ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS UNDER CBCS PATTERN(w.e.f.2017-18)

B.Sc. CHEMISTRY – PROGRAMME STRUCTURE

Sem	Part	Course Code	Title of the Course	Cr.	Hrs./ Week	Marks		Total
						Int.	Ext.	
I	I	711T	**Tamil/other languages – I**	3	6	25	75	100
	II	712E	**English – I**	3	6	25	75	100
	III	7BCH1C1	**Core-I**-Fundamentals of Chemistry	4	6	25	75	100
		7BCH1P1	**Core – II –** Inorganic and organic Volumetric Analysis Practical – I	4	6	**40**	**60**	100
		-----	**Allied – I –** (Theory only) **(or)**	5	5	25	75	100
			Allied – I – (Theory cum Practical)	4	3	15	60	75
			Allied Practical – I	-	2**	--	--	---
	IV	7NME1A / 7NME1B / 7NME1C	**(1) Non-Major Elective – I (A)** தமிழ்மொழியின் அடிப்படைகள்/ **(B)** இக்கால இலக்கியம் / **(C)** Communicative English	2	1	25	75	100
			Total(Allied – Theory only)	**21**	**30**	**-**	**-**	**600**
			Total(Allied-Theory cum Practical)	**20**				**575**
II	I	721T	**Tamil/other languages – II**	3	6	25	75	100
	II	722E	**English – II**	3	6	25	75	100
	III	7BCH2C1	**Core –III–** Physical Chemistry –I	4	5	25	75	100
		7BCH2C2	**Core – IV –** Inorganic Chemistry–I	4	6	25	75	100
			Allied – II – (Theory only) **(or)**	5	5	25	75	100
			Allied– II – (Theory cum Practical)	4	3	15	60	75
			Allied Practical – I	2	2	20	30	50
	IV	7BES2	**(3) Environmental Studies**	2	2	25	75	100
			Total(Allied – Theory only)	**21**	**30**	**-**	**-**	**600**
			Total(Allied-Theory cum Practical)	**22**				**625**
III	I	731T	**Tamil /other languages – III**	3	6	25	75	100
	II	732E	**English – III**	3	6	25	75	100
	III	7BCH3C1	**Core – V –**Organic Chemistry – I	4	5	25	75	100
		7BCH3P1	**Core – VI –** Inorganic and organic Qualitative Analysis Practical – II	4	5	**40**	**60**	100
			Allied – III – (Theory only) **(or)**	5	5	25	75	100
			Allied– III –(Theory cum Practical)	4	3	15	60	75
			Allied Practical – I	-	2**	--	--	---
	IV	7NME3A/ 7NME3B/ 7NME3C	**(1) Non-major Elective – II –** **(A)**இலக்கியமும் மொழிப்பயன்பாடும்/ **(B)** பழந்தமிழ் இலக்கியங்களும் இலக்கியவரலாறும்/ **(C)**Employability Skills	2	1	25	75	100
		7SBS3A1/ 7SBS3A2/ 7SBS3A3	**(2) Skill Based Subjects – I**	2	2	25	75	100

	V	7BEA3	**Extension activities**	1	--	100	--	100
			Total(Allied – Theory only)	**24**	**30**	-	-	**800**
			Total(Allied-Theory cum Practical)	**23**				**775**
IV	I	741T	**Tamil /other languages – IV**	3	6	25	75	100
	II	742E	**English – IV**	3	6	25	75	100
	III	7BCH4C1	**Core– VII–** Physical Chemistry– II	4	4	25	75	100
		7BCH4C2	**Core–VIII–**Inorganic Chemistry–II	4	5	25	75	100
			Allied – IV – (Theory only) **(or)**	5	5	25	75	100
			Allied– IV –(Theory cum Practical)	4	3	15	60	75
			Allied Practical – I	2	2	20	30	50
	IV	7SBS4B1/ 7SBS4B2/ 7SBS4B3	**(2) Skill Based Subjects – II**	2	2	25	75	100
		7BVE4/ 7BMY4/ 7BWS4	**(4) Value Education /Manavalakalai Yoga /Women's Studies**	2	2	25	75	100
			Total(Allied – Theory only)	**23**	**30**	-	-	**700**
			Total(Allied-Theory cum Practical)	**24**				**725**
V	III	7BCH5C1	**Core –IX–**Organic Chemistry– II	4	5	25	75	100
		7BCH5C2	**Core–X –** Physical Chemistry–III	4	5	25	75	100
		7BCH5P1	**Core–XI–**Gravimetric Estimation and Organic Preparation Practical-III	4	4	**40**	**60**	100
		7BCH6P1	**Core–XII–**Physical Chemistry–Practical–IV	-	2*	--	--	---
		7BCHE1A/ 7BCHE1B	**Elective–I–A)**Analytical Chemistry **(or) B)**Agricultural Chemistry	5	5	25	75	100
		7BCHE2A/ 7BCHE2B	**Elective–II–A)**Industrial Chemistry **(or) B)**Medicinal Chemistry	5	5	25	75	100
	IV	7SBS5A4/ 7SBS5A5/ 7SBS5A6/ 7SBS5A7	**(2) Skill Based Subjects – I**	2	2	25	75	100
			(2) Skill Based Subjects – I	2	2	25	75	100
			Total	**26**	**30**	-	-	**700**
VI	III	7BCH6P1	**Core–XII–**Physical Chemistry –Practical – IV	4	4	**40**	**60**	100
		7BCH6C1	**Core–XIII–**Inorganic Chemistry–III	4	6	25	75	100
		7BCH6C2	**Core–XIV–**Organic Chemistry-III	4	6	25	75	100
		7BCH6P2	**Core–XV–**Applied Chemistry Practical – V	4	5	**40**	**60**	100
		7BCHE3A/ 7BCHE3B/ 7BCHEPR	**Elective–III–A)**Polymer Chemistry **(or) B)**Material Chemistry & Nano-Science **(or) C)**Project*	5	5	25 **40***	75 **60***	100
	IV	7SBS6B4/ 7SBS6B5/ 7SBS6B6 7SBS6B7	**(2) Skill Based Subjects – II**	2	2	25	75	100
			(2) Skill Based Subjects – II	2	2	25	75	100
			Total	**25**	**30**	-	-	**700**
			Grand Total	**140**	**180**	-	-	**4100**

****** **University Examinations will be held in the Even Semesters only.**

B.Sc. CHEMISTRY

I YEAR - I SEMESTER
COURSE CODE: 7BCH1C1

CORE COURSE – I - FUNDAMENTALS OF CHEMISTRY

Unit I Atomic and molecular composition of matter:

1.1. Atom – constituents of an atom. Elementary particles and composite particles (hadrons). Atomic Structure: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Atomic spectrum of hydrogen. Zeemann effect. Molecules – molecular weight – mole – Avogadro number – calculating number of moles.

1.2. **Quantum mechanics:** Fundamental postulates of quantum mechanics. Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$. Schrödinger equation for hydrogen atom. Radial and angular parts of the wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals.

1.3. Quantum numbers – principal – orbital – angular momentum quantum numbers (n,l and m). Significances of quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin – spin quantum number (s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Relative energies of atomic orbitals – anomalous electronic configurations.

Unit II Periodic table:

2.1. **Periodicity of Elements:** Modern periodic law. Structure of modern periodic table (long form of periodic table). Classification of elements as s, p, d, f block elements.

2.2. **Periodic variation of properties:** Detailed discussion on the variation various fundamental properties of the elements. Effective nuclear charge – shielding or screening effect and Slater rules. Atomic radii (van der Waals) and ionic radii. Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy and applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of metallic character in periodic table.

2.3.**Comparison of different groups and periods:** anomalies between first and second rows. Diagonal relationships. Participation of d – orbital in compound formation. Periodic anomalies of the non-metals and posttransition metals.

Unit III

3.1.Sources of organic compounds.

3.2.Naming of organic compounds with single or more number of functional groups in trivial and IUPAC systems.

3.3.Molecular weight determination of organic acids and bases by silver salt and platinicchloride methods. Problems arriving empirical and molecular formula using percentage composition of elements and molecular weight.

3.4.Structural formula – Shapes of organic molecules. sp3, sp2 and sp hybridization in organic compounds with suitable examples.

3.5.Classification of organic compounds as aliphatic, aromatic, alicyclic and hetero cyclic compounds.

3.6.Steric and electromeric effects. Inductive effect, +I and –I effects, resonance effects (delocalized chemical bonding), rules for resonance, resonance stabilization energy, hyperconjugation. Explanation with suitable examples for each.

Unit IV Physical properties and chemical constitution:

4.1 Classification of physical properties of materials as additive properties, constitutive properties, additive constitutive properties and colligative properties with suitable examples. Vector and scalar properties with suitable examples. Extensive and intensive properties.

4.2 Dipole moment, calculation of dipole moment and bond length. Bond moment and dipole moment. Calculating percentage of ionic character from dipole moment and electronegativity differences.

4.3 Magnetic properties, para, dia, ferro antiferro and ferri magnetism. Curie temperature (TC). Magnetic susceptibility, Determination of magnetic susceptibility, spin only magnetic moment and its relationship to number of unpaired electrons.

4.4 Molar volume, surface tension and parachor. Atomic and structural parachors and their uses to fix the exact structure.

Unit V Introduction to computers:

5.1. **Basics:**Types of computer – different components o a computer – constants – variables – bits and bytes. Binary number system – representation of integers – conversion of a decimal to binary and vice- versa. Other number systems and their mutual conversion.

