[15 Hours]**

Coordination Chemistry- I: Introduction – Definition and Terminology, Ligands, Monodentate and Polydentate Ligands, Coordination Number, Chelation, Nomenclature of Coordination Compounds, Structural & Stereo Isomerism, Werner's Co-Ordination Theory, Sidgwick's Electronic Concept, EAN Rule, Metal Carbonyl Complexes, Bonding in Carbonyls-Mono and Binuclear Carbonyls of Ni, Fe, Cr, Co and Mn–Hybridisation and Structure, VB theory, Shortcomings of Valence Bond theory.

UNIT III **[15 Hours]**

Coordination Chemistry- II: Crystal Field Theory – Crystal Field Splitting of Energy Levels, Crystal Field Splitting of Octahedral and Tetrahedral Complexes, Crystal Field Stabilization Energy, Crystal Field Splitting in Tetragonal and Square Planar Complexes, Factors Affecting the Magnitude of Crystal Field Splitting, Magnetic Properties of Complexes, Ligand Field Theory, Evidences of Covalent Bonding in Metal-Ligand Bonding, Molecular orbital theory of Complexes.

UNIT IV **[15 Hours]**

Bioinorganic Chemistry and Solids: Bioinorganic Chemistry – Essential and Trace Elements in Biological processes- Biological role of Haemoglobin, Myoglobin, Metalloprophyrins and Chlorophyll (Elementary idea of Structure and Mechanism of their Action), Biological Functions and Toxicity of Some Elements, Biological Fixation of Nitrogen

Solids – Band Theory of Conductors, Semiconductors and Insulators. Imperfections in a Crystal-Outline of Schottky Defects, Frenkel defects, Metal Excess and Metal Deficiency Defects and Line Defects. Nanomaterials – an Elementary Study

UNIT V **[15 Hours]**

Organometallic Compounds and Inorganic Polymers: Organometallic Compounds – Definition, Classification-Ionic, σ-bonded and π-bonded Organometallic compounds, Preparation, properties and uses of Organometallic compounds; Olefin Complexes-Synthesis and Structure of Zeisels salt; Cyclopentadienyl Complexes - Preparation, properties, structure and uses of Ferrocene

Inorganic Polymers – Introduction, Classification, Preparation of Borazine, Substituted Borazine, Poly-Phosphonitritic Chloride, Poly-Phosphoric acid, Borophosphate glasses, TetraSulphur Tetranitride, Trithiazyl trifluoride, Imides of Sulphur

Text Books:

1. R.D. Madan, **Sathya Prakash's Modern Inorganic Chemistry**, New Delhi: S.Chand and Company Private Limited, 3rd Edition, 2012. [Chapter 9]
2. Wahid.U. Malik, G.D. Tuli, & R.D. Madam, **Selected Topics in Inorganic Chemistry**, S.Chand & Company Ltd., New Delhi, 1st Edition, 2007. [Chapter 8, 9, 10, 11 & 12]

Reference Books:

3. P.L. Soni, & Mohan Katyal, **Text Book of Inorganic Chemistry**, Sultan Chand & Sons, New Delhi, 2006.
4. B.R. Puri, L.R. Sharma & K.C. Kalia, **Principle of Inorganic Chemistry,** Milestone Publishers & Distributors, New Delhi, 2013.
5. R. Gopalan & V. Ramalingam, **Concise Coordination Chemistry,** New Delhi, Vikas Publishing House Pvt. Ltd., 2001.
6. Sathya Prakash, G.D. Tuli, S.K. Basu & R.D. Madan, **Advanced Inorganic Chemistry (Volume 1),** New Delhi, S. Chand & Company Ltd., 1997.
7. R. Methrotra & A. Singh, **Organometallic Chemistry,** New Delhi, New Age International Pvt. Ltd. Publishers, 2003.
8. Gary Wulfsberg, **Inorganic Chemistry,** New Delhi, Viva Books Private Limited, 2002.
9. K.N. Upadhyaya, **Modern Aspects of Inorganic Chemistry,** New Delhi, Sanjay Printers, 2003.
10. F. Albert Cotton, Geoffrey Wilkinson, A. Murillo Carlos & Manfred Bochmann, **Advanced Inorganic Chemistry**, A Wiley Interscience Publications, Newyork, 1999.
11. B.R. Puri, L.R. Sharma & K.C. Kalia, **Principle of Inorganic Chemistry,** Vallabh Publications, New Delhi, 2006.
12. James E. Huheey, Ellen A. Keiter, L. Keiter Richard & Okhil K. Medhi, **Inorganic Chemistry,** Dorling Kindersely Pvt. Ltd., South Asia, 2006.
13. G.S. Manku, **Theoretical Principle of Inorganic Chemistry,** Tata MCGraw Hill Publishing Company Limited, New Delhi, 1996.

CORE XV - PHYSICAL CHEMISTRY–III

(For those who joined from since 2018-19)

Semester: VI **Hours/Week: 5**
Subject Code: GBCHC63/FBCHC631/FBCHC64 **Credits: 4**

CO 1: To gain knowledge about electrochemistry
CO 2: To gain knowledge about of photochemistry
CO 3: To widen knowledge about spectroscopy
CO 4: To widen knowledge about colloidal state

UNIT I **[15 Hours]**

Photochemistry: Photochemistry – Interaction of Radiation with Matter, Differences between Thermal and Photochemical processes, Laws of Photochemistry – Grothus-Draper Law, Stark-Einstein Law; Jablonski Diagram Depicting Various Processes Occurring in the Excited State (Internal Conversion, Intersystem Crossing) Qualitative Description of Fluorescence, Phosphorescence, Chemiluminescence, Quantum Yield, Photosensitized Reactions. Kinetics of Photochemical Combinations - H_2-Cl_2 and H_2-Br_2 reactions

