The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce
(AUTONOMOUS)
College with Potential for Excellence
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Syllabus for T. Y. B. Sc. Programme: Chemistry (Six Units)

Syllabus as per **Choice Based Credit System**

(June 2020 Onwards)

Submitted by

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(AUTONOMOUS)

❖ Syllabus as per Choice Based Credit System

1. Name of the Programme	**T. Y. B. Sc. Chemistry (Six Units) : CBCS**	
The T. Y. B. Sc. in Chemistry course is a one Year Full Time Course consisting of two semesters, to be known as Semester V and Semester VI. Each semester consists of four core courses and one Applied component course.		
2. Course Code	SCH501	SCH601
	SCH502	SCH602
	SCH503	SCH603
	SCH504	SCH604
	SHFC501	SHFC601
3. Course Title	Physical Chemistry : Paper - I	
	Inorganic Chemistry : Paper - II	
	Organic Chemistry : Paper - III	
	Analytical Chemistry : Paper - IV	
	Heavy and Fine Chemicals : HFC-AC (Applied components)	
4. Semester wise Course Contents	Copy of the detailed syllabus Enclosed	
5. References and additional references	Enclosed in the Syllabus	
6. No. of Credits per Semester	16 and 4.0 for HFC-AC = 20	
7. No. of lectures per Unit	15	
8. No. of lectures per week	04 of each course and 3.0 for HFC-AC	
9. No. of Tutorial per week	--	
10. Scheme of Examination	Semester End Exam: **60 marks** (4 Questions of 15 marks each)	
	Internal Assessment : **40 marks**	
	Class Test : 15 marks	
	Project/ Assignment : 15 marks	
	Class Participation : 10 marks	
11. Special notes, if any	No	
12. Eligibility, if any	As laid down in the College Admission brochure / website	
13. Fee Structure	As per College Fee Structure specifications	
14. Special Ordinances / Resolutions, if any	No	

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Programme Structure and Course Credit Scheme :

Programme : T. Y. B. Sc.	Semester: V	Credits	Semester: VI	Credits
Course 1 : Physical Chemistry	**Course Code** SCH501	2.5	**Course Code** SCH601	2.5
Course 2 : Inorganic Chemistry	**Course Code** SCH502	2.5	**Course Code** SCH602	2.5
Course 3 : Organic Chemistry	**Course Code** SCH503	2.5	**Course Code** SCH603	2.5
Course 4 : Analytical Chemistry	**Course Code** SCH504	2.5	**Course Code** SCH604	2.5
Course 5: Chemistry Practicals paper I & II	**Course Code** SCHP501	3.0	**Course Code** SCHP502	3.0
Course 6: Chemistry Practicals paper III & IV	**Course Code** SCHP502	3.0	**Course Code** SCHP602	3.0
Course 7 : Applied component Heavy and fine chemicals HFC-AC	**Course Code** SHFC501	2.0	**Course Code** SHFC601	2.0
Course 8 : Chemistry Practicals HFC	**Course Code** SHFCP501	2.0	**Course Code** SHFCP601	2.0

❖ Semester-wise Details of Chemistry Course

Semester - V									
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA) 40 marks**			**End Semester Examination Marks**		**Total**
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	04	01	2.5	15	15	10	60	--	100
Course 2	04	01	2.5	15	15	10	60	--	100
Course 3	04	01	2.5	15	15	10	60	--	100
Course 4	04	01	2.5	15	15	10	60	--	100
Course 5, Pracs.	--	--	3.0	--	--	--	--	100	100
Course 6, Pracs.	--	--	3.0	--	--	--	--	100	100
Course 7 - HFC	03	01	2.0	15	15	10	60	--	100
Course 8, Pracs.	--	--	2.0	--	--	--	--	100	100
Total credits of the course = 10 + 06 + 02+ 02 = **20**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

Semester - VI									
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA) 40 marks**			**End Semester Examination Marks**		**Total**
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	04	01	2.5	15	15	10	60	--	100
Course 2	04	01	2.5	15	15	10	60	--	100
Course 3	04	01	2.5	15	15	10	60	--	100
Course 4	04	01	2.5	15	15	10	60	--	100
Course 5, Pracs.	--	--	3.0	--	--	--	--	100	100
Course 6, Pracs.	--	--	3.0	--	--	--	--	100	100
Course 7 - HFC	03	01	2.0	15	15	10	60	--	100
Course 8, Pracs.	--	--	2.0	--	--	--	--	100	100
Total credits of the course = 10 + 06 + 02+ 02 **= 20**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

- L - Lectures
- T - Tutorials
- P - Practical
- C - Credits

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System

Semester - V

PAPER – I : Physical Chemistry

Course Name: Physical Chemistry (60 lectures)		Course Code: **SCH501**	
Periods per week (1 period 50 minutes)		**04**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- To introduce various branches of spectroscopy
- To explore further colligative properties in Thermodynamics like vapor pressure and osmotic pressure
- To get acquainted with applications of radioisotopes, nuclear reactions ,fission and fusion processes.
- To make learner aware of adsorption phenomena and colloidal state.

		No. of lectures
Unit I	**1.0 Molecular Spectroscopy** **1.1.1** Introduction to dipole moment, polarization of a bond, bond moment, molecular structure **1.1.2 Vibrational spectrum**: Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. **1.1.3 Vibrational-Rotational spectrum of diatomic molecule**: Energy levels, selection rule, nature of spectrum, P and R branch lines. Anharmonic oscillator - energy levels, selection rule, fundamental band, overtones. Application of vibrational-rotational spectrum in determination of force constant and its significance. Infrared spectra of simple molecules like H_2O and CO_2. **1.1.4 Raman Spectroscopy** Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule.	**11** **04**

Unit II	**2.0 Chemical Thermodynamics** **2.1.1** Recapitulation of entropy. Third law of thermodynamics and its applications **2.1.2 Colligative properties** Vapor pressure and relative lowering of vapour pressure. Measurement of lowering of vapour pressure – Static and Dynamic method. **2.1.3 Solutions of Solid in Liquid** **2.1.3.1** Elevation in boiling point of a solution, thermodynamic derivation relating elevation in boiling point of the solution and molar mass of non-volatile solute. **2.1.3.2** Depression in freezing point of a solution, thermodynamic derivation relating the depression in the freezing point of a solution and the molar mass of the non-volatile solute. Beckmann Method. **2.1.4 Osmotic Pressure :** Introduction, thermodynamic derivation of Van't Hoff equation, Van't Hoff Factor, Reverse Osmosis. **2.2 Chemical Kinetics** **2.2.1 Collision theory of reaction rates** : Application of collision theory to 1. Unimolecular reaction Lindemann theory and 2. Bimolecular reaction. (derivation expected for both) **2.2.2 Catalysis** Recapitulation of catalysis **2.2.3** Mechanisms and kinetics of enzyme catalyzed reactions (Michaelis-Menten equation)	**09** **06**
Unit III	**3.0 Nuclear Chemistry** **3.1 Introduction**: **B**asic terms-radioactive constants (decay constant, half life and average life) and units of radioactivity **3.2 Detection and Measurement of Radioactivity:** Types and characteristics of nuclear radiations, behavior of ion pairs in electric field, detection and measurement of nuclear radiations using G. M. Counter and Scintillation Counter. **3.3 Application of use of radioisotopes as Tracers** **C**hemical reaction mechanism, age determination - dating by C^{14}. **3.4 Nuclear reactions** Nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy. **3.5 Fission Process** Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process.multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor. **3.6 Fusion Process** Thermonuclear reactions occurring on stellar bodies and earth.	**15**

Unit IV	**4.1 Surface Chemistry** 4.1.1 **Adsorption:** Physical and Chemical Adsorption, types of adsorption isotherms . Langmuir's adsorption isotherm (Postulates and derivation expected). B.E.T. equation for multilayer adsorption, (derivation not expected). Determination of surface area of an adsorbent using B.E.T. equation. **4.2 Colloidal State** **4.2.1 Introduction to colloids** - Emulsions, Gels and Sols **4.2.2 Electrical Properties** Origin of charges on colloidal particles, Concept of electrical double layer, zeta potential, Helmholtz and Stern model. Electro-kinetic phenomena - Electrophoresis, Electro-osmosis, Streaming potential, Sedimentation potential; Donnan Membrane equilibrium **4.2.3 Colloidal electrolytes** Introduction, micelle formation, **4.2.4 Surfactants** Classification and applications of surfactants in detergents and food industry.	**06** **09**

Learning Outcomes:

On studying the syllabi the learner will be able to

1. Differentiate between various branches of spectroscopy.
2. Interpret various thermodynamic properties and their determination
3. Explain various aspects of nuclear chemistry
4. Elaborate the knowledge of colloidal state, colloidal electrolytes and surfactants.

Reference Books :

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rd edition , John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.