5.2. Programming – algorithm – flow charts . operating systems. Expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Compiled versus interpreted languages. Debugging. Simple programs using these concepts for calculating the rate constants, velocity of gaseous molecules and molar concentration, normality of a solution, matrix addition, matrix Multiplication and statistical analysis.

5.3. List of computer software and their uses in chemistry.

Text Books:

1. Inorganic chemistry – R.D. Madhan
2. Advanced inorganic chemistry – Sathyapraash
3. Inorganic Chemistry – J.D. Lee
4. Organic chemistry – PL. Soni
5. Organic Chemistry – Sharma
6. Organic Chemistry – Morrison & Boyd
7. Organic Chemistry – I.L. Finar (Vol. I & II)
8. Advanced Physical Chemistry –Puri,Sharma & Pathania.
9. Physical Chemistry – G. W. Castellan 7th edition
10. Physical Chemistry – S. Glasstone

Books for Reference:

1. Inorganic Chemistry – Shriver and Atkins 7th edition
2. Inorganic Chemistry – Catherine 2nd edition.
3. Organic Chemistry – Mc Muray 7th edition
4. Organic Chemistry – L. G. Wade 6th edition
5. Organic Chemistry – J. Clayden 7th edition
6. Organic Chemistry – Y. Paula 4th edition
7. Physical Chemistry – Iran N Levin 6th edition
8. Physical Chemistry – Peter Atkins 7th edition
9. Physical Chemistry – Paul Monk 4th edition

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I YEAR – I SEMESTER
COURSE CODE: 7BCH1P1

CORE COURSE II - INORGANIC AND ORGANIC VOLUMETRIC ANALYSIS PRACTICAL - I

Inorganic Volumetric Estimation:

S. No	Standard	Link	Estimation
	Acid – Base neutralization		
1	Sodium carbonate	Hydrochloric acid	Sodium hydroxide
2	Oxalic acid	Sodium hydroxide	Oxalic acid
3	Sodium carbonate	Hydrochloric acid	Sodium Carbonate
	Redox – Permanganometry		
4	Oxalic acid	permanganate	Ferrous sulphate
5	Ferrous ammonium sulphate	permanganate	Ferrous sulphate
6	Oxalic acid	permanganate	Oxalic acid
7	Ferrous ammonium sulphate	permanganate	Oxalic acid
	Dichrometry		
8	Ferrous ammonium sulphate	Potassium dichromate	Ferrous sulphate
	Iodimetry		
9	Potassium dichromate	Sodium thiosulphate	Potassium dichromate
10	Potassium dichromate	Sodium thiosulphate	Copper sulphate
11	Potassium dichromate	Sodium thiosulphate	Permanganate

II. Organic Volumetric Estimation:

1. Estimation of phenol
2. Estimation of aniline
3. Estimation of glucose

Distribution of marks in the external practical examinations.

Total marks – 60

Record Note – 10 marks
Viva – voce – 10 marks
Inorganic procedure – 5 marks
Organic procedure – 5 marks
Correct report with less than 1% error – each 15 – marks
Report with more than 1% error less 1 mark for every 0.3%
Report with more than 3% error - only 3 marks

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I YEAR - II SEMESTER
COURSE CODE: 7BCH2C1

CORE COURSE - III - PHYSICAL CHEMISTRY- I

Unit I Gaseous state – 1

1.1.**Gaseous state:** Kinetic molecular model of a gas: postulates and derivation of the kinetic equation of gaseous state. Derivation of laws of gaseous state from equation of kinetic theory of gases. Different types of velocities, derivation of expressions for different types of velocities and calculating different types of velocities.

1.2.**Collision parameters:** Collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η.

1.3.Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Unit II Behaviour of real gases:

2.1. Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases.

Reasons for deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining the behaviour real gas, other equations of state (Berthelot, Dietrici, virial equation of state), van der Waals equation expressed in virial form. Significances of van der Waals constants.

2.2. Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states.

2.3. Critical state, relation between critical constants and van der Waals constants. Law of corresponding states and reduced equation of states. Significances of reduced equation of state.

Unit III Liquid state & Surface chemistry

3.1. Qualitative treatment of the structure of the liquid state. Vacancy theory of liquids and free volume in a liquid. Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Temperature dependence of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water. Cohesive forces. Mixture of liquids. Henry's law.

3.2. Liquid crystals, general structural and electronic features of compounds existing in liquid crystalline forms. Classification of liquid crystals with suitable examples. Theory of liquid crystals. Uses of liquid crystals.

3.3.**: Adsorption** – definition of adsorption, adsorbents and adsorbates. Adsorption of gases on solids. Classification of adsorptions with examples. Differences between kinds adsorptions. Adsorption isotherms, derivation of Langmuir's and BET adsorption isotherms. Adsorption from solutions. Gibb's adsorption isotherm,

3.4 **Catalysis:** Catalysts – characteristics of catalysts – classification of catalysts – theories of catalysis – specific and general acid base catalysis. Enzyme catalysis – characteristics of enzyme catalysis – lock and key mechanism – Michaelis – Menten equation.

Unit IV Colloidal state:

4.1 Colloids definition, differences between colloids, solutions and suspensions. Classification of colloids with suitable examples for each class. Sols, classification of sols and differences between lyophilic and lyophobic sols. Hydrophilic and hydrophobic sols with suitable examples. Purification of colloids – dialysis. Stability of colloids and double layer theory. Zeta potential and stability of colloids. Coagulation . Hardy – Schulz law. Hofmeister's series. Protective colloids – gold number.

4.2. **Properties of colloids:** Optical property – kinetic properties – electrical properties such as electrophoresis and electro osmosis.

4.3. **Emulsions:** definition – classification – stability of emulsion – emulsifier – Bancraft's rule. Gels: classification of gels. Imbition – syneresis – thixotropy.

4.4. Applications of colloids in medicine, pollution control – Cottrell precipitator – waste water treatment. Delta formation – smoke screen. Explanation of cleaning action of detergents. Separation of proteins.

Unit V Chemical equilibrium:

5.1. Reversible and irreversible chemical reactions with suitable examples. Law of mass action and derivation of the law of mass action from collision theory of chemical reactions. Chemical equilibrium – equilibrium constants in terms of concentration of reactants (Kc) mol fraction (Kx) and partial pressure (Kp). Relationship between Kp and Kc.

5.2. Application of law of mass action to derive the equilibrium constants Kc & Kp for chemical reactions such as formation of ammonia from H2 and N2, decomposition of PCl5, N2O5, CaCO3 and CuSO4.5H2O. Calculating equilibrium constants Kp & Kc for the above reactions and mutual conversions.

5.3 Le – Chatelier principle:

Le – Chatelier principle and its significances. Application of the principle and identification of suitable reaction conditions to the formation of ammonia, PCl5, N2O5, CaCO3 and the decomposition of CuSO4.5H2O.

Text Books:

1. Advanced Physical Chemistry –Puri,Sharma & Pathania.
2. Physical Chemistry – G. W. Castellan 7th edition
3. Physical Chemistry – S. Glasstone

Books for Reference:

4. Physical Chemistry – Iran N Levin 6th edition
5. Physical Chemistry – Peter Atkins 7th edition
6. Physical Chemistry – Paul Monk 4th edition

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I YEAR - II SEMESTER
COURSE CODE: 7BCH2C2

CORE COURSE - IV - INORGANIC CHEMISTRY – I

Unit I Chemical Bonding – I

1.1. **Ionic bond:** General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinski expression for lattice energy. Madelung constant, Born-Haber cycle and its applications. Energy of dissolution.

1.2. **Covalent bond:** Lewis structure, Valence Bond theory (Heitler-London approach). Hybridization energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl, BeF2, CO2.

1.3. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds. Bond moment and dipole moment. Percentage of ionic character from dipole moment and electronegativity differences.

1.4 Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules containing lone pairs and bond pairs of electrons such as H2O, NH3 and CH4. Multiple bonding (σ and π bond approach) and bond lengths.

Unit II Solid State

2.1. Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, law of symmetry, unit cell, space lattice and Bravais lattice. Crystalline parameters. Seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Lattice energy and calculation of lattice energy. Born – Lande equation and Born – Haber cycle. Applications of lattice energy calculations.

2.2. **Types of crystals:** Ionic crystals, general characteristics and crystalline structures of NaCl, CsCl and KCl. Molecular crystals. Covalent crystals, structure of graphite and diamond. Allotropes and isomorphs with suitable examples.

2.3. **Metallic crystals:** Properties of metals. Band theory and its significances in explaining conductance, semi conductance and insulators. Defects in crystals and types of crystal defects. Types of semiconductors.

2.4 **Weak Chemical Forces:** van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces. Hydrogen bonding (theories of hydrogen bonding, valence bond treatment). Effects of chemical force, melting, boiling points and solubility. Solubility and energy of dissolution process.

Unit III Aqueous and non – aqueous medium

3.1 Acid base chemistry in aqueous medium: properties of water – self ionisation of water. Amphoteric nature of water.

3.2. Classification of compounds as acids and bases. Theories of acid and bases. Arrhenius theory, Lowry – Bronsted theory (conjugate acid – base theory) and Lewis theory. Relationship between acid – base strength and molecular structure. Acid – base interaction and

HOMO – LUMO concept. Lewis acid – base theory and frontier orbitals. HOMO – LUMO energy and solubilities. Hard and soft acid base theory.

3.3. Non – aqueous media (aprotic solvents) :Acid–base behaviour in non-aqueous solvents. Liquid ammonia, Liquid hydrogen fluoride, Sulfuric acid, fluorosulfonic acid, Bromine trifluoride, Dinitrogen tetraoxide Ionic liquids Supercritical fluids.