UNIT II **[15 Hours]**

Electrochemistry – II: Electromotive Force, Electrolytic and Galvanic Cells, Daniel Cell, Standard Weston Cadmium Cell, Reversible and Irreversible Cells, Conventional Representation of Electrochemical Cells, EMF of a Cell and its measurement, Computation of Cell EMF, Nernst Equation, Types of Reversible electrodes –Single Electrode Potential, Standard Hydrogen Electrode, Reference Electrodes and Standard Electrode Potential; Fuel Cells (H_2-O_2 Cell), Lead Storage Battery

Statistical Thermodynamics– Postulates of Macroscopic Thermodynamics, Maxwell's Derivation of the Molecular, Velocity Distribution, Maxwell-Boltzmann Statistics

UNIT III **[15 Hours]**

The Colloidal State: Introduction, Classification of Colloidal Solutions, Characteristics of Hydrophilic and Hydrophobic Sols, Preparation of Colloidal Solution, Lyophilic & Lyophobic Solution, Preparation methods, Condensation Methods such as by Double Decomposition, Hydrolysis, Reduction, Oxidation, Exchange of Solvent, Controlled Condensation, Change of Physical State in Short, Dispersion Methods such as Bredig's Method, by Grinding, Peptization in Short, Purification of Colloidal Solution – Dialysis, Ultrafiltration, Ultra centrifuging, Properties of Colloidal Solutions, Optical Properties such as Tyndall Effect, Brownian Effect, Color, Electrical Properties such as Electrical Charge, Electrical double layer & Zeta Potential, Cataphoresis, Electro-Osmosis. The Protective Colloid (Gold Number), Application of Colloidal State in Short

UNIT IV **[15 Hours]**

Spectroscopy-I: Introduction– Electromagnetic Radiation, Different Regions, Absorption spectroscopy, Molecular spectra, Types of Molecular Spectra

IR Spectroscopy – Principle, Molecular Vibrations, Finger-Print Region, Applications of IR Spectroscopy (Qualitative & Quantitative Analysis and Determination of Molecular weight), Interpretation of IR Spectra

UV Spectroscopy – Introduction, Origin of Electronic Spectra, Laws of Absorbance. Types of Electronic Transitions, Chromophores and Auxochromes, Effect of Conjugation, Applications of UV Spectroscopy (Qualitative & Quantitative Analysis and Measurement of Beer-Lamberts Law), Woodward-Fieser rules

UNIT V **[15 Hours]**

Spectroscopy-II: Raman Spectra – Raman Effect, Stokes and Anti Stokes Lines, Basic ideas of IR and Raman spectra

Electronic spectra – Franck – Condon Principle

NMR Spectroscopy – Introduction, Spinning of Proton in a Magnetic field, Various aspects of NMR Spectrum, Position of Signals and Chemical Shift, Factors Affecting Chemical Shift, Number of Peaks in the NMR Spectra, Equivalent and Non-Equivalent Protons, Peak Area and Proton Counting, Splitting of Signals, Interpretation of the NMR Spectrum of Ethanol, Acetaldehyde

Text Book:

1. B.R. Puri, L.R. Sharma, & S. Pathania, **Principles of Physical Chemistry,** Vishal Publishing Co., New Delhi, 2005. [Chapter 6, 7, 28 & 29]

Reference Books:

2. L.R., Sharma, B.R., Puri & Madan S. Pathania, **Elements of Physical Chemistry,** Vishal Publishing Co., New Delhi, 2014.

3. B.S. Bahl, G.D. Tuli & Arun Bahl, **Essentials of Physical Chemistry,** S.Chand & Company Ltd., New Delhi, 12th Edition, 2011.
4. P.L. Soni, **Text Book of Physical Chemistry**, New Delhi, Sultan Chand & Co., 2014.
5. S.H. Maron & J.B. Lando, **Fundamentals of Physical Chemistry,** New Delhi, Macmillan Limited, 1966.
6. Peter Atkins & Julio de Paula, **Atkins Physical Chemistry**, Oxford University Press, YMCA Library Building, New Delhi, 2006.
7. K.L. Kapoor, **A Text Book of Physical Chemistry (Volume 3),** Macmillan Indian Limited, Madras, 1994.
8. Samuel Glasstone, **Text Book of Physical Chemistry,** S.G. Wasani for Macmillan Indian Limited, Madras, 1986.
9. Ira. N. Levine, **Physical Chemistry,** New Delhi, Tata McGraw Hill Publishing Company Limited, 2002.
10. B.R. Puri, L.R. Sharma, & Madan S. Pathania, **Principles of Physical Chemistry**, New Delhi, Vishal Publishing, Co., 1962.
11. J.O.M. Bockris & A.K.N. Reddy, **Electrochemistry,** New York, Plenum, 1977.
12. C.M.A. Brett & A.M.O. Brett, **Electrochemistry, Principles, Methods and Application,** OUP, Oxford, New Delhi, **1993**.
13. C.N. Banwell, & E.M. McCash, **Molecular Spectroscopy,** Tata McGraw Hill, New Delhi, 1995.
14. Robert. M. Silverstein, **Spectrometric Identification of Organic Compounds,** Francis Webster, John Wiley &Sons Inc., 2004.

CORE XIV - INDUSTRIAL CHEMISTRY AND INORGANIC PREPARATION

(For those who joined from since 2018-19)

Semester: VI **Hours/Week: 4**
Subject Code: GBCHC64P /FBCHC641P **Credits: 4**

CO 1: To learn principles and procedures employed in industrial and inorganic preparation
CO 2: To develop skills required in chemistry such as the proper handling of apparatus and chemicals
CO 3: To learn principles and procedures employed in inorganic preparation
CO 4: To widen knowledge about chromatography and electrochemical systems

PART –I

Industrial Chemistry **(30 Hours)**

1. Determination of pH of the soil by pH meter.
2. Corrosion experiment (Weight loss method)
3. Analysis of Electrochemical Systems
    - Copper Electroplating
    - Nickel Electroplating
4. Paper Chromatography
    - Chromatographic separation of a mixture of Cobalt, Manganese, Nickel and Zinc.
    - Chromatographic separation of mixtures of dyes.
5. Column Chromatography

- Separation of a mixture of ortho- and para- nitro aniline.
- Separation of potassium permanganate and dichromate.
- Separation of dyes.