10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, VISHAL PUBLISHING Company, 2008.
11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..
14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987

PRACTICALS

SEMESTER - V

PHYSICAL CHEMISTRY

COURSE CODE: SCHP501 **CREDITS: 03**

RECAPITULATION: Laboratory Safety Practices

Non-Instrumental

1) **Phase rule** : To study phase diagram of three component system water – chloroform/ toluene - acetic acid
2) **Chemical Kinetics**:
   To determine the order between $K_2S_2O_8$ and KI by fractional change method
3) **Surface phenomena**
   To investigate the adsorption of acetic acid on activated charcoal and test the validity of Freundlich adsorption isotherm.

Instrumental

4) **Potentiometry**
   To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.

5) **Conductometry**
   To determine the velocity constant of alkaline hydrolysis of ethyl acetate by conductometric method.

6) **pH-metry**
   To determine acidic and basic dissociation constants of amino acid and hence to calculate isoelectric point.

References:

1. Experimental Physical Chemistry, V.D. Athawale and P. Mathur, New Age International Publishers, 2001
2. Practical Physical Chemistry, B. Viswanathan and P.S. Raghavan, Viva Books Private Limited, 2005.
3. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
4. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
5. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A.Gulati, R Chand and Co.. 2011

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System			
Semester - V			
PAPER – II : Inorganic Chemistry			
Course Name: Inorganic Chemistry (60 lectures)		Course Code:	**SCH502**
Periods per week (1 period 50 minutes)		**04**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- ❖ It is important for the learner to understand the concept of symmetry elements, symmetry operations and point group as it will be helpful in study of structure of molecules and their properties. The learner is introduced to application of Molecular Orbital Theory to explain certain properties of polyatomic species and band theory for explaining electrical properties of conductors and semiconductors.
- ❖ The study of structure of solids and defects in solids will help in understanding physical properties of compounds. Superconductors are of great importance in days to come and hence brief introduction their types and applications is included.
- ❖ The learner should understand the consequences of lanthanide contraction, the method of separation of lantahnides and application of lanthanides.
- ❖ The learner is introducing with the concept of non aqueous solvents and importance of non aqueous solvents to carry out various chemical reactions.
- ❖ Learners are introduce with the concept of allotropy, synthesis and application of H2SO4.
- ❖ It is important for the learner to understand the concept of oxy acids, their properties and structure on the basis of VSEPR theory.

		No. of lectures
Unit I	1.0 **Molecular Symmetry And Chemical Bonding**	**06**
	1.1 Molecular Symmetry **1.1.1** Introduction and Importance of symmetry in Chemistry **1.1.2** Symmetry elements and symmetry operations **1.1.3** Concept of a point group with illustrations using the following point groups : i) C∞v ii) D ∞h iii) C_{2v} iv) C_{3v} v) C_{2h} vi) D_{3h}	**06**
	1.2 Molecular Orbital Theory Polyatomic species LCAO –MO for triatomic species : H_3^+ and H_3 (correlation between Bond angle and Molecular orbitals) **1.2.2** Molecular orbital approach for bonding in AB_2 molecules. Application of symmetry concepts for linear and angular species considering σ bonding only. Examples BeH_2 and H_2O (Terms such as Walsh correlation diagram, Symmetry Adapted Linear Combinations (SALC's) Ligand Group Orbitals(LGOs), transformation of atomic orbitals into appropriate symmetry types expected to be discussed.	**03**
	1.3 Metallic bonding : Band theory, Explanation of electrical properties of conductors, insulators, semiconductors, extrinsic and intrinsic semiconductors.	

Unit II	**2.0 Solid State Chemistry.** **2.1** Structure Of Solids. **2.1.1** Explanation of terms ,viz., crystal lattice , lattice points, unit cells and lattice constants **2.1.2** Closest packing of rigid spheres (hcp, ccp) , packing density in simple cubic, bcc, fcc and hcp lattices. (Numerical problems expected). Relationship between density of unit cell, lattice parameters (Numerical problems expected). **2.1.3** Stoichiometric Point defects in Solids: Discussion on Frenkel and Schottky defects expected. **2.2 Superconductivity.** **2.2.1** Discovery of Superconductivity **2.2.2** Explanations of terms like superconductivity, transition temperature, Meissner effect **2.2.3** Different types of Superconductors viz, conventional Superconductors , alkali metal fullerides, High temperature Superconductors **2.2.4** Brief applications of superconductors	**11** **04**
Unit III	**3.0 Chemistry of Inner Transition Elements** **3.1** Introduction: Position in the periodic table and electronic configuration of Lanthanides and actinides. **3.2** Chemistry Of Lanthanides with reference to i) Lanthanide contraction and its consequences. ii) Oxidation states, iii) Ability to form complexes iv) Magnetic and spectral properties. **3.3** Occurrence Extraction And Separation Of Lanthanides by i) Solvent Extraction ii) Ion exchange method.(Principles and Techniques). **3.4** Applications of Lanthanides.	**15**
Unit IV	**4.0 Some Selected Topics** **4.1** Chemistry Of Non- Aqueous Solvents. **4.1.1** Classification of solvents and importance of non aqueous solvents. **4.1.2** Characterization and study of liquid ammonia, dinitrogen tetraoxide as non aqueous solvents with respect to : i) Acid base reaction and ii) redox reactions. **4.2 Comparative Chemistry of Group 16.** **4.2.1** Electronic configurations, trends in physical properties, allotropy. Manufacture of sulphuric acid by contact process.Impact of H_2SO_4 on environment. **4.3 Comparative Chemistry of Group 17.** **4.3.1** Electronic configuration, general characteristics, anomalous properties of flourine, comparative study of acidity of oxyacids of chlorine with respect to acidity, oxidising properties and structures (on the basis of VSEPR theory).	**05** **05** **05**

Learning Outcomes:

On studying the syllabi, the learner will be able to

- Discuss the symmetry elements present in a molecule and assign the point group for the molecule. Draw Molecular orbital Diagram of triatomic (AB2) molecules and explain their shapes with the help of Walsh Correlation diagrams
- Discuss electrical properties of conductors, semiconductors on the basis of Band Theory.
- Understand the different types packing in solids , stoichiometric defects in solids
- Discuss superconductivity . types of superconductors and their applications.
- Understand the unusal position of inner transition elements, describe the solvent extraction, ion exchange methods used for seperation of lanthanides and recite the application of lanthanides, deduce the expression in solvent extraction and ion – exchange method.
- Discuss the properties of aqueous, non aqueous solvent, protic and aprotic solvent and memorize application of non aqueous solvents
- Write the electronic configuration of group 16 elements, recollect the preparation of H_2SO_4 by contact process, recite application of H_2SO_4, and understand catalysis in V_2O_5 and platinised asbestos.
- Define interhalogen compounds, draw the structures of different interhalogen compounds and explain their shapes. Analyse the structure of oxy acids on the basis of VSEPR theory and describe the properties of oxy acids.

Références :

1. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
2. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993
3. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
4. Greenwood, N.N. & Earnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
5. Gary Wulfsberg, Inorganic chemistry, Viva Books Pvt,.Ltd. (2002).
6. Purecell, K.F. and Kotz, J.C., Inorganic Chemistry W.B. Saunders Co. 1977
7. D.Banerjea, Coordination Chemistry, tata NcGraw Hill, New Delhi,1993
8. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
9. Basolo, F, & Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
10. R. Gopalan , V. Ramalingam Concise Coordination Chemistry ,Vikas Publishing House
11. Satya Prakash, G.D.Tuli, R.D. Madan , Advanced Inorganic Chemistry. S. Chand & Co Ltd
12. Lesley E. Smart, Elaine A. Moore Solid State Chemistry: An Introduction, 2nd Edition CRC Press,
13. C. N. R. Rao Advances in Solid State Chemistry
14. Ram Charan Mehrotra, Organometallic Chemistry: A Unified Approach, New Age International

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PRACTICALS

SEMESTER - V

INORGANIC CHEMISTRY

COURSE CODE: SCHP501 **CREDITS: 03**

RECAPITULATION : Laboratory Safety Practices

I. Inorganic preparations and characterization

1. Preparation of tris(ethylenediamine) nickel(II) thiosulphate.
   (Estimation of nickel complexometrically)
2. Preparation of tetraammine copper(II) sulfate
   (Estimation of copper iodometrically)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests). (Any three salts of transition metal ions)

III. Estimation of boric caid

Référence Books

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
2. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
3. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System			
Semester - V			
PAPER – III : Organic Chemistry			
Course Name: Organic Chemistry (60 lectures)		Course Code:	**SCH503**
Periods per week (1 period 50 minutes)		**4**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- To identify the different organic reactions mechanisms and write the expected reaction products based on the type of reaction.
- To introduce students to basic photochemistry and photochemical reactions involving carbonyl compounds and olefins.
- To identify the symmetry elements in organic compounds and the optical activity of substituted cummulenes and biphenyls.
- To predict the stereochemical outcome of nucleophilic substitution and electrophilic addition reactions.
- To write the IUPAC nomenclature of given compound and draw the structure of compounds corresponding to a given IUPAC name.
- To expose the students to the principles of Green Chemistry, Principle and applications of Microwave and Ultrasound assisted Organic synthesis and their comparison with conventional methods.
- To familiarize students with the concept of retrosynthesis and designing of organic synthesis from simple starting compounds
- To learn about basic concept of UV, IR, NMR and Mass spectroscopy and their application in structure determination of organic compounds.