Unit IV Nuclear chemistry:

4.1.Constitution of nuclei – stability of nuclei and (n-p) ratio – relationship. Magic number, mass defect, mass energy relationship, binding energy and calculation of binding energy from mass defect.

4.2.**Radioactivity:** Natural radioactivity – Q value, cross sections, types of reactions, — Soddy's group displacement law – Radioactivity equilibrium – Rate of radioactive disintegration – half life period and average life period– radioactive disintegration series. Detection and estimation of radioactivity, G. M. Counter, ionization counter and proportional counter.

4.3.**Artificial radioactivity:** Definition and various types of induced nuclear reactions.

4.4.**Nuclear fission & fusion:** Theory of nuclear fission, fissionable and non-fissionable elements, nuclear chain reactions, critical size. Applications – principle of atom bomb and nuclear power generation. Theory of nuclear fusion, proton – proton chain reactions. Solar and Stellar energy – principle of hydrogen bomb

4.5.**Applications of radioactivity:** medicine – agriculture – industry – structural elucidations– carbon dating.Radioactive technique; tracer technique, neutron activation analysis.

4.6.**Particle accelerators:** linear accelerator – cyclotron.

Unit V Metallurgy

5.1. **Basic principles of Metallurgy :** Ore dressing: Gravity separation – Froath flotation – Magnetic separation – Roasting– Calcination – Smelting – Flux – Purification – Electrolytic refining – Zone refining – Van-Arkel vapour phase refining – Alumino thermit process.

5.2. **Oxides:** classification of oxides on the basis of composition, acidic and basic characters with suit examples. Preparation of hydrogen peroxide and its properties.

5.3. **Hydrides:** definition classification of hydrides with suitable examples. Preparation, properties, structure and uses of boranes. Sodium borohydride, lithium aluminium hydride. Hydrides as reducing agents.

5.4. **Carbides:** Definition, classification, preparation and uses.

Text Books:

1. Inorganic chemistry – R.D. Madhan
2. Advanced inorganic chemistry – Sathyapraash
3. Inorganic Chemistry – J.D. Lee

Books for Reference:

1. Inorganic Chemistry – Shriver and Atkins 7th edition
2. Inorganic Chemistry – Catherine 2nd edition.
3. Inorganic Chemistry – James E. Hu

II YEAR - III SEMESTER
COURSE CODE: 7BCH3C1

CORE COURSE - V - ORGANIC CHEMISTRY – I

Unit I Isomerism:

1.1. Constitutional Isomerism (Structural isomerism) such as chain isomerism, functional isomerism, positional isomerism, tautomerism.

1.2. **Conformational Analysis:** two dimensional representations of three dimensional molecular structures such as Fischer projection, Newman projection and sawhorse formula. Conformations and their relative stabilities of ethane, propane and butane. Stability of cyclic hydrocarbons, Bayer strain theory and its modification. Conformations of cyclohexane.

1.3. Configurational Isomerism (Stereo isomerism): Geometrical isomerism and E – Z notation. Cis – trans isomerism in maleic and fumaric acid, 2- buteen and di-substituted cyclohexane derivatives.

1.4. **Optical Isomerism:** Conditions for a compound to be optically active with suitable examples. Optical activity, specific rotation and its experimental method of determination. . Absolute configuration. R and S notation of configurational isomers. Enantiomers and diastereomers. Optical isomerism in lactic acid and tartaric acid. Optical activity in substituted biphenyles, allenes, spiranes and organic nitrogen derivatives. Racemic mixture and resolution of racemic mixtures by chemical and chromatographic methods. Calculating enantiomeric excess and optical purity. Biological importance of configurational isomerism.

Unit II

2.1. **Reaction intermediates:** Homolytic fission and Heterolytic fission of bonds. Sources and stability of carbocations and carbanions. Role of Steric and electromeric effects on the stability of reaction intermediates. Relative stabilities of primary, secondary, tertiary and allyl carbocations, carbanions and free radicals. Nucleophilic and electrophilic reagents.

2.2. **Types of reactions:** Substitution, addition, elimination, rearrangement, insertion and polymerization reaction with suitable examples. SN1, SN2, SNI, SE1, SE2 E1 and E2reaction mechanisms. Competition between SN1 and E1. Structural and medium preference between competing reactions.

2.3. **Free radicals:** sources of free radicals, stability of free radicals. Role of steric and electromeric effects on the stability of free radicals. Long living and short living free radicals. Mechanism of reactions involving free radicals. Radical inhibitors and their role in food preservation. BHA and vitamin E. Carbenes, formation structure and electrophilic and nucleophilic nature of carbenes.

Unit III

3.1. **Aliphatic hydrocarbons:** classification of hydrocarbons – alkanes, alkenes alkynes and cycloalkanes. Sources of alkanes, petroleum refining, catalytic cracking. Structure and properties of alkanes. Uses of alkanes, LNG, LPG and gasoline. Octane number and its variation with structure.

3.2. **Alkenes:** preparation of alkenes by catalytic cracking, dehydration, dehydrohalogenation. Bredt's rule, Zaitsav's rule and Hoffman products. Cis – trans isomerism

in alkenes and their relative stabilities.Properties of alkenes. Electrophilic addition to double bonds - hydrohalogenation and markovnikov's rule. Halogenation – halonium ion formation. Free radical addition and peroxide effect. Hydration – oxymercuration and demercuration, hydroboration. Hydrogenation of alkenes addition of carbenes to alkenes. Epoxidation and hydroxylation – osmium tetrxoide hydroxylation. Osonolysis, polymerization and hydrogenation of alkenes. Commercial importance of alkenes.

3.3. **Alkynes:** Synthesis of alkynes from acetylide ion, by elimination reaction, manufacture of acetylene. Acidity of alkynes and the synthesis of other alkynes from acetylide ion. Reduction of alkynes by using lithium in ammonia and hydrogenation over the Lindlar catalyst. Addition of hydrogen halides, halogens to alkynes. Mercury (II) catalyzed hydration of alkynes. Oxidation of alkynes by hydroboration reaction. Commercial importance of acetylene and methyl acetylene and MAPP gas.

Unit IV Aromatic hydrocarbons:

4.1. **Sources of aromatic compounds:** Naming of aromatic compounds (aryl derivatives and aryl substituted alkyl derivatives). Structure and stability of benzene, molecular orbital theory. Aromaticity and the 4n + 2 (Huckel rule). Aromaticity of ions. Polycyclic aromatic compounds, annulenes.

4.2. **Reactions of benzene:** electrophilic aromatic substitutions. Halogenation, alkylation, acylation, nitration, sulphonation and hydroxylation and their mechanisms. Nucleophilic substitution reactions. Wurtz – Fittig reaction, comparison with Friedel – Crafts reaction.

4.3. Substituent effect on further substitution. Activating and deactivating groups. Directing effects, ortho, para directing groups and meta directing groups. Explanation for activating and directing effects of substituents in the conversion of mono substituents into disubstituents. Additive effects in the conversion of di- substituted into tri- substituted aromatic compounds.

Unit V Alcohols, Phenols and Ethers:

5.1. Alcohols: classification of alcohols, preparation properties and uses of alcohols. Rectified spirit, absolute alcohol, methylated spirit and power alcohol. Preparation, properties and uses of allyl alcohol. Polyhydric alcohol: Estimation of number of hydroxyl groups in a polyhydric alcohol.

5.2. **Phenols:** Preparation and properties phenols. Comparison of phenols with alcohols. Libermann, Lederer – Manasse, Reimer – Tiemann reactions. Elbs persulphate reaction. Conversion of phenol in to phenolic acids. Preparation properties and uses of substituted phenols such as anisole and quinols. Preparation and properties of catechol, resorcinol, pyrogallol, hydroxylquinol and phloroglucinol. Conversion of catechol into safrole. Protection of hydroxyl groups and their regeneration.

5.3. **Ethers:** Preparation of diethyl ether, chlorex and vinyl ether.Estimation of alkoxy group– Zeisel's method. Thioalcohols and thioethers: Preparation and uses of ethyl mercaptan, sulphonal, epoxides and mustard gas. Peroxides – preparation, properties and uses. Aromatic ethers, preparation properties and uses of guaicol, veratrole, eugenol, anethole phenacetin and dulcin. Conversion of ethers into alcohols. Crown ethers. Organic sulphides.

Text Books:

1. Organic chemistry – PL. Soni
2. Organic Chemistry – Sharma
3. Organic Chemistry – Morrison & Boyd
4. Organic Chemistry – I.L. Finar (Vol. I & II)

Books for Reference:

1. Organic Chemistry – Mc Muray 7th edition
2. Organic Chemistry – L. G. Wade 6th edition
3. Organic Chemistry – J. Clayden 7th edition
4. Organic Chemistry – Y. Paula 4th edition
5. Organic chemistry – Jerry March

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II YEAR - III SEMESTER
COURSE CODE: 7BCH3P1

CORE COURSE - VI -INORGANIC & ORGANIC QUALITATIVE ANALYSIS PRACTICAL - II

Hrs. Per week: 6

I.Inorganic Qualitative Analysis:

To analyse a mixture of inorganic salt contains two anions and two cations. One of the anion should be interfering anionic radicals.

II.Organic Qualitative Analysis:

To analyse an organic compound to identify the special elements present, Aromaticity, saturation and functional groups.