6. Thin Layer chromatography
    - Preparation of the TLC plates – Checking the purity of the compounds by TLC –Acetylation of salicylic acid, aniline, Benzoylation of aniline and phenol, Determination of Rf. Values and identification of organic compounds by TLC, preparation and separation of 2, 4 –dinitrophenyl hydrazones of acetone and 2- butanone using toluene and light petroleum (40 :60).
7. Separation of components of a binary mixture
    - Separation of Benzoic acid and Naphthalene/Toluene.
    - Separation of Aniline / Phenol/ 2-Naphthol and Toluene.
8. Extraction of Natural products
    - Isolation of caffeine from Tea
    - Isolation of Lactose from milk
    - Isolation of Citric acid from Lemon

PART –II

Preparation of Inorganic compounds: (30 hours)

1. Tetraammine Copper II sulphate
2. Tris (thiourea) Copper I chloride
3. Potassium trioxalato ferrate II
4. Ferrous ammonium sulphate
5. Microcosmic salt
6. Manganous sulphate
7. $[Ni(NH_3)_6]SO_4$
8. $CoCl_3.4NH_3$
9. Sodium trioxalato ferrate
10. $Co[Hg(SCN)_4]$

Reference Books:

1. N.S. Gnanapragasam, & G. Ramamurthy, **Organic Chemistry Lab Manual,** New Delhi, Viswanathan Publishers Pvt. Ltd., 2010.
2. A.O. Thomas, **Practical Chemistry for B.Sc. Main Students**, Scientific Book Centre, Kerala, 1995.
3. B. Viswanathan & P.S. Raghavan, **Practical Physical Chemistry**, Viva Book Private Limited, New Delhi, 2014.
4. V. Venkateswaran, R. Veeraswamy & A. R. Kulandaivelu, **Basic Principles of Practical Chemistry**, Sulthan Chand & Sons Publications, New Delhi, 1999.
5. G. Suehla, **Vogel's Qualitative Inorganic Analysis,** Dorling Kindersely PVT. Ltd., South Asia, 2011.
6. J. Bassett, **Text Book of Quantitative Chemical Analysis,** Longmann, U.K., 1989.

7. V.V. Ramanujam, **Inorganic Semi micro Qualitative Analysis,** The National Publishing Co., Chennai, 1974.
8. A.I. Vogel, **Text Book of Practical Organic Chemistry,** London, ELBS, 2010.
9. J. J. Meketta, **Cathodic Protection Theory and practice,** Marcel Dekker Publication, New York, 1993.

ELECTIVE III (A) - INTRODUCTION TO GREEN CHEMISTRY & NANOCHEMISTRY

(For those who joined from since 2018-19)

Semester: VI **Hours/Week: 5**
Subject Code: GBCHE6A /FBCHE61A/ FBCHE6A **Credits: 5**

CO 1: To understand how complex natural products are assembled in the laboratory through synthetic organic chemistry
CO 2: To widen knowledge about chemistry of carbohydrates and aminoacids
CO 3: To acquire knowledge of chemistry of proteins, terpenes, and alkaloids
CO 4: To know the basics of green Chemistry and its developments
CO 5: To know the basic ideas of nano Chemistry
CO 6: To learn the instrumental techniques used in characterization of nanomaterials

UNIT I **[15 Hours]**

Introduction to Green Chemistry: Introduction, Basic Principles of Green Chemistry with Explanation and Examples, Green Chemistry in Day to Day Life, Dry Cleaning of Clothes, Versatile Bleaching Agent

UNIT II **[15 Hours]**

Synthesis and Reactions involving Basic Principles of Green Chemistry: Introduction, Green Synthesis of the Following Compounds Advantages Over the Conventional Methods – Styrene, Adipic Acid, Urethane, 4-Aminodiphenylamine and Acetaldehyde, Alkylation of Active Methylene Group, Free Radical Bromination of Toluene, Preparation of Furfural from Biomass, Synthesis of Paracetamol and Citral, Use of Molting Accelerators in Place of Insecticides, Environmentally Safe Marine Antifoulant

UNIT III **[15 Hours]**

Green Reagent and Green Catalysts: Green Reagent– Dimethyl Carbonate for Methylation of Active Methylene Compounds, Green Catalysts– Definition of Titanium Silicate as Catalyst for Hydroxylation of Phenol, Microencapsulated Scandium Ttrifluoro Methane Sulphonate as Catalyst for Friedel Crafts Acylation, Phase Transfer Catalyst –Application of PTC in Synthesis of Nitrile from Alkyl or Acyl Halides, Oxidation of H_2O_2 under PTC Condition, Saponification by Crown Ethers, Aqueous Phase Reactions – Aldol Condensation, Benzoin Condensation, Strecker Synthesis – Organic Synthesis in Solid State, Claisen Rearrangement of Allyl Phenyl Ether to O-Allylphenol, Aldol Condensation of Lithium Ennolate of Methyl, 3,3-Dimethyl Butonate, Grignard Reaction of Ketone (Benzophenone) (understanding the concepts with the help of reactions specified is only needed)

UNIT IV **[15 Hours]**

Nano Particles Synthesis and Characterization: Introduction, General Method of Synthesis– Top Down Method, Bottom Up Method, Chemical Synthesis - Reduction of

Metal Atoms, Thermal Decomposition Methods, Photolysis, Radiolysis, Laser Vaporization etc., General Properties of Nanoparticles, Methods of Characterizing Nanoparticle: SEM, TEM, STEM, Scanning Probe Microscope, Scanning Tunneling Microscope (STM) and Atomic Force Microscope (AFM)

UNIT V [15 Hours]

Certain Class of Nanoparticles and their Application: Synthesis, Purification, Properties and Application of Fullerenes, Carbon Nan tubes, Au and Ag Nan particles; Sensors –Chemical Sensors, Biosensors and Optical Sensors– Synthesis, Characterization and their Use; Application of Nan particles– Biology and medicine, Core-Shell Nan particles, Catalysis, Sensing, Chemical Reactivity, Targeted Drug, Delivery etc, Particle Size Analysis and Surface Area Measurements of Nanoparticles