		No. of lectures
Unit I	**Mechanism of organic reactions** **1.1** The basic terms & concepts: bond fission, reaction intermediates, electrophiles & nucleophiles, ligand, base, electrophilicity vs. acidity & nucleophilicity vs basicity. **1.1.2** Neighbouring group participation in nucleophilic substitution reactions: participation of lone pair of electrons, kinetics and stereochemical outcome. **1.1.3** Acyl nucleophilic substitution (Tetrahedral mechanism): Acid catalyzed esterification of carboxylic acids (AAC2) and base promoted hydrolysis of esters (BAC2). **1.1.4.1** Pericyclic reactions, classification and nomenclature Electro cyclic reactions (ring opening and ring closing), cycloaddition, sigmatropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type) **1.1.4.2** Pyrolytic elimination: Cope, Chugaev, pyrolysis of acetates	**10**

	1.2 Photochemistry **1.2.1** Introduction: Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization. **1.2.2** Photochemical reactions of olefins: photoisomerization, photochemical rearrangement of 1,4- dienes (di- π methane) **1.2.3** Photochemistry of carbonyl compounds: Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol)	**05**
Unit II	**2.1 Stereochemistry I** **2.1.1** Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation -reflection (alternating) axis. **2.1.2** Chirality of compounds without a stereogenic center: cummulenes and biphenyls. **2.2 Stereochemistry II** 2.2.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and diastereoselectivity (de) , Topicity : enantiotopic and diasterotopic atoms, groups and faces. 2.2.2 Stereochemistry of : i) Substitution reactions : SNi (reaction of alcohol with thionyl chloride) ii) Elimination reactions: E2–Base induced dehydrohalogenation of 1- bromo -1,2- diphenylpropane. iii) Addition reactions to olefins: a) bromination (electrophilic anti addition) b) syn hydroxylation with OsO4 and $KMnO_4$ c) epoxidation followed by hydrolysis.	**07** **08**
Unit III	**3.1 IUPAC Nomenclature** IUPAC Systematic nomenclature of the following classes of compounds (including compounds upto two substituents / functional groups): **3.1.1** Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) – saturated and unsaturated compounds. **3.1.2** Biphenyls **3.1.3** Cummulenes with upto 3 double bonds **3.1.4** Quinolines and isoquinolines **3.2 Synthesis of organic compounds** **3.2.1** Introduction: Linear and convergent synthesis, criteria for an ideal synthesis, concept of chemo selectivity and regioselectivity with examples, calculation of yields. **3.2.2** Multicomponent Synthesis: Mannich reaction and Biginelli reaction. Synthesis with examples (no mechanism)	**04** **07**

Unit III	**3.2.3** Green chemistry and synthesis: Introduction: Twelve principles of green chemistry, concept of atom economy and E-factor, calculations and their significance, numerical examples. i) Green reagents: dimethyl carbonate. ii) Green starting materials : D-glucose iii) Green solvents : supercritical CO_2 iv) Green catalysts: Bio catalysts. **3.2.4 Introduction to retrosynthesis :** Analysis and synthesis, technical terms: target molecule (TM), retrosynthetic analysis, FGA, FGI, disconnection, synthon and reagent. retrosynthetic analysis of limolene, salbutamol and proparacaine.	**04**
Unit IV	**Spectroscopy** **4.1** Introduction : Electromagnetic spectrum, units of wavelength and frequency **4.2** UV visible spectroscopy: Basic theory, allowed and forbidden transitions, selection Rule , concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore interactions and chromophore –auxochrome interactions; Woodward Fieser Rules for calculation of λ_{max} of simple polyenes . **4.3** IR spectroscopy: Basic theory, selection rule , fingerprint region and functional group region, characteristic IR peaks for different functional groups. **4.4** PMR spectroscopy: Basic theory of PMR, Internal standard , solvents chemical shift, factors affecting chemical shift, spin -sin coupling and coupling constant , exchangeable protons, application of PMR in structure determination. **4.5** Mass spectrometry : Basic theory,, molecular ion peak and base peak and their importance, isotopic peaks, Nitrogen rule, rule of 13 for determination of empirical formula and molecular formula, fragmentation of alkanes, alkenes and aliphatic carbonyl compounds including McLafferty rearrangement. **4.6** Problems of structure elucidation of simple organic compounds using individual or combined use of UV-VIS, IR, PMR and Mass spectral data.	**15**

Learning Outcomes:

After completing the course, the student should be able to;

- Explain electrophilicity & nucleophilicity and distinguish them from acidity and basicity.
- Write the mechanism and products of nucleophilic substitution reactions involving NGP
- Write the mechanism and product of nucleophilic substitution of acid derivatives
- Identify and classify a pericyclic reaction
- Predict the mechanism and product of pyrolytic elimination reactions

- ❖ Explain and discuss theories for photoinduced electron transfer and excitation energy transfer,
- ❖ Explain the mechanisms of common photochemical transformations.
- ❖ Predict symmetry elements of organic compound, optical activity of cumulenes and biphenyls.
- ❖ Predict the mechanism and stereochemical outcome of nucleophilic substitution reactions and electrophilic addition reactions..
- ❖ Write correct IUPAC name and structure of organic compounds including heterocyclic compounds.
- ❖ Design synthesis of organic compounds by retrosynthetic analysis.
- ❖ Determine the structure of organic compounds by analyzing their spectral data.

Suggested Reading :

1. A guidebook to mechanism in Organic Chemistry, 6th edition, Peter Sykes, Pearson education, New Delhi
2. Organic Reaction Mechanism, 4th edition, V. K. Ahluwalia, R. K. Parashar, Narosa Publication.
3. Organic reactions & their mechanisms,3rd revised edition, P.S. Kalsi, New Age International Publishers.
4. M. B. Smith and J. March, Advanced organic chemistry- reactions mechanism and structure, 5th edition.
5. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
6. Organic chemistry,8th edition, John Mc Murry
7. L. Eliel , stereochemistry of carbon compounds, Tata McGraw Hill
8. Stereochemistry P.S.Kalsi , New Age International Ltd.,4th Edition
9. Stereochemistry by Nassipuri.
10. Nomenclature of Organic Chemistry: IUPAC recommendations and preferred Names 2013, RSC publication.
11. IUPAC nomenclature by S. C. Pal.
12. Green chemistry an introductory text : Mike Lancaster
13. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
14. Green chemistry: V. K. Ahluwalia (Narosa publishing house pvt. ltd.)
15. Green chemistry an introductory text : RSC publishing.
16. New trends in green chemistry V. K. Ahluwalia , M. Kidwai, Klumer Academic publisher
17. Green chemistry by V. Kumar.
18. Organic chemistry: Francis Carey
19. Organic chemistry: Carey and Sundberg.
20. Organic Synthesis: The Disconnection Approach 2nd Edition, Wiley, by Stuart Warren, Paul Wyatt
21. Organic spectroscopy (Second edition),Jag Mohan ,Narosa publication
22. Spectroscopy, Pavia, Lampman, Kriz,Vyvyan.
23. Elementary organic spectroscopy (Third edition), Y.R.Sharma, S.Chand publication..
24. Introduction to spectroscopy (third edition), Pavia ,Lampman,Kriz,john vondeling,Emily Barrosse.
25. Organic chemistry Paula Y. Bruice, Pearson education.
26. Spectral identification of organic molecules by Silverstein.
27. Absorption spectroscopy of organic molecules by V.M.Parikh.

PRACTICALS

SEMESTER V

ORGANIC CHEMISTRY

COURSE CODE: SCHP502 **CREDITS: 03**

RECAPITULATION: Laboratory Safety Practices

SEMESTER V: **Separation of Binary solid-solid mixture** (2.0 gms mixture to be given).

- Minimum Six mixtures to be completed by the students.
- Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble bases (nitroanilines) , water soluble neutral (thiourea) and water insoluble neutral compounds (anilides , amides, m-DNB, hydrocarbons)
- After correct determination of chemical type, the separating reagent should be decided by the student for separation.
- Follow separation scheme with the bulk sample of binary mixture.
- After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with m.p..

References: 1. Practical organic chemistry – A. I. Vogel

2. Practical organic chemistry – H.Middleton.
3. Practical organic chemistry – O.P.Aggarwal.

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System

Semester - V

PAPER – IV : Analytical Chemistry

Course Name: Analytical Chemistry (60 lectures)		Course Code: **SCH504**	
Periods per week (1 period 50 minutes)		**4**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

The primary objective of this course is to acquire basic concepts, principles, and techniques of modern analytical chemistry that would empower students with an analytical mind set and the abilities to solve diverse analytical problems in an efficient and quantitative way that conveys the importance of accuracy and precision of the analytical results. On successful completion of this course, students will be able

- ❖ To introduce basic analytical techniques and practical aspects of classical chemical analysis.
- ❖ To establish an appreciation of the role of chemistry in quantitative analysis
- ❖ To provide an understanding of chemical methods employed for elemental and compound analysis.
- ❖ To provide experience in some scientific methods employed in analytical chemistry.