External mark distribution:

Record note book – 10 marks
Viva – voce – 10 marks
Inorganic qualitative analysis – 20 marks
Organic qualitative analysis – 20 marks

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II YEAR - IV SEMESTER
COURSE CODE: 7BCH4C1

CORE COURSE - VII - PHYSICAL CHEMISTRY – II

Unit I Thermodynamics – 1

1.1.**First law of thermodynamics:** systems and surroundings. State of a system and state variables. extensive and intensive properties. Process and their types. State functions and path functions. Exact and inexact differentials. Euler reciprocal relation. Cyclic rule. Internal energy, heat and work. First law of thermodynamics.

1.2.Enthalpy of a system. Heat capacity of a system Cv and Cp and the relationship between them. Isothermal and adiabatic expansions of a gas. Reversible and irreversible processes with suitable examples and differences between them. Work done in reversible and irreversible isothermal and adiabatic processes. Calculation of q, w, ΔU, ΔH, Cv, Cp. Joule – Thomson expansion, Joule – Thomson coefficient of an ideal and real gases. Derivation of expressions for Joule – Thomson coefficient of ideal and real gases. Inversion temperature and derivation of relationship between inversion temperature and vander Waal's constants. Zeroth law of thermodynamics.

1.3.**Thermochemistry:** Heat of a reaction. Exothermic and endothermic reactions. Relationship between heat o reaction at constant volume and at constant pressure. Variation of the heat of a reaction with temperature – Kirchoff's equation. Hess's law of constant heat summation. Applications of Hess's law. Calculation of bond energy and its applications. Limitations of first law of thermodynamics.

Unit II Thermodynamics – 2

2.1. Second law of thermodynamics – Kelvin statement. Cyclic processes. Carnot cycle, derivation of equation for the efficiency of a heat engine. Carnot theorem. Entropy, entropy changes in a reversible and in irreversible processes. Entropy changes of phase changes. Dependence of entropy of a process on pressure, temperature and volume. Entropy of mixing of ideal gases and van der Waal's gases. Significances of entropy. Calculations related to the efficiency of a heat engine.

2.2. Gibb's free energy and Helmholtz free energy. Variation of free energy change of a process with temperature. Derivation of various Maxwell's relationships. Gibbs – Helmholtz equation. Partial molar properties. Partial molar free energy and chemical potential. Gibbs – Duhem equation. Variation of chemical potential with temperature and pressure. Dependence of chemical potential on partial pressures in a mixture of ideal gases. Derivation Clapeyron – Clausius equation and its applications for various calculations. Fugacity and activity and their physical significances. Calculating ΔG, ΔS, ΔA and ΔH.

2.3. Third law of thermodynamics: third law, absolute entropy, Debye's law. Exemption to third law of thermodynamics. Temperature dependence of the equilibrium constant – van't Hoff equation.

Unit III Electro chemistry – 1

3.1. **Conductance and transference:** comparison of electronic and electrolytic conductors. Specific conductance, equivalent conductance and the relationship between them. Cell constant. Molar conductance and its variation with dilution.

3.2. Transport number. Experimental determination of transport number. Kohlrausch's law. Relationship between molar ionic conductance and ionic mobility. Determination of ionic mobility. Applications of Kohlrausch's law. Diffusion and ionic mobility. Molar ionic mobility and viscosity. Walden's rule. Determination of transport numbers. Measurement of conductance of an electrolyte.

3.3. Applications of conductance measurements to determine degree of dissociation of weak electrolytes, ionic product of water, solubility product of a sparingly soluble electrolyte, conductometric titrations and precipitation titrations. Ostwald's dilution law. Classification of electrolytes. Debye – Huckle theory of strong electrolytes and Debye – Huckle limiting law.

Unit IV Electro chemistry – 2 – Ionic Equilibria

4.1. Acid and bases, Arrhenius concept, Lowry and Bronsted concept and Lewis concept of acid and base. Conjugate acid and bases. Relative strength o acids and bases. Influence of solvent on the strength of acids and bases. Dissociation constants of acids (k_a) and bases (k_b). Ionic product of water (Kw). pH of a solution and its calculation. Common ion effect and its application in chemical analysis and purification.

4.2. Buffer solutions, different classes of buffers. Henderson – Hasselbalch equation and calculation of PH of a buffer. Hydrolysis of a salt, hydrolysis constant and degree of hydrolysis of different types of salts. Determination of degree of hydrolysis.

4.3. Indicators and theory of indicators. Range of indicators and choice of indicators. Solubility product and applications of solubility products.

Unit V Electro chemistry – 3: Electromotive force and electrochemical cells.

5.1. Electrochemical cells. Types of electrochemical cells. Electromotive force of a cell. Different type of electrodes and electrode potentials. Single electrode potentials. Standard electrodes and electrode reactions. Electrochemical cells and cell reactions.

5.2. Electromotive force (EMF) of a cell. Relations between thermodynamic variables and electromotive force of a cell. Relation between EMF of a cell and equilibrium constant. Nernst equation. Electrochemical series. Concentration cells. Fuel cells. Measurement of cell EMFand Applications of EMF such as determination of transport number, valency of ions, solubility product,and pH.

5.3. Corrosion, basic principles of corrosion inhibition and various methods of mitigation of corrosion.

Text Books:

1. Advanced Physical Chemistry –Puri,Sharma & Pathania.
2. Physical Chemistry – G. W. Castellan 7th edition
3. Physical Chemistry – S. Glasstone

Books for Reference:

1. Physical Chemistry – Iran N Levin 6th edition
2. Physical Chemistry – Peter Atkins 7th edition
3. Physical Chemistry – Paul Monk 4th edition

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II YEAR – IV SEMESTER
COURSE CODE: 7BCH4C2

CORE COURSE - VIII - INORGANIC CHEMISTRY - II

Unit I XIV & XV – Group (nitrogen and carbon groups):

1.1.Occurrence of elements, variation of their properties and biological and industrial importance.

1.2.Hydrides of fifth group elements. Manufacture of ammonia – properties – industrial importance – preparation properties and uses of hydrazine, hydroxylamine and hydrazoic acid. Preparation, properties and uses of phosphine.

1.3.Oxy acids and salts of nitrogen and phosphorous: industrial importance of nitric acid and phosphoric acid. Physicochemical principles involving in the manufacture nitric acid. Nitrates as fertilizers. Phosphorous chlorides preparation and uses as halogenating agent and structure. Phosphazene preparation properties and uses. Biomedical applications of polyphosphazenes.

1.4.Comparison of fundamental properties of Elements of the carbon group. Allotropes of carbon – graphene and fullerenes and their uses as semi conductors. Manufacture of calcium carbide and silicon carbide and their uses. Silanes preparation and properties. Oxides of silicon and tin and their industrial uses. Halides of carbon group elements and their Lewis acidic character.

Unit II Group XVI to XVIII

2.1. Elements of 16th group. Variation properties of among the group elements. Hydrogen compounds of the group elements. Anomalous behaviour of water. Oxides of sulphur, selenium and tellurium. Various oxyacids of sulphur such as sulphurous, dithionic and sulphuric acids and their industrial importance.

2.2. Elements of 17th group. Variation of properties among the group elements. Anomalous behaviour of fluorine. Hydrogen fluoride preparation properties and uses. Preparation properties and uses of chlorine oxides. Oxy acids of chlorine preparation properties and uses. Interahlogen compounds preparation, properties, structure and uses. Pseudo halogens preparation properties and uses.

2.3. Elements of 18th group: various elements and comparison of properties of noble gases. Chemical reactivity of noble gases. Basic nature of noble gases. Preparation properties and structures of xenon – halogen compounds such as xenon hexafluoride and xenon hexafluoroplatinate. Uses of noble gases.

Unit III Alkaline and alkaline earth metals:

3.1. Alkaline metals: comparison of group elements, anomalous behaviour of Li. Extraction of Li, Na and K. Preparation properties and uses of $LiAlH_4$ and $NaBH_4$. Role of Na & K in biological systems.

3.2. Alkaline earth metals: comparison of group elements, anomalous behaviour of Be. Extraction Be, Mg and Ba. Role Mg, Ca and Ba in biological systems.

3.3. Industrially important compounds of alkaline and alkaline earth metals: Manufacture and uses of Na2CO3, NaOH, NaCl, KCl, MgCO3, CaCO3.Uses of Mg compounds in fire works.

Unit IV Transition elements, Lanthanides and actinides.

4.1. General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

4.2. Important ores and extraction of Ti, V, Ni and Cu. Need of alloys and classification of alloys. Compositions and uses of alloys of Fe, Ni, Cu, Mn & Zn. Steels, classification of steels and their uses.

4.3. **Lanthanides actinides:**Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only). General trend in the properties of actinides. Occurrence and extraction of U and Th.

Unit V Inorganic materials and industrial importance

5.1**. Inorganic Polymers:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, polysulphates and zeolites.

5.2. **Glass:** Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass.Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

5.3. **Ceramics:** Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications.

5.4. **Fertilizers:** Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Text Books:

1. Inorganic chemistry – R.D. Madhan
2. Advanced inorganic chemistry – Sathyapraash
3. Inorganic Chemistry – J.D. Lee

Books for Reference:

1. Inorganic Chemistry – Shriver and Atkins 7th edition
2. Inorganic Chemistry – Catherine 2nd edition.
3. Inorganic Chemistry – James E.Hu.