Text Books:

1. V. K. Ahluwalia, **Introduction to Green Chemistry,** Manish Sejwal for Anamaya Publishers, New Delhi, 2004. [Chapter 1, 3, 4, 6, 7, 8, 13 & 15]
2. A. Ravikrishnan, **Engineering Chemistry**, Sir Krishna Hitech publishing Company Pvt. Ltd., Chennai, 13th Edition, 2012. [Chapter 9]

Reference Books:

3. V.K. Ahluwalia, **Green Chemistry,** Narosa Publishers, New Delhi, 2011.
4. S. Shanmugam, **Nanotechnology,** MJP Publishers, Chennai, 2010.
5. V. Kumar, **An Introduction to Green Chemistry,** Vishal Publishing Co., Jalandhar, 2007.
6. V.C.N.R. Rao, A. Muller, & A.K. Cheetham, **The Chemistry of Nano Materials – Synthesis, Properties and Application,** WileyVCH Verlag Gmoh & co., New Delhi, 2004.
7. Robert W. Kelsall, IanW. Hanley & Mark Geoghegan, **Nano Scale Science and Technology,** John Wiley & Sons Ltd., USA, 2005.
8. R.S. Sanghi & M.M. Srinivatava, **Green Chemistry: Environmental Friendly Alternatives,** Narosa Publishing House, New Delhi.
9. Patrick Salomon, **A Handbook on Nanochemistry**, Dominant Publishers and Distributers. New Delhi.
10. S. Balaji, **Nano biotechnology,** Chennai, MJP Publishers, 2010.

ELECTIVE III (B) – POLYMER CHEMISTRY

(For those who joined from since 2018-19)

Semester: VI Hours/Week: 5

Subject Code: GBCHE6B / FBCHE61B/FBCHE6B Credits: 5

CO 1: To know about the types of polymers
CO 2: To acquire knowledge of polymerization techniques
CO 3: To know the basic ideas of commercial polymers
CO 4: Acquire knowledge of polymers and their applications
CO 5: To widen knowledge about rubber, polymer additive and polymer processing
CO 6: To widen knowledge about conducting and biodegradable polymer

UNIT I [15 Hours]

Introduction to Polymers: Definiton and Basic Terminology – Monomers, Polymers, Plastics,

Elastomers, Fibres and Resins
Classification of Polymers– Classification Based on Composition - Homo and Co-Polymers, Classification Based on Physical Properties - Thermoplastic and Thermosetting, Difference Between Thermoplastic and Thermosetting Polymers, Classification Based on Reaction Mode of Polymerization, Addition and Condensation Polymers, Difference between Addition and Condensation Polymers
Molecular Weight of Polymers – Number Average Method, Weight Average Method; Glass Transition Temperature, Characteristics of Polymers

UNIT II [15 Hours]

Mechanism of Polymers and Rubber: Addition Polymerisation – Mechanism of Free Radical Addition Polymerisation, Ionic Polymerisation, Anionic Polymerisation and Cationic polymerisation, Co-Polymerisation, Coordination polymerization, Ziegler Natta Catalysis and Mechanism
Rubber –Natural and Synthetic Rubbers, Isoprene Rule, Preparation and Uses of Butyl Rubber, Buna-S, Buna-N, Neoprene, Thiocol, Polyurethane and Silicon rubbers, Compounding of Rubber-Reclaim Rubber, Spongy Rubber and Foam Rubber, Vulcanization process

UNIT III [15 Hours]

Polymer Additives and Polymer Processing: Polymer Additives – Definition and Examples - Fillers, Reinforcements, Anti-Oxidants and Thermal Stabilizers, UV Stabilizers and Absorbers, Fire Retardants, Colourants, Curing agents
Polymer Processing – Bulk Polymerisation, Solution Polymerisation, Suspension Polymerisation and Emulsion Polymerisation

UNIT IV [15 Hours]

Manufacture and Application of Selected Industrial Polymer: Plastics and Resins – Definition, Thermoplastics and Thermosetting Resins, Constituents of Plastics, Fillers, Dye, Pigment, Plasticizers, Lubricants and Catalysts; Preparation and Uses of Polyethylene, PTFE, PVC, PVA, Polypropylene and Polystyrene, Polyamides - Preparation and Uses of Nylon - 6 and Nylon – 6, 6, Polyesters- Preparation and Uses of Terylene and Viscose Rayon

UNIT V [15 Hours]

Conducting Polymers and Biodegradable Polymers: Introduction, Conductivity, Reason for Conductivity, Uses of Conducting Polymers, Process of Doping, Potential Application of Conductivity Polymers, Uses of Conducting Polymers

Biodegradable Polymers, Composition of Biodegradable Plastics, Starch Based Plastics, Bacteria Based Plastics, Soy-Based Plastics, Application of Biodegradable Polymers on Various Fields

Text Books:

1. G.S. Misra, **Introductory Polymer Chemistry,** New Age International (P) Limited Publishers, New Delhi, 2008. [Chapter 1, 2, 3, 4, 6,8,11& 12]
2. V.R. Gowariker, N.V. Viswanathan, & Jayadev Sreedhar, Polymer **Science,** New age International Publishers, New Delhi, 2009. [Chapter 3, 9, 10 & 15]

Reference Books:

3. Joel R. Fried, **Polymer Science & Technology,** Pearson Education Pvt. Ltd., India, 2005.

4. P. Bhadur & N.V. Sastry, **Principles of Polymer Science,** Narosa Publishing House, New Delhi, 2005.
5. Joel R. Fried, **Polymer Science & Technology,** Pearson Education Pvt. Ltd., India, 2005.
6. P. Bhadur & N.V. Sastry, **Principles of Polymer Science,** Narosa Publishing House, New Delhi, 2005.
7. Goel R. Fried, **Polymer Science and Technology, New** Delhi, Prentice-Hall of India. 2003.
8. Premamoy Ghosh, **Polymer Science and Technology of Plastics and Rubbers,** New Delhi, Tata McGraw-Hill Publishing Company Ltd., 2009.
9. Fred W. Billmeyer, **Text Book of Polymer Science,** JR. John Wiley Publishers, New Delhi, 2003.
10. R.B. Seymour, **Introduction to Polymer Chemistry,** New York, MC Craw Hill, 1971.
11. S.S. Dara, **A Text Book in Engineering Chemistry,** New Delhi, S. Chand & Company Ltd., 1992.