UNIT		No. of lectures
UNIT I	**Introduction To Quality Concepts, Chemical Calculations And Sampling**	
	1.1 Quality in Analytical Chemistry **1.1.1** Concepts of Quality, Quality Control and Quality Assurance **1.1.2** Importance of Quality concepts in Industry **1.1.3** Chemical Standards and Certified Reference Materials; Importance in chemical analysis Quality of material: Various grades of laboratory reagents	**05**
	1.2 Chemical Calculations (Numericals and word problems are expected) **1.2.1** Inter conversion of various concentration units. (Conversion of concentration from one unit to another unit with examples) **1.2.2** Percent composition of elements in chemical compounds	**04**
	1.3 Sampling **1.3.1** Purpose, significance and difficulties encountered in sampling **1.3.2** Sampling of solids: Sample size – bulk ratio, size to weight ratio, multistage and sequential sampling, size reduction methods, sampling of compact solids, equipments and methods of sampling of compact solids, sampling of particulate solids, methods and equipments used for sampling of particulate solids. **1.3.3** Sampling of liquids: Homogeneous and heterogeneous, Static and flowing liquids. **1.3.4** Sampling of gases: Ambient and stack sampling: Apparatus and methods for sampling of gases. **1.3.5** Collection, preservation and dissolution of the sample.	**06**

UNIT II : CLASSICAL METHODS OF ANALYSIS (TITRIMETRY)			
2.1	**Redox Titrations (Numerical and word Problems are expected)**		**08**
	2.1.1	Introduction	
	2.1.2	Construction of the titration curves and calculation of E_{system} in aqueous medium in case of: (1) One electron system (2) Multielectron system	
	2.1.3	Theory of redox indicators, Criteria for selection of an indicator Use of diphenyl amine and ferroin as redox indicators	
2.2	**Complexometric Titrations**		**07**
	2.2.1	Introduction, construction of titration curve	
	2.2.2	Use of EDTA as titrant and its standardisation, absolute and conditional formation constants of metal EDTA complexes, Selectivity of EDTA as a titrant. Factors enhancing selectivity with examples. Advantages and limitations of EDTA as a titrant.	
	2.2.3	Types of EDTA titrations.	
	2.2.4	Metallochromic indicators, theory, examples and applications	
UNIT III: OPTICAL METHODS			
3.1	**Atomic Spectroscopy: Flame Emission spectroscopy(FES) and Atomic Absorption Spectroscopy(AAS)**		**07**
	3.1.1	Introduction, Energy level diagrams, Atomic spectra, Absorption and Emission Spectra	
	3.1.2	Flame Photometry – Principle, Instrumentation (Flame atomizers, types of Burners, Wavelength selectors, Detectors)	
	3.1.3	Atomic Absorption Spectroscopy – Principle, Instrumentation (Source, Chopper, Flame and Electrothermal Atomiser)	
	3.1.4	Quantification methods of FES and AAS – Calibration curve method, Standard addition method and Internal standard method.	
	3.1.5	Comparison between FES and AAS	
	3.1.6	Applications, Advantages and Limitations	
3.2	**Molecular Fluorescence and Phosphorescence Spectroscopy**		**04**
	3.2.1	Introduction and Principle	
	3.2.2	Relationship of Fluorescence intensity with concentration	
	3.2.3	Factors affecting Fluorescence and Phosphorescence	
	3.2.4	Instrumentation and applications	
	3.2.5	Comparison of Fluorimetry and Phosphorimetry	

	3.2.6	Comparison with Absorption methods	
3.3	**Turbidimetry and Nephelometry**		**04**
	3.3.1	Introduction and Principle	
	3.3.2	Factors affecting scattering of Radiation: Concentration, particle size, wavelength, refractive index	
	3.3.3	Instrumentation and Applications	
UNIT IV: METHODS OF SEPARATION			
4.1	**Solvent Extraction**		**06**
	4.1.1	Factors affecting extraction: Chelation, Ion pair formation and Solvation	
	4.1.2	Graph of percent extraction versus pH. Concept of $[pH]_{1/2}$ and its significance (derivation not expected)	
	4.1.3	Craig's counter current extraction: Principle, apparatus and applications	
	4.1.4	Solid phase extraction: Principle, process and applications with special reference to water and industrial effluent analysis.	
	4.1.5	Comparison of solid phase extraction and solvent extraction.	
4.2	**High Performance Liquid chromatography (HPLC)**		**06**
	4.2.1	Introduction and Principle Instrumentation- components with their significance: Solvent Reservoir, Degassing system, Pumps-(reciprocating pumps, screw driven- syringe type pumps, pneumatic pumps, advantages and disadvantages of each pump), Precolumn, Sample injection system, HPLC Columns, Detectors(UV – Visible detector, Refractive index detector)	
	4.2.2	Qualitative and Quantitative Applications of HPLC	
4.3	**High Performance Thin Layer Chromatography (HPTLC)**		**03**
	4.3.1	Introduction and Principle Stationary phase, Sample application and mobile phase	
	4.3.2	Detectors a) Scanning densitometer- Components. Types of densitometer- Single beam and Double beam b) Fluorometric Detector	
	4.3.3	Advantages, disadvantages and applications	
	4.3.4	Comparison of TLC and HPTLC	

Learning Outcomes

At the end of this course, the student will know

1. Perceive sound theoretical knowledge and understanding of the fundamental concepts, principles and processes in Analytical Chemistry.
2. Discuss the applications of Advanced Instrumental methods.
3. Solve practical problems and will be able to apply the skills learnt in the programme.
4. Outline the applications of Analytical methods in everyday life.

References:

1.	3000 solved problems in Chemistry, David E. Goldberg,PhD.,Schaums Outline	Unit/s: (1.2)
2.	A guide to Quality in Analytical Chemistry: An aid to accreditation, CITAC and EURACHEM, (2002),	Unit/s (1.1)
3.	A premier sampling solids, liquids and gases, Smith Patricia I, American statistical association and the society for industrial and applied mathematics, (2001)	Unit/s (1.3)
4.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (4.1,4.2,4.3)
5.	Analytical Chemistry Skoog, West ,Holler,7th Edition:	Unit/s (2.1)
6.	Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication	Unit/s (4.1,4.2,4.3)
7.	Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited	Unit/s (4.1,4.2,4.3)
8.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit /s (4.1,4.2,4.3)
9.	Fundamentals of Analytical Chemistry by Skoog and West, 8th Edition	Unit /s (4.1,4.2,4.3)
10.	Handbook of quality assurance for the analytical chemistry laboratory, 2ndEdn., James P. DuxVanNostr and Reinhold, 1990	Unit /s (1.1)
11.	High Performance Thin Layer Chromatography by Dr P.D. Sethi, CBS Publisher and Distribution	Unit/s(4.1,4.2,4.3)
12.	High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer	Unit/s (4.1,4.2,4.3)
13.	Instrumental methods of Analysis, by Dr Supriya S Mahajan, Popular Prakashan Ltd	Unit/s (4.1,4.2,4.3)
14.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (3.1,3.2,3.3)
15.	Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House	Unit/s (4.1,4.2,4.3)

16.	Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman	Unit/s (4.1,4.2,4.3
17.	Quality control and Quality assurance in Analytical Chemical Laboratory, Piotr Konieczka and Jacek Namiesnik, CRC press	Unit/s (1.1)
18.	Quality in the Analytical Chemistry Laboratory, Elizabeth Prichard, Neil T. Crosby, Florence Elizabeth Prichard, John Wiley and Sons, 1995	Unit/s (1.1)
19.	Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969	Unit/s (4.1,4.2,4.3)
20	Thin Layer Chromatography, A LAB. Handbook, Egon Stahl, Springer International Student Edition	Unit/s (4.1,4.2,4.3)

PRACTICALS

SEMESTER V

ANALYTICAL CHEMISTRY

COURSE CODE: SCHP502 **CREDITS: 03**

REACPITULATION: Laboratory Safety Practices

1. Spectrophotometric estimation of fluoride
2. Estimation of magnesium content in Talcum powder by complexometry, using standardized solution of EDTA
3. Determination of COD of water sample.
4. To determine potassium content of a Fertilizer by Flame Photometry (Calibration curve method).
5. To determine the amount of persulphate in the given sample solution by back titration with standard Fe (II) ammonium sulphate solution.
6. To determine the amount of sulphate in given water sample turbidimetrically.

Note: Calculation of percent error is expected for all the experiments.

References

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).