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III YEAR -V SEMESTER
COURSE CODE: 7BCH5C1

CORE COURSE - IX - ORGANIC CHEMISTRY – II

Unit I Organic halogen compounds:

1.1. **Alkyhalides:** classification and preparation. Reactions of alkyl halides: Substitution and elimination reactions of alkyl halides. Uses of alkyl halides as a starting material in organic synthesizes, insecticides, pesticides and refrigerants.Poly halogen derivatives: Preparation and applications of chloroform, carbon tetrachloride, westron and Freon. Halogen derivatives of unsaturated hydrocarbons: Preparation and uses of vinyl chloride, allyl chloride and allyl iodide.

1.2**. Aryl halides:** aryl halides and aryl alkyl halides. Preparation, properties and uses of aryl halides. Nucleophilic substitution reactions of chlorobenzen. Bimolecular and elimination - addition (benzyne) mechanisms of nucleophilic substitution reactions. Von Richter reaction of halogenonitrobenzene. Benzyl chloride and benzylidene chloride. Distinguishing aryl and aryl alkyl halogen derivatives. BHC and DDT preparation and properties.

1.3. **Organo metallic compounds:** Grignard reagent preparation properties and uses of Grignard reagent as a synthetic agent. Organo copper and organo lithium compounds and their uses as synthetic agents and catalysts. Limitations, in the usage of organo metallic compounds as synthetic agents. Preparation and synthetic uses of Gilman reagent.

Unit II Carbonyl Compounds:

2.1. **Carbonyl Compounds (Aldehydes and Ketones):** general methods of preparation of aliphatic and aromatic aldehydes and ketones. Conversion of an alcohol in to carbonyl compound by using N-bromosuccinimide and Oppenauer oxidation. Rosenmund's reduction, Stephen's method and Sommelet reactions. General properties of aldehydes and ketones. MPV reduction, Clemmenson reduction, Wolff – Kishner reduction. Oxidation of aldehydes and ketones. Baeyer – Villiger oxidation.

2.2. Nucleophilic addition reactions and Condensation reactions. Comparison of reactivity of aliphatic and aromatic aldehydes and ketones. Addition of hydrogen cyanide, and alcohols and protection of carbonyl groups and regeneration. Addition of amines to produce imines and enamines. Schmidt reaction, aldol condensation, Claisen codensation, Claisen – Schmidt condensation, Knovenagel, benzoin and Darzen - Glycdic condensation – Stork condensation reactions. Perkin reaction. Differences between aldehydes and ketones. Wittig reaction of carbonyl compounds and its synthetic applications. Preparation and properties of formaldehyde and acetaldehyde, polymerization, Cannizzaro reaction. Tischenko reactions. Chloral preparation and its properties.

2.3. α, β – unsaturated carbonyl compounds. Preparation and properties α, β unsaturated carbonyl compounds. Conjugated nucleophilic additions. Reactions of α, β unsaturated compounds with Grignard reagent and with Gilman reagent. Preparation and properties of acetyl acetone and acetonyl acetone. Active methylene group and generation of carbanion.

Unit III Aliphatic and aromatic carboxylic acids and their derivatives:

3.1. C**arboxylic acids:** preparation and properties of aliphatic and aromatic mono – carboxylic acids. Systematic conversion of a hydrocarbon into a carboxylic acid with same and more number of carbon atoms. Comparison of acidity of aliphatic and aromatic carboxylic acids.

Effects of substituents and their position on the acidity of carboxylic acids. Ortho effects. Reactions of carboxylic acids and formation acyl halides, amides, esters, etc. Preparation, properties and estimation of urea.

3.2. **Dicarboxylic acids and substituted carboxylic acids:** preparation, properties and uses of oxalic acid, malonic acid, succinic acid and phthalic, maleic and fumaric acids. Preparation and properties of hydroxy acids, amino acids and halogen substituted acids. Action of heat on various hydroxyl acids and amino acids.

3.3. **Carboxylic acid derivatives:** carboxylic esters, carboxyl chlorides and amides preparation and their properties. Active methylene group. Preparation of malonic ester and its synthetic uses. Acetoacetic ester and its synthetic uses.

Unit IV Organic Nitrogen derivatives.

4.1. **Organic nitro compounds:** preparation and properties of nitro methane, nitroso methane, nitrobenzene, dinitrobenzene, trinitrobenzene, trinitrotoluene, trinitrophenol and trinitroglycerine.

4.2. **Amines:** classification of amines, preparation aliphatic and aryl amines. Systematic conversion of a hydrocarbon into an amine through different intermediates. Properties of aliphatic amines and aryl amines. Comparison of basicity of aliphatic amines with aromatic amines. Effect of substituents on the basicity of amines and anilines. Alkylation and acylation of amines. Substitution reactions of amines with alkyl halides. Hoffmann elimination. Electrophilic substitutions of aryl amines. Diazotization of amines – Sandmeyer reaction. Synthetic applications of diazonium chloride.

4.3. **Heterocyclic compounds:** definition and classification heterocyclic compounds. Preparation and properties of furan, pyrole, pyridine and thiophene. Comparison of the basicity of pyrole and pyridine. Preparation, properties and biological importance of imidazole, pyrimidine and purine. Fischer indole synthesis and properties of indole.

Unit V Colourants

5.1. **Dyes and pigments:** Definition of dyes, pigments, chromophores and auxo – chromes with suitable examples. Differences between dyes and pigments. Classification of dyes based on chromophores, method of application and uses with suitable examples. Chromophores – auxochrome theory and modern theory of colour and constitution. Definitions and examples of mordents and leuco bases. Colour index of dyes and its significances. Phototropism and its importance in applications of dyes with suitable examples. Toxicity of dyes and pigments.

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III YEAR - V SEMESTER
COURSE CODE: 7BCH5C2

CORE COURSE - X - PHYSICAL CHEMISTRY – III

Unit I Spectroscopy

1.1. **Fundamentals of spectroscopy:** Definition, fundamentals of light such as wavelength, velocity, frequency, photons and definite energy of a photon. Electromagnetic spectrum. Fundamentals of materials such as equipartion principle and different types of movements of particles in a material and quantization of electronic, rotational, vibrational and spin energies. Selection rule. Beer – Lambertz law. Different types of spectroscopy and their applications.

1.2.**Rotational or microwave spectroscopy:** rigid rotator, derivation of equation for rotational constant for a diatomic molecule. Calculation of bond length and hence dipole moment and percentage of ionic character of a bond.

1.3. **Vibrational spectroscopy:** harmonic oscillator, zero – point energy, force constant, Hook's law. Anharmonicity, overtones, combination bands and Fermi resonance. Different types of vibrations. Factors determining the absorption frequency of a functional group. Effect of hydrogen bonding. Vibrational frequencies of different functional groups.

1.4. **Magnetic Resonance Spectroscopy:** Introduction to Nuclear magnetic resonance (nmr) and electron spin resonance spectroscopy (esr). NMR active elements and esr active species. Larmor precession and larmor frequency. Shielding and deshielding of protons, shielding constant , chemical shift and factors determine chemical shift. Spin – spin coupling and spin coupling constants. Chemically and magnetically equivalent nuclei. Introduction to esr and hyperfine structure.

Unit II Phase rule:

2.1. **Fundamentals:** Definition of phase, component and degrees of freedom. Derivation of phase rule. Phase diagram of one component systems such as water, sulphur and carbon dioxide.

2.2. **Two component systems:** Reduced phase rule. Classification of two component systems. Phase diagram of simple eutectic systems such as lead – silver, potassium iodide – water system. Phase diagram of two component systems that forms compounds with congruent melting point and incongruent melting points like ferric chloride – water and copper sulphate – water systems respectively.

2.3. **Solutions of non – electrolytes:** Solution of liquids in liquids. Ideal and non-ideal solutions, Raoult's law. Azeotropic mixtures. Steam distillation. Solubility of different types of partially miscible liquids, critical solution temperature (CST).

2.4. **Distribution law:** Distribution law and its validity. Derivation of distribution law. Deviation from distribution law. Applications of distribution law. Solvent extraction.

Unit III Chemical Kinetics

3.1. **Rate of a reaction:** Law of mass action. Rate and rate constant of a chemical reaction. Definitions and comparison of order and molecularity of a reaction. Rate equation for a zero – order reaction with examples.

3.2. **Rate of a first order reaction:** derivation of rate equation for a first order reaction. Examples for first order reactions. Pseudo first order reaction. Application of first order rate equation to acid catalysed ester hydrolysis and inversion of sucrose.

3.3. **Second order reactions:** derivation of rate equation or a second order reaction involving a single reactant and reactions involving two reactants. Examples for second order reactions. Applications of second order rate equation to saponification of esters.

3.4. Half – life of a reaction, relationship between initial concentration and half – life of reactions of different orders.

3.5. Methods for determining the order of a reaction: by using differential and integral rate equations. Half – life method. Isolation method.

3.6. **Theories of reaction rate:** collision theory. Effect of temperature on the rate of a reaction – Arrhenius equation. Activated complex formation theory (absolute reaction rate theory (ARRT). Lindemann theory of unimolecular reactions.

Unit IV Photochemistry

4.1. **Fundamentals:** photochemical reactions. Comparison of photochemical and thermal reactions. Consequences of light absorption - Jablonsky diagram. Fluorescence and phosphorescence. Chemiluminescence.

4.2. **Laws of photochemistry:** Beer – Lambert law and its limitations. Grotthus – Draper law of photochemical activation. Stark – Einstein law of photochemical equivalence. Quantum efficiency and reasons for variation of quantum yield. Experimental dtermination of quantum yield.

4.3. **Kinetics of photochemical reactions:** derivation of kinetic equation or a photochemical reaction. Rate equations for photochemical reactions between hydrogen and chlorine and hydrogen and bromine.