SKILL BASED ELECTIVE–VI: PRACTICAL INDUSTRIAL CHEMISTRY

(For those who joined from since 2018-19)

Semester: VI **Hours/Week: 3**
Subject Code: GBCHE65P/FBCHE651P/FBCHE66P **Credits: 2**

CO 1: Be acquainted with current development in the field of Industrial Chemistry
CO 2: To acquire knowledge of energy sources and significance of renewable sources of energy
CO 3: To learn about various industrial processes and appreciate the chemistry behind them
CO 4: To develop skill in testing and analyzing organic compounds

A Practical Course on the preparation of the following Industrial Products in the Cottage Industry level.

(30 Hours)

1. Determination of alkalinity in water samples
2. Separation of essential oils by soxhlet extractor
3. Testing of turmeric powder, milk and mustard oil for adulterants
4. Estimation of glucose in food samples
5. Extraction of natural colouring and flavouring agent from flowers and fruits
6. Estimation of available Oxygen in Hydrogen Peroxide
7. Preparation of Soap
8. Analysis of Cement
9. Preparation of Pigment (zinc oxide)
10. Estimation of Amino acid (Alanine)

Reference Books:

1. O.P. Pandey, D.N. Bajpal & S. Giri, **Practical Chemistry,** S. Chand and Company Ltd., New Delhi, 2006.
2. V. Venkateswaran, R. Veeraswamy, & A. R. Kulandaivelu, **Basic Principles of Practical Chemistry,** Sultan Chand and Sons, New Delhi, 2012.
3. P.C. Jain, **Engineering Chemistry,** Dhanpat Rai Publishing Company Ltd., New Delhi, 2010.

4. S. S. Dara, & S. S. Umare, ***A* Text Book of Engineering Chemistry,** S. Chand & Company Ltd., New Delhi, 2013.
5. O. P. Vermani & A. K. Narula, **Industrial Chemistry,** Galgotia Publications, Pvt. Ltd., New Delhi.
6. V. Veeraiyan and L. Devaraj Stephen, **Engineering Chemistry Laboratory,** VRB Publishers Pvt. Ltd., Chennai, 2013-2014.
7. A. Ravikrishnan, **Engineering Chemistry Laboratory,** Sri Krishna Hi-tech Publishing Company Pvt. Ltd., Chennai, 2013-2014.

ALLIED FOR B. Sc HOME SCIENCE: BASIC CHEMISTRY

(For those who joined from since 2018-19)

Semester: I **Hours/Week: 6**
Subject Code: GBNDA13/FBNDA13/EBNDA13 **Credits: 5**

CO 1: To understand the chemistry of oils, fats, food additives, water and ozone applications
CO 2: To acquire knowledge of coal and commerical cells applications
CO 3: To widen knowledge about petroleum, petrochemical industry, H_2O_2 and carbohydrates applications
CO 4: To know the basics of vitamins and dyes applications
CO 5: To gain knowledge about of lubricants and cements applications
CO 6: To enable students to understand the corrosion related problems and applications

UNIT I **[18 Hours]**

Oils, Fats and Food Additives: Oils and Fats –Classification of Oils, Fat Splitting, Distillation of Completely Miscible and Non Miscible Oils, Hydrogenation of Oils, Rancidity, Saponification Value, Iodine number, Acid Value

Soap and Synthetic Detergent– Preparation of Soap and Detergent, Different types of Soap and their Composition, Surfactants (LAS, ABS, LABS), Detergent binders and builders

Food additives – A general study of Food Flavours, Colours and Preservatives, Artificial Sweetners

UNIT II **[18 Hours]**

Water, Ozone and H_2O_2: Water –Types of Water, Types of Hardness, Removal of Hardness by Reverse Osmosis and Ion Exchange Method, Estimation of Hardness by EDTA Method, Degrees of hardness

Ozone –Manufacture, Composition, Structure and Properties & Uses

H_2O_2 – Manufacture, Structure and Uses of Hydrogen Peroxide, Estimation of Hydrogen Peroxide by Permanganometry

UNIT III **[18 Hours]**

Coal, Commerical cells, Peteroleum and Peterochemical Industry: Coal –Uses of Coal (Fuel and non-Fuel) in Various Industries and its Composition, Carbonization of Coal, Coal gas, Producer gas and Water gas - Composition and Uses, Fractionation of Coal Tar, Uses of Coal Tar bases chemicals, Requisites of a good Metallurgical Coke

Petroleum and Petrochemical Industry: Composition of Crude Petroleum, Refining and Different Types of Petroleum Products and their Applications

Commercial Cells – Primary and Secondary Cells, Weston Cadmium Cell, Lead Storage Cell

UNIT IV **[18 Hours]**

Carbohydrates, Vitamins and Dyes: Carbohydrates – Classification and Examples of Carbohydrates, Structure of Glucose, Fructose, Sucrose (Structure only)

Vitamins – Definition, Classification, Sources, Deficiency Diseases of Vitamins

Dyes – Definition, Theory of Colour and Constitution, Classification of Dyes, Preparation of Methyl Orange, Congo Red and Malachite Green, Crystal Violet, Phenolphthalein, Fluorescein, Eosin and Indigo

UNIT V **[18 Hours]**

Lubricants, Cements and Corrosion: Lubricants –Classification of Lubricants, Lubricating Oils (Conducting and Non-Conducting) Solid and Semisolid Lubricants, Synthetic Lubricants

Glass – Glassy State and its Properties, Classification (Silicate and Non Silicate Glasses), Manufacture and Processing of Glass