2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System

Semester - VI

PAPER – I : Physical Chemistry

Course Name: Physical Chemistry (60 lectures)		Course Code: **SCH601**	
Periods per week (1 period 50 minutes)		**4**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- To introduce classification of polymers ,types of molar masses and light emitting polymers
- To know basics of quantum chemistry, concepts of progressive and standing waves, operators and eigen vaules
- To be aware of renewable energy sources like solar energy
- To get basics of Nuclear Magnetic resonance and electron spin resonance spectroscopy

		No. of lectures
Unit I	**1.1 Electrochemistry** **1.1.1 Activity and Activity Coefficient** Lewis concept, ionic strength, Mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye- Huckel limiting law (No derivation). **1.1.2 Classification of cells** Chemical cells and Concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations are expected), **1.2 Applied Electrochemistry** **1.2.1 Polarization**: concentration polarization and it's elimination **1.2.2 Decomposition Potential and Overvoltage:** Introduction, experimental determination of decomposition potential, factors affecting decomposition potential. Tafel's equation for hydrogen overvoltage, experimental determination of over –voltage. **1.2.3** Hydrogen –Oxygen fuel cell	**07** **08**
Unit II	**2.0 Polymers** **2.1 Basic terms :** macromolecule, monomer, repeat unit, degree of polymerization. **2.2 Classification of polymers:** Classification based on source, structure, thermal response and physical properties. **2.3 Molar masses of polymers:** Number average, Weight average, Viscosity average molar mass, Monodispersity and Polydispersity	**15**

	2.4 Method of determining molar masses of polymers : Viscosity method using Ostwald Viscometer. (derivation expected) **2.5 Light Emitting Polymers :** Introduction, Characteristics, Method of preparation and applications. **2.6 Antioxidants and Stabilizers :** Antioxidants , Ultraviolet stabilizers, Colourants, Antistatic agents and Curing agents.	
Unit III	**3.1 Basics of Quantum Chemistry** **3.1.1 Classical mechanics**: Introduction, limitations of classical mechanics, Black body radiation, photoelectric effect, Compton effect. **3.1.2 Quantum mechanics :** Introduction, Planck's theory of quantization, wave particle duality, de –Broglie's equation, Heisenberg's uncertainty principle. **3.1.3 Progressive and standing waves-** Introduction, boundary conditions, Schrodinger's time independent wave equation (no derivation expected), interpretation and properties of wave function. **3.1.4 Quantum mechanics** State function and its significance, Concept of operators - definition, addition, subtraction and multiplication of operators, commutative and non - commutative operators, linear operator, Hamiltonian operator, Eigen function and Eigen value. **3.2 Renewable Energy Resources** **3.2.1** Renewable energy resources: Introduction. **3.2.2 Solar energy** Solar cells, Photovoltaic effect, Differences between conductors, semiconductors, insulators and its band gap, Semiconductors as solar energy converters, Silicon solar cell **3.2.3 Hydrogen** Fuel of the future, production of hydrogen by direct electrolysis of water, advantages of hydrogen as a universal energy medium.	**10** **05**
Unit IV	**4.1 NMR -Nuclear Magnetic Resonance Spectroscopy** **Principle** : Nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, Relaxation processes in NMR (spin -spin relaxation and spin - lattice relaxation). **Instrumentation**: NMR Spectrometer **4.2 Electron Spin Resonance Spectroscopy** **Principle:** Fundamental equation, g-value -dimensionless constant or electron g-factor, hyperfine splitting. **Instrumentation**: ESR spectrometer, ESR spectrum of hydrogen and deuterium.	**07** **08**

Note :** ***Numericals and Word Problems are Expected from All Units

Learning Outcomes

On studying the syllabi, the learner will be able to

1. Classify polymers and determine their various types of molar masses.
2. Outline the basics of quantum Chemistry and interpret the Schrodinger time-independent wave equation
3. Recognise importance of solar Cellsexplore the utility of hydrogen as a fuel.
4. Compare the basic concepts of Nuclear Magnetic Resonance with electron spin resonance spectroscopy.

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Reference Books :

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co.Ltd.
2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.
3. Physical Chemistry, R.J.Silbey, & R.A.Alberty,3rd edition,John Wiley & Sons, Inc [part 1]
4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.
5. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint,2006 Springer
6. Fundamental of Molecular Spectroscopy, 4th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2008.
7. Physical Chemistry, G.M. Barrow, 6th Edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
8. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford Universtity Press Oxford.
9. Physical Chemistry, G.K. Vemullapallie, 1997, Prentice Hall of India, Pvt.Ltd. New Delhi.
10. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publishing Company, 2008.
11. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.
12. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.
13. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , New Age International (P) Ltd., Publishers, 2011..
14. Chemical Kinetics,K. Laidler, Pearson Education India, 1987.

PRACTICALS

SEMESTER - VI

PHYSICAL CHEMISTRY

COURSE CODE: SCHP601 **CREDITS: 03**

Non-Instrumental

Chemical Kinetics

To interpret the order of reaction graphically from the given experimental data and calculate the specific rate constant. (No fractional order)

Viscosity

To determine the molecular weight of high polymer polyvinyl alcohol (PVA) by viscosity measurement.

Instrumental

Potentiometry

1. To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate.
2. To determine the number of electrons in the redox reaction between ferrous ammonium sulphate and cerric sulphate potentiometrically.

Conductometry

To titrate a mixture of weak acid and strong acid against strong base and estimate the amount of each acid in the mixture conductometrically.

Colorimetry

To estimate the amount of Fe(III) in the complex formation with salicylic acid by Static Method.

References

1. Practical Physical Chemistry 3rd edition A.M.James and F.E. Prichard, Longman publication
2. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
3. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
4. Advanced Experimental Chemistry. Vol - I J.N.Gurtu and R Kapoor, S. Chand and Co.
5. Experimental Physical Chemistry By V.D.Athawale.
6. Senior Practical Physical Chemistry By: B. D. Khosla, V. C. Garg and A. Gulati, R Chand and Co.. 2011

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System			
Semester - VI			
PAPER – II : Inorganic Chemistry			
Course Name: Inorganic Chemistry (60 lectures)		Course Code:	**SCH602**
Periods per week (1 period 50 minutes)		**04**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- The learner is introduced to basic tenets of Crystal Field theory and its application to explain variation in properties of coordination compounds. Experimental evidences suggesting covalence in metal -ligand bond will be discussed. Also, the application of Molecular Orbital Theory to explain properties of octahedral complexes is included in the syllabus.
- An understanding of stability, reactivity and Electronic spectra of metal complexes will help learner to discuss the properties of the metal complexes.
- The learner is introduced to the concept of synthesis and application of organometallic compounds and Sandwich type of compounds. Also the structure and bonding of ferrocenes on the basis of VBT and homogeneous catalysis with the example of Wilkinson's catalyst in hydrogenation of alkenes.
- Learners are introduced to the concept of compounds of Xenon with respect to preparation and structure (VSEPR) ,applications. Also the concept of nano materials with synthesis and application. They were introducing to the role of inorganic elements in biological system along with the sodium and potassium pump.

		No. of lectures
Unit I	**1.0 Theories of Metal Ligand Bond.**	**10**
	1.1 Crystal field Theory (CFT) for coordination compounds	
	1.1.1 Basic tenents of CFT	
	1.1.2 Effect of crystal field on d orbitals in octahedral, square planar and tetrahedral complexes.	
	1.1.3 Distortions from octahedral geometry : Jahn teller Distortions	
	1.1.4 Crystal field splitting parameter 10 Dq / Δ , its calculation and factors affecting it in octahedral complex, Spectrochemical series.	
	1.1.5 Crystal Field Stabilazation Eergy (CFSE) , calculation of CFSE for octahedral and tetrahedral complexes d^0 - d^{10} metal ion configurations.	
	1.1.6 Consequences of crystal field splitting on various properties such as ionic radii, hydration energy ,lattice energy, colour and magnetic properties	
	1.1.7 Limitations of CFT : Evidences for covalence in metal complexes: i) intensities of d-d transitions , ii) ESR spectrum $[Ir\ Cl_6]^{2-}$ iii) Nephelauxetic effect	**05**
	1 .2 Molecular Orbital theory for Coordination Compounds	
	1 .2.1 Identification of central metal orbitals and their symmetry suitable for formation of σ and π bonds with ligand orbitals.	