4.4. Lasers – population inversion, optical pumping, Q – switching

Unit V Group theory

5.1. **Fundamentals:** definition of a group. Various symmetry elements and corresponding symmetry operations. Identification of possible symmetry elements in a molecule. Deduction of point group. Order of a group, sub – groups and classes.

5.2. Group multiplication table. Construction group multiplication tables for C2V, C3V C2h and D2h with suitable examples.

5.3. Matrix representation of symmetry operations.

5.4. Applications of symmetry operations and group theory in chemistry.

Text Books:

1. Advanced Physical Chemistry –Puri,Sharma & Pathania.
2. Physical Chemistry – G. W. Castellan 7th edition
3. Physical Chemistry – S. Glasstone
4. application of group theory in chemistry - F.A. Cotton

Books for Reference:

1. Physical Chemistry – Iran N Levin 6th edition
2. Physical Chemistry – Peter Atkins 7th edition
3. Physical Chemistry - Paul Monk 4th edition

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III YEAR – V SEMESTER
COURSE CODE: 7BCH5P1

CORE COURSE - XI - GRAVIMETRIC ESTIMATION AND ORGANIC PREPARATION PRACTICAL – III

Max. Marks: 60 **Duration: 6 Hrs.**

I. Gravimetric Estimation

1. Estimation of barium as barium chromate / sulphate
2. Estimation of lead as lead chromate / sulphate
3. Estimation of calcium as calcium oxalate
4. Estimation of nickel as nickel dimethyl glyoxime complex

II. Preparation of organic compounds

Preparations involving the following methods
a). Oxidation, b). Reduction, c). Hydrolysis, d). Nitration
e). Ozasone formation, f). Bromination, g). Diazotisation
h). Benzoylation.

III. Determination of melting and boiling points of simple organic compounds: (not for examination purpose)

IV. Separation of organic mixture: (not for examination purpose)

Distribution of External marks:

1. Record	10 marks	
2. Viva – voce	10 marks	
3. Gravimetric estimation	20 marks	
a. Procedure	5 marks	
b. Experiment	15 marks	
4. Organic preparation		20 marks
a. Procedure	5 marks	
b. Crude sample	10 marks	
c. Recrystallized sample	5 marks	
		60 marks

Gravimetric Experiments:

Less than 1% error.....15 marks
1 – 2 % error…...12 marks
2 – 3 % error…...9 marks
3 – 4 % error…... 6 marks
>4% error.....3 marks

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III YEAR - V & VI SEMESTER
COURSE CODE: BCH6P1

CORE COURSE – XII - PHYSICAL CHEMISTRY PRACTICAL – IV
(University Examination will be held in the sixth semester only)

Max. Marks: 60 **Duration: 6 Hrs.**

1. Phase diagram:
a. Simple eutectic
b. Compound formation
2. Determination of molecular weight:
a. Rast-macro method (using naphthalene as solvent)
b. Transition temperature (using sodium thio sulphate penta hydrate as salt hydrate)
3. Critical solution temperature
a. CST of phenol – water system
b. Estimation of sodium chloride by studying the CST of phenol-water system
4. Kinetics
Determination of relative strength of acids by acid catalysed hydrolysis of ester
5. Partition co-efficient
a. Study of equilibrium $KI + I_2 \leftrightarrow KI_3$ by studying the partition co-efficient of iodine between water and carbon tetra chloride.
b.Determination of association factor of benzoic acid in benzene
6. Electrochemistry
a. Conductometric titration between an acid and a base (HCl Vs NaOH)
b. Potentiometric method – Potentiometric titration between 1. an acid and a base (HCl Vs NaOH) and 2. $KMnO_4$ Vs FAS
7. Thermochemistry
a. Determination of heat of solution – ammonium oxalate

Distribution of External marks:

Record	10 marks
Viva – voce	10 marks
Procedure	10 marks
Experiment	30 marks
	60 marks

III YEAR - V SEMESTER
COURSE CODE: 7BCHE1A

ELECTIVE COURSE - I (A) – ANALYTICAL CHEMISTRY

Unit I Analytical data analysis and Laboratory hygiene:

1.1.**Need of statistical analysis:** definition for accuracy precision and error. Sources of errors and classification of errors – systematic (determinate) errors and random (indeterminate) errors. Distribution of errors. Methods of minimisation of errors.

1.2.**Data analysis:** Mean standard deviation and coefficient of variance. Significant figure.

1.3.**Reliability of results:** Q – test. Student – t – test and F-test – confidence limit and rejection of experimental data. curve fitting – methods of least squares – problems involving straight line graphs.

1.4. **Laboratory Hygiene and Safety:** Storage and handling of chemicals – carcinogenic, corrosive, explosive, toxic and poisonous chemicals – general precautions for avoiding accidents – first aid techniques for acid in eye, alkali in eye, acid burns, alkali burns, bromine burns, poisoning, inhalation of gases, cut by glasses and heat burns – methods to avoid poisoning – treatment for specific poisons.

Unit II Separation purification and Chromatographic and Electrophoretic methods:

2.1. **Separation and Purification Techniques:**Solvent extraction – Soxhelt extraction – Principles and applications of distillation, fractional distillation, steam distillation – crystallization and sublimation.

2.2. Basic principle of chromatography. Various types of chromatographic technique. Column chromatography, thinlayer chromatography, Paper chromatography, Gas chromatography, ion exchange chromatography and HPLC.

2.3. Basic principles of electrophoresis. Isoelectric point. Electrophoretic mobility. Electrophoretic separation of proteins.

Unit III Colorimetry and spectrophotometry:

1.1.**Theory of colorimetry and spectrophotometry**: Beer – Lambert's law and its limitations. Standard series method and balancing methods.

1.2.Reagents, solutions and experimental procedure for the estimation of iron, lead nickel and tin.

1.3Basic principles of spectrofluorimetry. Reagents, solutions and experimental procedure for the estimation of aluminium, cadmium, calcium and zinc.

Unit IV Gravimetry:

4.1. Basic principle, advantages of gravimetric analysis. Solubility product. Super saturation. Co-precipitation and post precipitation. Digestion. Precipitation from homogeneous solutions. Precipitants . specific and selective precipitant. sequestering agents.

4.2.Thermogravimetric analysis – Principle – instrumentation – characteristics of thermogravimetric curve – Applications of TGA for calcium oxalate monohydrate. Differential Thermal Analysis – Principle – instrumentation – characteristics of differential thermal curve – Applications of DTA for calcium oxalate monohydrate.

Unit V Electro-analytical techniques:

5.1. Electro- gravimetry: theory of electro-gravimetry. Faraday's laws. Ohm's law. Electrical units – ampere, volt, ohm and coulomb. Polarised and depolarised electrodes. Current density, current efficiency, decomposition potential and overpotential. Electrolytic separation of copper from nickel and copper from lead. Estimation of antimony, copper, lead and tin in alloys.

5.2. **voltammetry:** principles of voltammetry. Experimental setup for polorographic analysis. Types of polorographic methods. Determination of lead in tap water.

5.3. **Electrochemical analytical techniques:** Basic principles of voltametric analytical techniques. Potentiometric titrations and conductometric titrations. Irreversible electrode processes and overvoltage. Applications of overvoltage. Polorography and its applications.

Books for Reference:

1. R.Gopalan, P.S.Subramanian and K.Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1995.
2. Douglas A.Skoog and D.M.West, Principles of Instrumental Analysis, W.B.Saunders, New York, 1982.
3. Gurdeep Chatwal, Sham Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, Mumbai, 1998.
4. Vogel's quantitative chemical analysis – 5th edition.

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III YEAR – V SEMESTER
COURSE CODE: 7BCHE1B

ELECTIVE COURSE - I (B) – AGRICULTURAL CHEMISTRY

Unit I

1.1.Origin of earth – Geological formations of India – Soil forming rocks and minerals – Classification – weathering of rocks and minerals – processes of weathering and factors affecting them. Soil formation – Factors of soil formation – soil forming processes – profile development – definition of soil – soil composition.

1.2.Soil Physical properties – soil separates and particle size distribution – soil texture and structure – Bulk density, particle density, pore space, soil air, soil temperature, soil water, soil consistence and significance of physical properties to plant growth.

1.3.Soil chemical properties – soil colloids – Inorganic colloids – clay minerals – amorphous – exchange reactions – organic colloids – soil organic matter – decomposition – Humus formation – significance of soil fertility, soil reaction – Biological properties of soil – nutrient availability.

Unit II

2.1.Fertilizer – definition – fertilizer selection based on soil testing – fertility index – Nitrogenous fertilizers – effect of nitrogen on plant growth and development. Phosphate fertilizers – Effect of phosphorus on plant growth and development – super phosphate and Bone meals. Potassium fertilizers – function of potassium on plant growth.

2.2. Secondary and micronutrient fertilizers – complex and mixed fertilizers – sources, manufacture, properties and reactions in soils.

2.3.Biofertilizers – nitrogen fixing biofertilizer – rhizobium, azospirillum – phosphate mobilizing biofertilizer – bacteria – bacillus, pseudomonas, fungi – aspergillus, pencillium

Unit III

3.1.Nutrient potential of different organic manures – Agricultural, industrial and urban waste preparation of enriched farm yard manures – Zinc enriched organics.

3.2.Green manures – green leaf manure – bulky organic and concentrated organic manures – compost – enriched farmyard manures, composting of coir pith; sugarcane trash, leaf litters and farm wastes – oil cakes, bone meal, fish meal, guano poultry manures – integrated nutrient management.