Cements – Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements

Corrosion and Passivity – Rusting of Iron, Preventive Methods from Rusting, Cathodic Protection, Galvanization, Use of Inhibitors

Text Books:

1. H.K. Chopra, & P.S. Panesar, **Food Chemistry,** Narosa Publishing House, New Delhi, 2010. [Chapter 3, 4, 7 & 8]
2. B.K. Sharma, **Industrial Chemistry**, Goel publishing, New Delhi, 15thEdition, 2006.[Chapter 1, 4, 15 & 23]

Reference Books:

3. P.C. Jain, **Engineering Chemistry,** New Delhi: Dhanpat Rai Publishing Company Ltd, 2010.
4. S.S. Dara, & S.S. Umare, **A Text Book of Engineering Chemistry,** S. Chand & Company Ltd., New Delhi, 2013.
5. W. D. Kingery, H. K. Bowen & D. R. Uhlmann, **Introduction to Ceramics,** Wiley Publishers, New Delhi.
6. J. A. Kent, **Riegel's Handbook of Industrial Chemistry,** CBS Publishers, New Delhi.
7. P.L. Soni and H.M. Chalwa, **Text book of Organic Chemistry**, Sultan Chand & Sons, New Delhi, 2006.
8. Sathya Prakash, G.D. Tuli, S.K. Basu, & R.D. Madan**, Advanced Inorganic Chemistry (Volume 1),** New Delhi, S. Chand & Company Ltd., 1997.
9. R.D. Madan, **Modern Inorganic Chemistry,** S. Chand & Company Private Limited, New Delhi, 1987.

NON -MAJOR ELECTIVE PAPERS OFFERED FOR STUDENTS OTHER THAN B.Sc CHEMISTRY

(For those who joined from since 2018-19)

Sem	Subject Code	Subject Title	Hrs/wk	Credit	ESE	Total
III	GBNM3CH	Chemistry in Every Day Life	4	2	50	50
IV	GBNM4CH	Chemistry in the Service of Mankind	4	2	50	50

CHEMISTRY IN EVERY DAY LIFE

(For those who joined from since 2018-19)

Semester: III **Hours/Week: 4**
Subject Code: GBNM3CH **Credits: 2**

CO 1: To know the basics of chemistry in our life
CO 2: To know about the general Survey of chemicals used in everyday life
CO 3: To know about the cosmetics, perfumes, drugs etc.
CO 4: To know the basics of Indian Medicinal plants and First Aid and safety

UNIT I **[12 Hours]**

Cosmetics and Perfumes: A general study including preparation and uses of the following: Hair dye, Hair spray, Shampoo, Sun-tan lotions, Face powder, Lipsticks, Talcum powder, Nail enamel, Creams (Cold, Vanishing and Shaving creams), Antiperspirants and Artificial Flavours; Essential oils and their importance in Cosmetic Industries with reference to Eugenol, Geraniol, Sandal wood Oil, Eucalyptus, Rose Oil, Jasmone, Civetone, Muscone

UNIT II **[12 Hours]**

Basic Concepts of Surface Coatings: Objectives of Coatings Surfaces, Preliminary Treatment of Surface, Classification of Surface Coatings; Paints and Pigments – Formulation, Composition and Related Properties, Oil Paint, Vehicle, Modified Oils, Toners and Lakes Pigments, Fillers, Thinners, Enamels, Emulsifying Agents; Special Paints (Heat Retardant, Fire Retardant, Eco-friendly Paint, Plastic Paint), Dyes, Wax Polishing, Water and Oil Paints, Additives, Metallic Coatings (Electrolytic and Electroless)

UNIT III **[12 Hours]**

Coal, Petroleum and Petrochemical Industry: Coal – Uses of Coal (Fuel and Non-Fuel) in Various Industries, its Composition and Carbonization of Coal; Coal Gas, Producer Gas and Water Gas – Composition and Uses

Petroleum and Petrochemical Industry – Composition of Crude Petroleum, Refining and Different Types of Petroleum Products and their Applications

Unit IV **[12 Hours]**

Drugs and Pharmaceuticals: Definition and application of the Representative Drugs of the following Classes – Analgesics Agents, Antipyretic Agents, Anti-Inflammatory Agents (Aspirin, Paracetamol, Ibuprofen); Antibiotics (Chloramphenicol); Antibacterial and Antifungal agents (Sulphonamides, Sulphacetamide); Antiviral agents (Acyclovir), Central Nervous System Agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl Trinitrate), Antilaprosy (Dapsone), HIV-AIDS Related Drugs (AZT- Zidovudine)

UNIT V **[12 Hours]**

Indian Medicinal Plants, First Aid and Safety: Indian Medicinal Plants **–** Palak, Vallarai, Kizhanelli, Thumbai, Hibiscus, Adadodai, Thoothuvalai, Nochi, Thulasi, Aloe Vera, Neem and Omavalli - Chemical Constituents and Medicinal Uses (Structures are not required)

First Aid and Safety **–** Treatment of Shock, Haemorrage, Cuts and Wounds; Burns – Classification and First Aid; Asbestos, Lead Paints, Cement, Welding Fumes and Gases – Hazard Alert and Precautions for Safety

Text Books:

1. Jayashree Ghosh, **Fundamental Concepts of Applied Chemistry,** S. Chand and Company Limited, New Delhi, 2006. [Chapter 10 & 19]
2. B.K. Sharma, **Industrial Chemistry**, Goel publishing, New Delhi, 15th Edition, 2006. [Chapter 5 & 53]

Reference Books:

3. P.C. Jain, and Monica Jain, **Engineering Chemistry**, Dhanpat Rai Publishing Company Ltd., New Delhi, 15th Edition, 2010.
4. S.C. Rastogi, **Biochemistry,** Tata McGraw Hill Publishing Co., New Delhi, 1993.
5. Rasheeduz Zafar, **Medicinal Plants of India,** CBs Publishers and Distributors, New Delhi, 2000.
6. B.L. Oser & Hawk's, **Physiological Chemistry**, Tata-McGraw - Hill Publishing Co. Ltd., New Delhi,
7. A.H. Beckett, & J.B. Stenlake, **Practical Pharmaceutical Chemistry,** New Delhi, CBS Publishers and Distributors, 2000.