	1.2.2 Construction of Ligand Group orbitals **1.2.3** Construction of σ Molecular orbitals for ML_6 complexes. **1.2.4** Effect of π bonding on Δ values **1.2.5** Molecular Orbital diagram for complexes : $[Ti(H_2O)_6]^{+3}$ $[Fe(CN)_6]^{-3}$, $[Fe(F)_6]^{-3}$, $[Fe(CN)_6]^{-4}$, $[Fe(F)_6]^{-4}$, $[Co(NH_3)_6]^{+3}$, $[Co(F)_6]^{-3}$	
Unit II	**2.0 Properties of complexes** **2.1** Stability of Metal Complexes **2.1.1** Thermodynamic and Kinetic Stability of metal complexes **2.1.2** Stability constants : Stepwise and overall stability constants and their Interrelationship **2.1.3** Factors affecting thermodynamic stability : nature of metal, nature of ligand, Chelate effect **2.2 Reactivity of Metal Complexes.** **2.2.1** Types of reactions in metal complexes **2.2.2** Inert and Labile complexes: Correlation between electronic configurations and lability of complexes. **2.2.3** Ligand substitution reactions : Associative and Dissociative mechanisms. **2.2.4** Acid hydrolysis , base hydrolysis and anation reaction. **2.3 Electronic Spectra.** **2.3.1** Origin of electronic spectrum **2.3.2** Types of electronic transitions in coordination compounds; Intrametal, intraligand , charge transfer. **2.3.3** Selection rules for electronic transitions. **2.3.4** Electronic configuration and electronic microstates, Terms and Term symbols for transition metal ions, rules for determination of ground state Terms. **2.3.5** Determination of Terms for p^2 and d^2 electronic configurations. Orgel Diagram for D and F Terms (in octahederal crystal field)	**05** **05** **05**
Unit III	**3.0 Organo Metallic Chemistry.** **3.1** Organo metallic Compounds Of Main Group Metals. **3.1.1** General Characteristics of various types of organometallic compounds i.e. ionic, σ- bonded and electron deficient compounds. **3.1.2** General Synthetic methods of organometallic compounds: i) Oxidative addition ii) Metal- metal exchange reaction (trans-metallation), iii) Carbanion- halide exchange, iv) Metal hydrogen exchange (metallation) and v) Methylene insertion reactions. **3.1.3** Some chemical reactions of organometallic compounds: i)Reactions with oxygen and halogens, ii) Alkylations and arylations iii) Reactions with protic reagents, iv) Redistributions reactions and v) Complex formation reactions.	**07**

	3.2 Metallocenes Introductions, Ferrocene: Synthesis, properties, structure and bonding on the basis of VBT. **3.3 Catalysis.** **3.3.1** Comparison between homogeneous and heterogeneous catalysis. **3.3.2** Basic steps involved in catalysis reactions i) Oxidative addition ii) Reductive elimination iii) Insertion reaction iv)Application of EAN rule/ 18 electron rule. **3.3.3 Catalytic Reactions** i) Wilkinson ii) Suzuki Coupling iii) Heck Reactions. .	**03** **05**
Unit IV	**4.0 Some Selected Topics.** 4.1 Chemistry of Group 18. 4.1.1 Historical perspectives. 4.1.2 General Characteristics and trends in physical and chemical properties. 4.1.3 Isolation of noble gases. 4.1.4 Compounds of Xenon (Oxides and Flourides) with respect to preparation and structure (VSEPR). 4.1.5 Uses of noble gases. **4.2 Nanomaterials** **4.2.1** Introduction and importance of nanomaterials. **4.2.2** Properties (Comparison between bulk and nanomaterials): i) Optical properties ii) Electrical conductivity iii) Melting points, and iv) Mechanical properties. **4.2.3** Forms of nanomaterials: nanofilms, nanolayers, nanotubes, nanowires and nano particles. **4.2.4** Synthesis of nanoparticles using colloidal route. **4.3 Introduction To Bio- Inorganic Chemistry.** **4.3.1** Essential and non- essential elements in biological systems. **4.3.2** Biological importance of metal ions such as Na^+, K^+,Fe^{2+}/ Fe^{3+} and Cu^{2+} (Role of Na^+ and K^+ with respect to ion pump.)	**07** **05** **03**

Learning Outcomes

On studying the syllabi, the learner will be able to:

- Explain observed variation in properties like color, magnetic moment etc, distortion in geometry of octahedral complexes on the basis of Crystal Field Theory ,
- Calculate CFSE for tetrahedral and octahedral complexes
- Draw Molecular Orbital diagram of octahedral complexes and explain variation in properties.
- Differentiate between Thermodynamic and Kinetic Stability, discuss factors affecting thermodynamic stabilities
- Understand terms labile and inert complexes and discuss different mechanisms of substitution reactions metal complexes
- Determine terms, term symbols and draw Orgel Diagrams for metal complexes.
- Understand organometallic compounds, recognize different methods used in the synthesis of organometallic compounds,

- Define sandwich type of compounds, write the structure of ferrocene, recollect thepreparation of ferrocene
- Write the electronic configuration of group 18 elements,draw the structure of Xenon compounds and understand methods of preparation of Xenon.
- Distinguish between homogeneous and heterogeneous catalysis, understand the mechanisam of catalysis,write mechanism of Wilkionson's catalyst in hydrogenetion of alkenes.
- Define nanomaterial,write different methods of synthesis of nanomaterial,recite application of nanomaterials
- Explain the role of inorganic elements applied to biological system, Understand sodium pump , potassium pump, distinguish between essential and non essential elements.

References:

1. Geoffrey A. Lawrance Introduction to Coordination Chemistry John Wiley & Sons.
2. R. K. Sharma Text Book of Coordination Chemistry Discovery Publishing House
3. R. Gopalan , V. Ramalingam Concise Coordination Chemistry , Vikas Publishing House;
4. Shukla P R, Advance Coordination Chemistry , Himalaya Publishing House
5. Glen E. Rodgers, Descriptive Inorganic, Coordination, and Solid-State Chemistry Publisher: Thomson Brooks/Cole
6. Ramesh Kapoor and R.S. Chopra, Inorganic Chemistry, R. Chand publishers,
7. Basolo, F, &Pearson, R.C, Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY,
8. Twigg ,Mechanisms of Inorganic and Organometallic Reactions Publisher: Springer
9. R.K. Sharma Inorganic Reaction Mechanisms Discovery Publishing House
10. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition..
11. H.W. Porterfield, Inorganic Chemistry, Second Edition, Academic Press, 2005
12. B D Gupta & Anil J Elias Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University press
13. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press India.
14. D. F. Shriver and P. W. Atkins, Inorganic chemistry, 3rd edition, Oxford University Press
15. Cotton, Wilkinson, Murillo and Bochmann, Advanced Inorganic Chemistry, 6th Edition.
16. Jack Barrett and Mounir A Malati, Fundamentals of Inorganic Chemistry, Affiliated East west Press Pvt. Ltd., New Delhi.
17. Puri ,Sharma Kalia Inorganic chemistry. Chapter 10, Metals and metallurgy.(328-339)
18. Greenwood,N.N.andEarnshaw, Chemistry of the Elements, Butterworth Heinemann. 1997.
19. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
20. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
21. Satya Prakash, G.D.Tuli, R.D. Madan , , Advanced Inorganic Chemistry.S. Chand Co Ltd

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PRACTICALS

SEMESTER - VI

INORGANIC CHEMISTRY

COURSE CODE: SCHP601 **CREDITS: 03**

I. Inorganic preparations

1. Preparation of Tris(acetylacetonato) iron(III)
2. Green synthesis of bis(dimethylglyoximato) nickel(II) complex using nickel carbonate and sodium salt of dmg .
3. Preparation of potassium trioxalato aluminate (III)

II. Determination of percentage purity of the given water soluble salt and qualitative detection w.r.t added cation and/or anion (qualitative analysis only by wet tests).
(Any three salts of main group metal ions)

III. Estimation of talcum powder

Référence:

1. Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
2. Advanced experiments in Inorganic Chemistry., G. N. Mukherjee., 1st Edn., 2010., U.N.Dhur & Sons Pvt Ltd .
3. Vogel's. Textbook of. Macro and Semimicro qualitative inorganic analysis. Fifth edition.

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System

Semester - VI

PAPER – III : Organic Chemistry

Course Name: Organic Chemistry (60 lectures)		Course Code: **SCH603**	
Periods per week (1 period 50 minutes)		**04**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

- To inculcate knowledge about synthesis, reactivity & importance of heterocyclic compounds.
- To learn about general structure, configuration, synthesis of amino acids, polypeptides and proteins, nucleic acid and their applications
- To identify, write mechanism and product of name reactions involving rearrangements
- To learn about monosaccharides- linear and ring structures of ribose, glucose, fructose and mannose ,physical and chemical properties of glucose and fructose
- To identify and classify terpenoids, determine structure of citral
- To identify alkaloids and the different methods for structure determination of alkaloids; structure determination of nicotine and understand hormones and their physiological action
- To focus on the synthesis, structure and bonding, properties and reactivity of main group organometallics (including Grignard reagents, organolithium reagents, organozinc compounds)
- To learn the mechanism of reactions involving enolates and their applications
- To learn about redox reagents, their selectivity and synthetic applications.