3.3.Preparation of different fertilizer mixtures.

Unit IV

4.1.Pest management and control

Pesticides – formulations – emulsifiable concentrate, water miscible liquids, wettable powder dusts, granules, classification of pesticides – mode of action – characteristics – uses – fate of pesticides in soil and plants – impact of pesticides on environment – safety measures in analysis and handling of pesticides.

4.2.Insecticides – plant products – Nicotine, pyrethrum, rotenone, petroleum oils. Inorganic pesticides – Arsenical fluorides, borates. Organic pesticides – organo chlorine compounds D.D.T, B.H.C, methoxychlor, chloredane, endosulfon. Organophosphorus

compounds – Dischlorevas, methyl Carbamic acid derivatives – carbaryl – structure and mode of action.

Unit V

5.1.Fungicides – Inorganic – Sulphur compounds – Copper compounds – Mercuric compounds Organic – dithiocarbamates – Dithane M and Boredeaux mixture.

5.2.Herbicides: Inorganic herbicides – Arsenical compounds Boron compounds – cyanamide – Cyanides and thiocyanates, chlorates and sulphamates. Organic herbicides & Nitro-compounds – chlorinated compounds – 2-4D-Phridine compounds – Triazine compounds – Propionic acid derivatives – Urea herbicides, Alachlor.

Books for Reference:

1. N.C.Brady, The Nature of properties of soils Eurasia publishing house, (P) Ltd., 9th Ed. 1984.
2. Biswas, T.D. and Mukherjee S.K. 1987 Text book of soil science.
3. A.J.Daji (1970) A Text book of soil science – Asia publishing house, Madras
4. Donahue. R.L. Miller.R.W. and Shickluna, J.C. 1987. soils – An introduction to soils and plant Growth – Prentice Hall of India (P) Ltd., New Delhi.
5. Colling, G.H. 1955, Commercial Fertilizers – McGraw Hill Publishing Co., New York.
6. Tisdale.S.L. Nelson.W.L. and Beaton.J.D. 1990, Soil fertility and fertilizers. Macmillan Publishing company, New York
7. Hesse, P.R. 1971. A text book of soil chemical analysis John Murray, New York.
8. Jackon, M.L. 1958, Soil Chemical Analysis, Prentice Hall of India, New Delhi.
9. Buchel, K.H. 1983, Chemistry of pesticides – John wiley & sons, Newyork.
10. Melnikov, N.N.1971. Chemistry of pesticides Vol.36 of Residue Review – springer verlac, New York.
11. Sree Ramula, U.S.1979, Chemistry of Insecticides and Fungicides – Oxford and IBH publishing Co., New Delhi.

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III YEAR – V SEMESTER
COURSE CODE: 7BCHE2A

ELECTIVE COURSE II (A) – INDUSTRIAL CHEMISTRY

Unit I

1.1.**Paints:** Paint – definition – classification of paints based on their applications – constituents – Requisites of a good paint

1.2.**Pigments:** Definition – composition, characteristics and uses of white lead, Zinc oxide Lithopone and TiO2 – Blue pigments – Ultra marine blue – characteristics – uses. Red pigments – red lead –characteristics and uses. Green pigments – chrome green, Guigwet's green and chromium oxide – characteristics and their uses.

1.3.**Varnishes:** Definition – constituents of varnish – characteristics of a good varnish – uses – Japans varnish. Enamel – definition – Types – Ingredients and uses.

Unit II

2.1.**Ceramics:** Definition, classification of ceramics, general properties of ceramics – permeable (porous) and impermeable (non porous wares) – Basic raw material – Manufacture – applications of colour to pottery.

2.2.**Glass:**Definition – physical and chemical properties of glass – raw materials – Manufacture – types of glasses.

2.3.**Cement:** Raw materials – Portland cement – composition – types of Portland cement – Manufacture – Uses of Cement – Cement Raw Materials in India – Growth of Cement Industry in India. Chemistry of setting of cements.

Unit III

3.1.**Soap:** Definition – General consideration in soap making – manufacture of soap – toilet and transparent soaps.

3.2.**Detergents:** Definition – classification of face active agents – anionic detergents – cationic detergents – shampoo – raw materials

3.3.**Refractories:-** Introduction, Classification – Properties – Manufacture – Fire clay bricks – manufacture – Uses

Unit IV

4.1.**Fertilizers:** Definition – manufacture of Ammonium sulphate, CAN. Manufacture of urea and estimation of urea. Manufacture of phosphoric acid. Manufacture of superphosphates and uses of phosphate as fertilizer. Mixed fertilizers (NPK) – Fertilizer industries in India.

4.2.**Sugar Industry:** Manufacture of sugar from molasses and beetroot – sugar industries in India. Fermentation: Manufacture of spirits and wines. Distillation: Manufacture of vinegar and ethyl alcohol.

4.3.**Match industries:** Manufacture – chemistry of lighting and pyrotechny

Unit V

5.1.**Adhesives:** definition – classification of adhesives – animal glue – preparation – uses– protein adhesives – starch adhesives – preparation – uses.

5.2.**Enamels:** Introduction – Raw Materials – Manufacture and Applications

5.3.**Explosives:** Definition – Classification – Characteristics of explosives – Nitro cellulose, T.N.T. Picric acid, Gun Powder, Cordite and Dynamite.

Books for Reference:

1. B.K. Sharma – "Industrial Chemistry", 1st Ed., (1983), Goel Publication, Meerut.
2. B.N. Charabarthy – "Industrial Chemistry", 1st Ed., Oxford and IBh Publishing. New Delhi.
3. P.L. Soni – "Text Book of Organic Chemistry", 26th Ed., (1994), S. Chand & Co, New Delhi.
4. Arun Bahl and B.S. Bahl – "Text Book of Organic Chemistry", 11th and 18th Ed., (2006), S.Chand, New Delhi.
5. Krishnamoorthy, P. Vallinayagan & K. Jaya Subramanian – "Applied Chemistry", 2nd Ed., (1999, 2001), Tata MaGraw-Hill Publishing Co. Ltd., New Delhi

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III YEAR – V SEMESTER
COURSE CODE: 7BCHE2B

ELECTIVE COURSE II (B) – MEDICINAL CHEMISTRY

Unit I Physical chemical factors and biological activity.

1.1.**Structure and pharmacological actions:** Factors governing ability of drugs to reach active site. Absorption, distribution, metabolism and excretion. Ferguson's theory. Steric factor – Taft's steric factor- Hammet substitution constant resonance effect and inductive effect. Verloop steric parameter. Hansch equation. Topless scheme.

1.2.Isosterism and bio-isosterism. Classical and non-classical bioisosteres.

1.3.**Basic concepts**: Definition: drug – classification of drugs: biological and chemical – Nomenclature of drugs.

Mechanism of drugs – factors affecting metabolic activity – chemical pathway of drug metabolism – bio transformation – oxidative, reductive and hydrolytic bio transformations – conjugate reactions – gluco uranides, amino acids, ethereal sulphate, methylated, acetylated and glucothione conjugations.

Absorption of drugs – routes of administration – factors affecting absorption – digestion of proteins – gastric, intestinal and exopeptidaces – absorption of proteins – digestion and absorption of fats.

Unit II Diagnostic Medical Instruments

Design of medical instruments – general components – transducers – types – biopotential recorders – Electrocardiograph (ECG) – principles, block diagram, measurement and analysis of the ECG.

Electroencephalography (EEG) – principles, block diagram, measurement and analysis of the EEG.

X-ray – principles, block diagram, measurement and analysis of x-ray.

Ultrasonic Scanning – principles block diagram, measurement and analysis of the scans.

C.T.Scan – principles, block diagram, measurement and analysis of the scan.

MRI Scan – principles, block diagram, measurement and analysis of the scan.

Unit III Clinical Chemistry

Clinical chemistry – Composition of blood – blood grouping – determination of blood groups and matching – blood pressure – hypertension – determination.

Determination of glucose in serum – Folin method, Wu's method, Nelson method, somogyi method and O-toluidine method – determination of serum cholesterol – Sackett's method – tests for cholesterol.

Estimation of glucose in urine – Benedict's test – tests for salt in serum – test for chlorides in serum – tests for salt in urine – tests for cholesterol in urine – Detection of diabetes and anemia

Estimation of hemoglobin (Hb concentration) – estimation of red blood cells (count).

Analysis of blood – determination of blood urea – urease method.

Estimation of bile pigment in serum – estimation of total protein in serum – estimation of total proteins and albumin based on Biuret and BCG methods.

First aid for accidents – important rules – first aids for cuts, bruisers, bleeding, fractures, burns, fainting and poisonous bites – composition of first aid box.

Determination of Hallucinogens and poisons – antidotes – common poisons and their antidotes

Unit IV Diseases and treatment

Common diseases – Causes and treatment of some common diseases – insect borne diseases – malaria and filariasis

Air borne diseases – diphtheria, woophing cough, influenza, cold, fever and tuberculosis Water borne – cholera, typhoid and dysentery

Digestive disorders – Jaundice – respiratory disorder – asthma – nervous disorder – epilepsy – other diseases – piles and leprosy.

Important Indian medicinal plants and their uses.

Structure, functions, dosage, uses and effects of the following drugs.

Cardiovascular drugs – antiarrythmic drugs – quinidine.

Anti hypertensive drugs – clondine and reserpine

Anti anginal drugs – glyceryl trinitrate and isosorbide dinitrate.

Sulpha drugs – sulphanilide and sulpha diazine.

Health care medicines – vitamins – structure, functions and deficiency disease of vitamins A, D, K, B1, B2, B6, B12 and C.