CHEMISTRY IN THE SERVICE OF MANKIND

(For those who joined from since 2018-19)

Semester: IV **Hours/Week: 4**
Subject Code: GBNM4CH **Credits: 2**

CO 1: To know the basics of chemistry in our life
CO 2: To know about the food colours, Plastics, drugs etc
CO 3: Acquire knowledge of food and nutrition
CO 4: To gain knowledge about of soap, detergent and green chemistry

UNIT I **[12 Hours]**

Food and Nutrition: Food and Nutrition – Carbohydrates, Proteins, Fats, Minerals and Vitamins, Definitions, Sources and their Physiological Importance - Balanced Diet; Adulterants in Milk, Ghee, Oil, Coffee Powder, Tea, Asafoetida, Chilli Powder, Pulses and Turmeric Powder – Identification; Colour Chemicals used in Food - Soft Drinks and its Health Hazards; Food Preservatives – Definition, Examples, Advantage and Disadvantage of preservation and green Fertilizers.

UNIT II **[12 Hours]**

Chemistry of Important Commercial Polymers: Definition, Classification of Polymers, Polyethylene, PVC, Polyamides, Polyesters, Bakelite, Phenolic Resins, Epoxy Resins and their Applications (Preparation is not required). Natural Rubber, Synthetic rubbers, Vulcanization – Definition and its Applications; Silicon Rubber, Biomedical Polymer – Contact Lens, Dental Polymers and Artificial Heart

UNIT III **[12 Hours]**

Soaps and Detergents and Green Chemistry: Manufacture of Soaps, Formulation of Toilet soaps, Different Ingradients Used – Soft Soaps, Shaving Soaps and Creams; Anionc Detergents –Manufacture and Applications; Cationic Detergents – Manufacture and Applications

Introduction to Green Chemistry – Need for Green Chemistry, Goals of Green Chemistry, Limitations/Obstacles in the pursuit of the goals of Green Chemistry

UNIT IV **[12 Hours]**

Diseases and Treatment–I: Common diseases, Causes and Treatment of Some Common Diseases – Insect Borne Diseases, Air Borne Diseases, Water Borne Diseases, Digestive Disorders, Respiratory Disorder, Nervous Disorder and Other Diseases, Important Indian Medicinal Plants and their Uses – Cardiovascular Drugs, Anti-Hypertensive Drugs, Anti-Anginal Drugs, Sulpha Drugs

UNIT V **[12 Hours]**

Diseases and Treatment– II: Cancer – Causes, Spread and Treatment, Dosage and Effects of Chlorambusil, Methotrexate (Preparation and Structure elucidation is not requied); Diabetes – Control, Dosage and Uses of Barbiturates, Hydantoin and Succinimides (Preparation and Structure elucidation is not requied); Antibiotics – Classification, Properties and Uses of Penicillin, Streptomycin, Erythromycin, Tetracycline and antihistamine(Preparation and Structure elucidation is not required).

Text Books:

1) John M. Deman, **Principles of Food Chemistry,** Springer Publisher, New Delhi, 3th Edition, 2007. [Chapter 1,2,3, 4, 5, 6 & 9]
2) Jeyashree Gosh, **Text Book of Pharmaceutical Chemistry**, S. Chand and company, New Delhi, 2008. [Chapter 6]

Reference books:

3) David Plummer**. Practical Biochemistry,** Tata McGraw-Hills Publishing Company, New Delhi, 2005.
4) G.R. Chatwal, **Medicinal Chemistry,** Himalaya Publishing House, New Delhi, 2002.
5) R.S. Khandpur, **Handbook of Biomedical Instrumentation 2ED,** Tata McGraw – Hill Publishing Company, New Delhi.
6) Leslie Cromewell, F.J. Weilbell and E.A. Pfeiffer, **Biomedical Instrumentation and Measurements,** Prentice Hall of India, New Delhi.
7) C. Raja Rao & S.K. Guha, **Principles of Medical Electronics and Biomedical Instrumentation,** New Delhi, Orient Longmann, 2005.
8) B. Srilakshmi, **Food Science,** New Age International Publishers, New Delhi, 2005.
9) Lillian Hoagland Meyer, **Food Chemistry,** New Delhi, CBS publishes & distributors, 2004.
10) Jayashree Ghosh, **Fundamental concepts of Applied Chemistry,** S. Chand & Co. Ltd., New Delhi.
11) G.S. Misra, **Introductory Polymer Chemistry,** New Age International (P) Limited Publishers, New Delhi, 2008.
12) Joel R. Fried, **Polymer Science & Technology,** Pearson Education Pvt. Ltd., India, 2005.
13) P. Bhadur & N.V. Sastry, **Principles of Polymer Science,** New Delhi, Narosa Publishing House, 2005.
14) P.C. Jain, & Monica Jain, **Engineering Chemistry**, Dhanphatrai and Sons, New Delhi, 2006.
15) Shrive, George and T. Austin, **Chemical Process Industries**, New Delhi, McGraw Hill Book Co., 1984.

CERTIFICATE PROGRAMME IN WASTE WATER TREATMENT

(For those who joined from since 2018-19)

S.No	Subject Code	Subject	Total contact hours	credits	ESE	Total
1.	GCWW1	Chemistry of Water	30	5	100	100
2.	GCWW2P	Industrial Waste Water Treatment Practical (LAB)	50	5	100	100
	Total		80	10	200	200

CHEMISTRY OF WATER

(For those who joined from since 2018-19)

Subject Code: GCWW1 **Hours/Week: 2**

CO 1: To know the basics of water Chemistry and its developments
CO 2: To know the basic ideas of water Chemistry
CO 3: Acquire knowledge of purification of water
CO 4: To gain knowledge about of boiler feed water and boiler corrosion

UNIT I **[6 Hours]**

Introduction to Water: Characteristics of Water, Uses of Water, Sources of Water, Quality of Natural Water, Main Quality Characteristics of Water, Effects of Water on Rocks and Minerals, Chemistry of Water, Water in Human Body, Impurities in Water, Disadvantages of Hard Water