		No. of lectures
Unit I	**1.1 Heterocyclic Chemistry** **1.1.1** Pyridine :Hantzsch synthesis ; basicity ; reduction ; Chichibabin reaction **1.1.2** Pyridine N-Oxide : preparation, electrophilic and nucleophilic reactions **1.1.3** Quinoline : Preparation by Skraup synthesis and reactions of quinoline with electrophiles and nucleophiles **1.1.4** Isoquinoline : Preparation by BischlerNapieralski and reactions of isoquinoline with electrophiles and nucleophiles. **1.2 Amino acids, proteins and Nucleic acids** **1.2.1** α -Amino acids , general structure, configuration, classification based on structure ; zwitterion; isoelectric point, preparation by Strecker synthesis and Gabriel phthalimide synthesis **1.2.2** Polypeptides and proteins :Nature of peptide bond, nomenclature and representation of polypeptides , Merrifield solid phase peptide synthesis, Proteins : general idea of primary, secondary and tertiary structure of proteins, Sanger's reagent for amino acid sequence in proteins **1.2.3** Nucleic acids : General structure , nucleosides, nucleotides structure of DNA and RNA including base pairing; Role of nucleic acids in self duplication and protein synthesis.	**08** **07**

Unit II	**2.1 Molecular rearrangements :** Mechanism of the following rearrangements with examples and stereochemistry wherever applicable **2.1.1** Wagner Meerwein rearrangement **2.1.2** Pinacol-pinacolone rearrangement **2.1.3** Beckman rearrangement **2.1.4** Favorskii rearrangement **2.1.5** Baeyer Villiger Oxidation **2.2 Carbohydrates** **2.2.1** Introduction : Classification, reducing and non reducing sugars, D/L notation **2.2.2** Structures of mono saccharides : Fischer projection (4-6 carbon mono-saccharides) , Haworth formula (Furanose and pyranose forms) ,Chair conformation for monosaccharides with six carbon atoms, Interconversion of different forms ; Anomers , stability of anomers epimers **2.2.3** Mutarotation and its mechanism **2.2.4** Chain lengthening and chain shortening reactions **2.2.5** Reactions of D-Glucose and D-fructose **2.2.6** Introduction to glycosides	**05** **10**
Unit III	**3.1 Natural Products** **3.1.1** Terpenoids : Introduction , Isoprene Rule, Special isoprene rule and the gem dialkyl rule **3.1.2** Citral : structure determination of citral, synthesis from methyl heptanone and isomerism in citral **3.1.3** Alkaloids :Inroduction and occurrence, reactions used in structure determination of alkaloids – Ziesel method , Reaction with MeI, test for unsaturation , functional group detection, to determine nature of amine, Hoffman exhaustive degradation in simple open chain and N-Substituted cyclic amines **3.1.4** Nicotine: Structure determination (Pinner's work), synthesis from nicotinic acid , harmful effects of nicotine. **3.1.5** Hormones: Introduction , structure of adrenaline , synthesis of adrenaline from catechol and physiological action of adrenaline **3.2 Organometallic chemistry** **3.2.**1 Intoduction: Carbon-metal bondNature, types reactivity. **3.2.2** Organo magnesium Compounds: Grignard reagent : Preparation, structure, and stability, Reaction with compounds containing acidic hydrogen,carbonyl compounds, cyanides and CO_2. **3.2.3** Organolithium Compounds : Preparation using alkyl/aryl halides. Reactions with compounds containing acidic hydrogen, alkyl halides, carbonyl compounds, cyanides and CO_2. Lithium dialkyl cuprates: Preparation and reactions with aliphatic /aromatic/vinylic halides.	**10** **05**

	3.2.4 Organozinc compounds: Preparation of dialkyl zinc. Reaction with water, acid chlorides and alkyl halides. Reformatsky reaction (with mechanism). **3.2.5** Organocopper reagents : Ullman reaction	
Unit IV	**4.1 Chemistry of enolates** **4.1.1** Introduction: generation of enolates, kinetically controlled and thermodynamically controlled enolates **4.1.2** Mechanism and applications of the following reactions i) Aldol reaction ii) Knoevenagel reaction iii) Michael reaction iv) Robinson annulations v) Wittig reaction vi) Cannizzaro reaction vii) Claisen ester condensation and Dieckmann condensation viii) Claisen -Scmidt reaction **4.2 Catalysts and reagents** Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism) **4.2.1** Catalysts for hydrogenation i. Raney Nickel ii. Pt & PtO_2 (C=C, CN, NO_2, aromatic ring) iii. Pd/C(C=C, COCl to CHO (Rosenmund reduction) iv. Lindlar catalyst (alkynes)	**10** **05**

Learning Outcomes :

At the end of this course, the student will be able to

- Explain various methods of ring synthesis, reactivity and applications of heterocyclic compounds.
- Design synthesis of organic compounds using organometallic reagents .
- Synthesise simple organic compounds using ceric ammonium nitrate (CAN), DCC, Grignard reagent, LDA, Gilman reagent, NBS and PCC.
- Explain and discuss structure determination and synthesis of citral, Alkaloids and Hormones.
- Predict the products of reactions involving rearrangements.
- Explain and discuss the structures of mono saccharides, Interconversion of different forms ; Anomers , stability of anomers epimers and Reactions of D-Glucose and D-fructose
- Predict the mechanism of reactions involving enolates
- Explain structures of amino acids, peptides and nucleic acids; classify the peptides, design synthesis of peptides using Merrifield Solid phase peptide synthesis.
- Explain the role of nucleic acids in self duplication and protein synthesis.

Suggested Reading :

1. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.
2. Handbook of Heterocyclic Chemistry, 2nd Edition, Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.
3. Heterocyclic Chemistry, 5th Edition, John A. Joule and Keith Mills, Wiley publication, 2010.
4. Heterocyclic chemistry, 3rd Edition, Thomas L. Gilchrist, Pearson Education, 2007.
5. Biochemistry, 8 th Ed., Jeremy Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto Pub. W. H. Freeman Publishers
6. Lehninger Principles of Biochemistry 7 th Ed., David Nelson and Michael Cox, Publisher W. H. Freeman
7. Name Reactions – Jie Jack Li, 4th Edition, Springer Pub
8. Organic chemistry R.T.Morrison and R.N.Boyd, 6th edition, pearson education S.H.Pine, organic chemistry 4th edition. McGraw Hill
9. Organic chemistry (fourth edition),G,Marc Loudon,Oxford University press.
10. Introduction to Organic Chemistry (Third edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmilan publishing.
11. Organic chemistry fourth edition, Morrision and Boyd.
12. Introduction to Organic chemistry,John McMurry.
13. Organic chemistry volume-1&2 (fifth and sixth edition) IL Finar.
14. Chemistry of natural products by Chatwal Anand – Vol I and Vol II
15. Chemistry of natural products by O.P. Agarwal
16. Chemistry of natural products by Meenakshi Sivakumar and Sujata Bhat.
17. Organic chemistry by Morrision and Boyd,7th edition.
18. I.L.Finar,Vol-I and Vol-II, 5th edition.
19. Principles of Organometallic Chemistry , by Coates G.E., K. Wade, P. Powell
20. Basic Organometallic Chemistry: Concepts, Syntheses and Applications by BD Gupta, Anil J. Elias
21. Organometallic Chemistry, by Gary O. Spessard, Gary L. Miessler
22. Organic chemistry by Francis Carey – McGrawHill .
23. Oranic chemistry by Carey and Sundberg, Part A & B
24. Modern Enolate Chemistry: From Preparation to Applications in Asymmetric Synthesis by Manfred Braun
25. Organic Chemistry 1st Edition, Structure, Mechanism, and Synthesis, by J. David Rawn Robert Ouellette

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PRACTICALS

SEMESTER - VI

ORGANIC CHEMISTRY

COURSE CODE: SCHP602 CREDITS: 03

A) SEMESTER VI:

Separation of Binary liquid-liquid and liquid- solid mixture.

- Minimum Six mixtures to be completed by the students.
- Components of the liq-liq mixture should include volatile liquids like acetone, methylacetate, ethylacetate, isopropylalcohol, ethyl alcohol, EMK and non volatile liquids like chlorobenzene , bromobenzene, aniline, N,N dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.
- Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.
- A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.
- After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.
- After separation into component A and component B, the compound to be identified can be decided by examiner.

References:

1. Practical organic chemistry – A. I. Vogel
2. Practical organic chemistry – H. Middleton.
3. Practical organic chemistry – O. P. Aggarwal.

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T. Y. B. Sc. CHEMISTRY (Six Units) : Choice Based Credit System

Semester - VI

PAPER – IV : Analytical Chemistry

Course Name: Analytical Chemistry (60 lectures)		Course Code: **SCH604**	
Periods per week (1 period 50 minutes)		**04**	
Credits		**2.5**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	**2.0**	**60**
	Theory Internal		**40**

Course Objectives :

The primary objective of this course is to acquire basic concepts, principles, and techniques of modern analytical chemistry that would empower students with an analytical mind set and the abilities to solve diverse analytical problems in an efficient and quantitative way that conveys the importance of accuracy and precision of the analytical results. On successful completion of this course, students will be able

1. To introduce basic analytical techniques and practical aspects of classical chemical analysis.
2. To establish an appreciation of the role of chemistry in quantitative analysis
3. To provide an understanding of chemical methods employed for elemental and compound analysis.