UNIT II **[6 Hours]**

Water Analysis: Hardness of Water, Unit Expressing the Hardness of Water, Collection of Samples, Colour, Turbitity, Odour, Free CO_2, Free Chlorine, Chlorine Demand, Ammonia, Sulphate, Chloride, Alkalinity, Acidity, Total Acidity, Suspended Solids, Dissolved Solids and P^H

UNIT III **[6 Hours]**

Clarification of Water and Chemical Methods: Clarification of water **–**Removal of Coarse, Dispersed and Colloidal Impurities from Water, Sedimentation, Coagulation of Water, Chemical and Bioflocculants, Disinfection of Water

Chemical methods **–** Precipitation, Aeration, Ionization-Advantages, Silver Ion Method-(oligodynamics), Dechlorination, Bleaching Powder Method, Physical Method of Sterilization, Boiling-Exposure to Sun Light and UV Light, Sterilization with UV Rays

UNIT IV **[6 Hours]**

Purification of Water: Potability of Water, Characteristics of Potable Water, Treatment for Potable Water, Break Point Chlorination, Flocculation, Sedimentation, Filtration, Treatment with Activated Carbon, Safety Chlorination and pH Adjustment (Elementary Ideas Only)

UNIT V **[6 Hours]**

Boiler Feed Water and Boiler Corrosion: Boiler feed water – Essential Requirements of Boiler Feed Water, Priming, Foaming, Sludge and Scale Formation in Boilers, Caustic embrittlement.

Boiler corrosion – Removal of Dissolved Oxygen, Removal of Carbon Dioxide, Removal of Acids. Algal Blooms: Eutrophication

Text Book:

1. B.K. Sharma, **Industrial Chemistry,** New Delhi, Goel publishing, 15th Edition, 2006. [Chapter 1]

Reference book

2. P.C. Jain, **Engineering Chemistry**, Dhanpat Rai Publishing Company Ltd., New Delhi, 2010.
3. S.S. Dara & S.S. Umare, **A Text Book of Engineering Chemistry,** S. Chand & Company Ltd., New Delhi, 2013.
4. Harish Kumar, Industrial **Chemistry,** New Delhi, Sarup & Sons, 2002.
5. P.C. Jain, **Engineering Chemistry**, Dhanpat Rai Publishing Company Ltd., New Delhi, 2010.
6. S.S. Dara & S.S. Umare, **A Text Book of Engineering Chemistry,** New Delhi, S. Chand & Company Ltd., 2013.
7. A. Ravikrishnan, **Engineering Chemistry,** Sir Krishna publication, Chennai, 2008.

INDUSTRIAL WASTE WATER TREATMENT PRACTICAL

(For those who joined from since 2018-19)

Subject Code: GCWW2P **Hours/Week: 2**

CO 1: Be acquainted with current development in the field of Industrial Chemistry
CO 2: To acquire knowledge of energy sources and significance of renewable sources of energy
CO 3: To learn about various industrial processes and appreciate the chemistry behind them
CO 4: To gain knowledge about of determination of hardness of water

A Practical Course on the preparation of the following Industrial Products in the Cottage Industry level.

[30 Hours]

1. Determination of Total Acidity in Water Sample
2. Estimation of Total Alkalinity of Water Samples (CO_3, HCO_3) using Double Titration Method
3. Determination of P^H in Water Sample
4. Measurement of Chloride, Sulphate and Salinity of Water Samples by Simple Titration Method ($AgNO_3$ and Potassium Chromate)
5. Determination of Calcium by EDTA method in Water Sample
6. Determination of Total Hardness by EDTA method in Water Sample
7. Determination of Chemical Oxygen demand in Water Sample
8. Determination of Biological Oxygen demand in Water Sample
9. Determination of Total Dissolved Solids in Water Sample
10. Determination of Mixed Liquid Suspended solids in Water Sample
11. Determination of Dissolved oxygen in Water Sample

Reference Books:

1. V. Veeraiyan & L. Devaraj Stephen, **Engineering Chemistry-I,** Chennai, VRB Publishers Pvt. Ltd., 2013-2014.
2. A. Ravikrishnan, **Engineering Chemistry-I,** Chennai, Sri Krishna Hi-tech Publishing Company Pvt. Ltd., 2013-2014.
3. V. Veeraiyan & L. Devaraj Stephen, **Engineering Chemistry Laboratory,** VRB Publishers Pvt. Ltd., Chennai, 2013-2014.
4. A. Ravikrishnan, **Engineering Chemistry Laboratory,** Sri Krishna Hi-tech Publishing Company Pvt. Ltd., Chennai, 2013-2014.
5. O.P. Pandey, D.N. Bajpal, & S. Giri, **Practical Chemistry,** S. Chand and Company Ltd., New Delhi, 2006.
6. V. Venkateswaran, R. Veeraswamy & A.R. Kulandaivelu, **Basic Principles of Practical Chemistry,** Sultan Chand and Sons, New Delhi, 2012.

DEPARTMENT OF CHEMISTRY

NOMINATION FOR THE NEXT BOARD OF STUDIES [2018-19]

SUBJECT EXPERTS LIST

S.No	Name & Designation
1	**Dr. P. Manisankar** UGC BSR Faculty Fellow Professor and Head (Rtd.) Department of Industrial Chemistry Alagappa University Karaikudi – 630 003
2	**Dr. H. Gurumallesh Prabu** Professor Department of Industrial Chemistry Alagappa University Karaikudi -630003
3	**Dr. G. Paruthimal Kalaignan** Professor Department of Industrial Chemistry Alagappa University Karaikudi -630003
4	**Dr. S. Abraham John** Professor & Director Centre for Nano science &Nano-technology Department of Chemistry Gandhigram Rural Institute-DU Gandhigram -624302
5	**Dr. K. M. Tajun Meera Begum** Head & Associate Professor Department of Chemistry Arignar Anna Government Arts and Science College Karaikal -609 6056