4 To provide experience in some scientific methods employed in analytical chemistry.

			No. of lectures
UNIT I:	**ELECTRO ANALYTICAL TECHNIQUES**		
1.1	**Polarography (Numerical and word problems are expected)**		**11**
	1.1.1	Difference between potentiometry and voltammetry, Polarizable and non-polarizable electrodes	
	1.1.2	Basic principle of polarography H shaped polarographic cell, DME (construction, working, advantages and limitations)	
	1.1.3	DC polarogram: Terms involved - Residual current, Diffusion current, Limiting current, Half-Wave Potential Role and selection of supporting electrolyte, Interference of oxygen and its removal, polarographic Maxima and Maxima Suppressors Qualitative aspects of Polarography: Half wave potential $E_{1/2}$, Factors affecting $E_{1/2}$ Quantitative aspects of polarography: Ilkovic equations: various terms involved in it (No derivation)	

	1.1.4	Quantification 1) Wave height – Concentration plots (working plots/calibration) 2) Internal standard (pilot ion) method 3) Standard addition method	
	1.1.5	Applications advantages and limitations	
1.2	**Amperometric Titrations**		**04**
	1.2.1	Principle, Rotating Platinum Electrode(Construction, advantages and limitations)	
	1.2.2	Titration curves with example	
	1.2.3	Advantages and limitations	
UNIT II: METHODS OF SEPARATION - II			
2.1	**Gas Chromatography** (**Numerical and word problems are expected**)		**09**
	2.1.1	Introduction, Principle, Theory and terms involved	
	2.1.2	Instrumentation: Block diagram and components,types of columns, stationary phases in GSC and GLC, Detectors: TCD, FID, ECD	
	2.1.3	Qualitative, Quantitative analysis and applications	
	2.1.4	Comparison between GSC and GLC	
2.2	**Ion Exchange Chromatography**		**06**
	2.2.1	Introduction, Principle.	
	2.2.2	Types of Ion Exchangers , Ideal properties of resin	
	2.2.3	Ion Exchange equilibria and mechanism, selectivity coefficient and separation factor Factors affecting separation of ions	
	2.2.4	Ion exchange capacity and its determination for cation and anion exchangers.	
	2.2.5	Applications of Ion Exchange Chromatography with reference to Preparation of demineralised water, Separation of amino acids	
UNIT III: FOOD AND COSMETICS ANALYSIS			
3.1	**Introduction to food chemistry**		**10**
	3.1.1	Food processing and preservation: Introduction, need, chemical methods, action of chemicals(sulphur dioxide, boric acid, sodium benzoate, acetic acid, sodium chloride and sugar) and pH control Physical methods (Pasteurization and Irradiation)	
	3.1.2	Determination of boric acid by titrimetry and sodium benzoate by HPLC.	

	3.1.3	Study and analysis of food products and detection of adulterants **1)** Milk: Composition & nutrients, types of milk (fat free, organic and lactose milk) Analysis of milk for lactose by Lane Eynon's Method **2)** Honey: Composition, Analysis of reducing sugars in honey by Coles Ferricyanide method **3)** Tea: Composition, types (green tea and mixed tea) Analysis of Tannin by Lowenthal's method **4)** Coffee: Constituents and composition, Role of Chicory Analysis of caffeine by Bailey Andrew method.	

3.2	**Cosmetics**		**05**
	3.2.1	Introduction and sensory properties	
	3.2.2	Study of cosmetic products – **1)** Face powder: Composition Estimation of calcium and magnesium by complexometric titration **2)** Lipstick: Constituents Ash analysis for water soluble salts: borates, carbonates and zinc oxide **3)** Deodorants and Antiperspirants: Constituents, properties, Estimation of zinc by gravimetry	
UNIT IV: THERMAL METHODS AND ANALYTICAL METHOD VALIDATION			
4.1	**Thermal Methods**		**08**
	4.1.1	Introduction to various thermal methods (TGA, DTA and Thermometric titration)	
	4.1.2	**Thermogravimetric Analysis(TGA)** Instrumentation-block diagram,thermobalance (Basic components: balance, furnace, temperature measurement and control, recorder) Thermogram (TG curve)for$CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ Factors affecting thermogram-Instrumental factors and Sample characteristics Applications: Determination of drying and ignition temperature range Determination of percent composition of binary mixtures	
		(Estimation of Calcium and Magnesium oxalate)	

	4.1.3	**Differential Thermal Analysis (DTA):** Principle**,** Instrumentation, and Reference material used	
		Differential thermogram (DTA curve) $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$	
		Applications Comparison between TGA and DTA.	
	4.1.4	**Thermometric Titrations –** Principle and Instrumentation Thermometric titrations of : i. HCl v/s NaOH ii. Boric acid v/s NaOH iii. Mixture of Ca^{+2} and Mg^{+2} v/s EDTA **iv.** Zn^{+2} with Disodium Tartarate**.**	
4.2	**Analytical Method Validation**		
	4.2.1	Introduction and need for validation of a method	**02**
	4.2.2	Validation Parameters: Specificity, Selectivity, Precision, Linearity, Accuracy and Robustness.	**02**
4.3	**4.3.1**	**Mass Spectroscopy** Basic principle, instrumentation, various components of instruments	**03**
	4.3.2	Applications of Mass spectrometry	

<u>Learning Outcomes</u> :

At the end of this course, the student will know

1. Discuss the principles of polarography and amperometric titrations,
2. Classify the different types of chromatography and discuss its applications.
3. Compare the food industry with the cosmetic industry
4. Differentiate between TGA and DTA
5. Evaluate the analytical method of validation and explain the principle and applications of mass spectrometry.

References :

1.	An Advance Dairy chemistry, V 3, P. F. Fox, P. L. H. McSweeney Springer	Unit/s (3.1,3.2)
2.	Analysis of food and Beverages, George Charalanbous, Academic press 1978	Unit/s (3.1,3.2)
3.	Analytical Chemistry of Open Learning(ACOL),James W. Dodd & Kenneth H. Tonge	Unit/s (4.1,4.2)
4.	Analytical chemistry David Harvey The ,McGraw Hill Companies, Inc.	Unit/s (4.1,4.2)
5.	Analytical Chemistry, Gary.D Christan, 5th edition	Unit/s (2.1,2.2)
6.	Analytical chemistry, R. K. Dave.	Unit/s (2.1,2.2)
7.	Chemical methods of separation, J A Dean, Van Nostrand Reinhold, 1969	Unit/s (2.1,2.2)
8.	Egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8	Unit/s (1.1,1.2,1.3)
9.	Food Analysis, Edited by S. Suzanne Nielsen, Springer	Unit/s (3.1,3.2)
10.	Food Analysis: Theory and practice, YeshajahuPomeranz, Clifton E. Meloan, Springer	Unit/s (3.1,3.2)
11.	Formulation and Function of cosmetics, Sa Jellineck	Unit/s (3.1,3.2)
12.	Fundamentals of Analytical Chemistry, D .A. Skoog and D. M. West and F. J. Holler Holt., Saunders 6th Edition (1992)	Unit/s (2.1,2.2)
13.	Government of India publications of food drug cosmetic act and rules.	Unit/s (3.1,3.2)
14.	Harry's Cosmetology, Longman scientific co.	Unit/s (3.1,3.2)
15.	High Performance Thin Layer Chromatography in Food analysis, by Prem kumar, CBS Publisher and distributer	Unit/s (3.1,3.2)
16.	Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd	Unit/s (1.1,1.2,1.3) (4.1,4.2,4.3)
17.	Introduction to Polarography and Allied Techniques, By Kamala Zutshi, New Age International, 2006.	Unit/s (1.1,1.2,1.3)
18.	Modern cosmetics, E. Thomessen Wiley Inter science	Unit/s (3.1,3.2)
19.	Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman	Unit/s (4.1,4.2,4.3)
20.	Principles of Polarography by Jaroslav Heyrovský , Jaroslav Kůta, 1st Edition, Academic Press, eBook ISBN: 978148326478	Unit/s (1.1,1.2,1.3)
21.	Solvent extraction and ion exchange, J Marcus and A. S. Kertes Wiley INC 1969	Unit/s (2.1,2.2,)

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PRACTICALS

SEMESTER - VI

ANALYTICAL CHEMISTRY

COURSE CODE: SCHP602 **CREDITS: 03**

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1. Estimation of Chromium in water sample spectrophotometrically by using Diphenyl carbazide.
2. Estimation of reducing sugar in honey by Willstatter method.
3. Estimation o Mg^{+2} & Zn^{+2} by anion exchange resin. using an anion exchange resin
4. Estimation of acetic acid in Vinegar sample by using Quinhydrone electrode potentiometrically.
5. Determination of phosphoric acid in cola sample pH metrically.

Note: Calculation of percent error is expected for all the experiments

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References:

1. Vogel's Textbook of Quantitative Chemical Analysis, 5thEdn., G. H. Jeffery, J Bassett, J Memdham and R C Denney, ELBS with Longmann (1989).
2. Vogel's Textbook of Quantitative Chemical analysis, Sixth edition, J.Mendham et.al
3. The chemical analysis of food and food products III edition Morris Jacob
4. The chemical analysis of food by David Pearson and Henry Edward

Bhalchandra Bhanage

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