Unit V Diseases and treatment II

Cancer – causes, spread and treatment – structure, dosage and effects of chlorambusil, methotreate, plant products and hormones.

Diabetes – control – structure, dosage and uses of barbiturates, hydantoin and succinimides.

Structure, uses and effects of the following drugs: Analgesics – narcotic analgesics – action, uses and structural activity of morphine. Non-narcotic analgesics – aspirin and paracetamol.

Anesthetic – general anesthetic – uses and disadvantages of vinyl ether and halothane. Intravenous anesthetics – thiopental sodium – local anesthetics – cocaine and chincocaine Anti psychotic drugs – piperazine and benzamides – anti-anxiety drugs – benzodiazepine Psychotogenic drugs – marijuana

Anti depressant drugs – barbiturates – mechanism of action and uses.

Antibiotics – classification – structure, properties, uses and assay of chloramphenicol, penicillin, streptomycin, erythromycin and tetracycline.

Books for Reference:

1. Practical Biochemistry – David Plummer – 2005, Tata McGraw-Hills Publishing Company.
2. Text Book of Pharmaceutical Chemistry – Jeyashree Gosh – 2003, S.Chand and company, New Delhi
3. Medicinal Chemistry – G.R.Chatwal, 2002, Himalaya Publishing House, New Delhi.
4. Drugs – G.L.D. Krupadanam, D.V.Prasad, K.V.Rao, K.L.N. Reddy and C.Sudhakar

5. Handbook of biomedical instrumentation 2ed – R.S.Khandpur, Tata McGraw – Hill Publishing Company, New Delhi.
6. Biomedical instrumentation and measurements – Leslie Cromewell, F.J.Weilbell, E.A.Pfeiffer, Prentice Hall of India, New Delhi.
7. Principles of Medical Electronics and Biomedical Instrumentation – C.Raja Rao and S.K.Guha, 2005, Orient Longmann
8. Medicinal Chemistry – Ashutosh Kar

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III YEAR - VI SEMESTER
COURSE CODE: 7BCH6C1

CORE COURSE – XIII - INORGANIC CHEMISTRY - III

Unit I Coordination chemistry – I.

1.1.**Definitions and terminology:** classification of inorganic compounds as double salts and complexes. Differences between normal compounds and co-ordination compounds. Ligands, classification of ligands with suitable examples for each class. Chelates. Ambidentate ligands. Co-ordination number. IUPAC nomenclature of complexes. EAN rule and calculation of effective atomic number of a complex.

1.2. **Isomerism in complexes:** Structural isomerisms such as ionization isomerism, hydrate isomerism, co-ordination isomerism and linkage isomerism. Stereo isomerism: geometrical isomerism and optical isomerism with suitable examples.

1.3. **Theories of co-ordination compounds:** Werner's theory, valence bond theory, crystal field theory and ligand field theory. Strong and weak ligands and spectrochemical series. Calculating crystal field stabilization energies.

Unit II Coordination chemistry– II – Reactions of complexes

2.1. **Stability of complexes:** Comparison of stability of simple complexes in terms stability constants. Inert and labile complexes. Factors affecting the stability of complexes. Stability of complexes and HSAB theory.

2.2. **Ligand Substitution Reactions:** various mechanisms of ligand exchange reactions in complexes with suitable examples. Factors influencing the ligand substitution reactions such as trans effect, steric effect leaving group, spectator ligand, pH and nucleophilicity (HSAB theory) with suitable examples.

2.3. **Redox reactions:** mechanisms of redox reactions such as inner – sphere mechanism and outer – sphere mechanism with suitable examples. Isomerisation reactions, photochemical reactions and charge transfer reactions with suitable examples.

Unit III Organo metallic compounds of d – block elements:

3.1. Bonding in d – block organo metallic compounds. Electronic configuration and geometry of d – block organo metallic compounds.

3.2. **Metal carbonyl complexes**: classification of mtal carbonyls with suitable examples. General methods of synthesis of homoleptic metal carbonyls. Physical and chemical properties of metal carbonyls such as oxidation and reduction, basicity of metal carbonyls, reactions of carbonyl. 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π - acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

3.3. **Metallocenes:** Synthesis and reactivity of cyclopentadienyl compounds. Metal clusters.

3.4.Magnetic properties of transition metal complexes. Magnetic susceptibility. Experimental determination of magnetic susceptibility of complexes. Spin only magnetic momentum and calculation of number of unpaired electrons in complexes.

Unit IV Bioinorganic Chemistry:

4.1. Essential elements in biological systems. Features of dose response curve for an essential element. A survey of metals in biological systems and their functions as charge carriers, structural units, as electron transfers, transporters and in enzyme catalysis.

4.2. **Electron transfer**: complementary and noncomplementary electron transfer reactions with examples.

4.3. **Metal porphyrin complexes:** Structure and mechanism of oxygen transporting by haemoglobin. Factors regulating oxygen transport capacity of oxygen carriers. Structure and role of chlorophyll in photo synthesis.

4.4. **Metallo enzymes:** Iron, magnesium and zinc enzymes. Hemocyanin structure and enzymatic activity.

4.5.**Chelates:** chelation – applications of chelate formation in biological systems. Toxic effects of metals. Chelate formation and removal of metal poisoning and its limitations. Metal derivatives as chemotherapeutic agents. Platinum containing anticancer agents.

Unit V Material Chemistry:

5.1. **Nanomaterials:** definition of nanoparticles. Properties of nanomaterials. Semiconducting nanoparticles and metallic nanoparticles. Optical properties of nanoparticles.

5.2. Fabrication of nanoparticles, solution based synthesis of nanoparticles, vapour phase synthesis of nanoparticles such as physical vapour deposition and chemical vapour deposition.

5.3. **Bulk materials:** synthesis of bulk materials by direct reactions in sold phase, by condensation reaction in solution and by chemical deposition.

5.4. **Solid electrolytes:** Advantages of solid state electrolytes. Solid cationic electrolytes, solid anionic electrolytes and mixed ionic – electronic conductors. Applications of solid electrolytes.

Text Books:

1. Inorganic chemistry – R.D. Madhan
2. Advanced inorganic chemistry – Sathyapraash
3. Inorganic Chemistry – J.D. Lee
4. Reference Books:
5. Inorganic Chemistry – Shriver and Atkins 7th edition
6. Inorganic Chemistry – Catherine 2nd edition.
7. Inorganic Chemistry- James E.Hu

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III YEAR – VI SEMESTER
COURSE CODE: 7 BCH6C2

CORE COURSE – XIV – ORGANIC CHEMISTRY - III

Unit I Carbohydrates

1.1.Definition of carbohydrates. Classification of carbohydrates as monosaccharides, disaccharides and polysaccharides with suitable examples. Classification of monosaccharides as aldoses and ketoses with suitable examples. Classification of sugars as reducing and nonreducing sugars.

1.2.**Stereochemistry of carbohydrates:** D- and L- configurations of carbohydrates. Erythro and threo diastereomers. Anomers and epimers with suitable examples.

1.3.**Monosaccharides:** Glucose, properties of glucose. Epimerisation of glucose. Anomers of glucose and mutarotation. Fructose and its properties. Conversion glucose into fructose and vice-versa. Formation of osazone and glycosides. Fischer open structure and evidences for open structure. Haworth projection cyclic structures (pyranose and furanose) and evidences for cyclic strucures of glucose and fructose. Stepping up – Kiliani- Fischer synthesis and stepping down – Ruff degradation of monosaccharides.

1.4.**Disaccharides:** α – and β – glucosidic linkages with suitable examples. 1,4' and 1,6' linkages with suitable examples. Structure and properties of sucrose.

1.5.**Polysaccharides:** Cellulose, combination of cellulose. Starches structure of amylose and glycogen.

Unit II Natural Products and Biochmistry:

2.1. **Alkaloids:** Definition and classification with suitable examples for each class. General properties and general procedure for the determination of structure. Sources, isolation, physiological activities and structure of piperine, conine, cocaine and quinine.

2.2. **Terpenoids:** definition, isoprene rule and classification with suitable examples. General methods of isolation. Properties structure and uses of citral, geraniol and limonene.

2.3. **Steroids and Hormones:** definition and classification of steroids. Occurrence, structure and physiological activities of cholesterol, estrogens and testosterone.

2.4. **Amino acids and proteins:** Definition and classification of amino acids. Essential amino acids. Peptide linkage and protein formation from amino acids. Structure of proteins. Tests for amino acids and proteins.

Unit III Dyes, organic photochemistry:

3.1. **Fundamentals:** Definition, theories of colour and chemical constitution, chromophores and auxochromes. Classification of dyes based on applications and chromophores. Requirements of a dye. Definition of mordants and examples. Nomenclature of dyes.

3.2. **Synthesis and uses of dyes:** synthesis, structure and uses of crystal violet, congo red, fluorescein, alizarin and indigo dyes. Fluorescent brightening agents. Food colours.

3.3. **Photochemical reactions**: Primary and secondary photochemical reactions. Norrish type – I, type – II and type –III reactions. Barton reaction and Paterno – Buchi reaction and photochemical isomerisation reactions. Photosensitized reactions.

Unit IV Rearrangement reactions:

4.1. **Fundamentals:** Definition of rearrangement reactions. Reasons for rearrangement reaction.

4.2. **Rearrangements involving ionic or radical intermediates:** pinacol – pinacolone, Wagner – Meerwein, Wolff, Homann and Beckmann rearrangements and their mechanisms.

4.3. **Sigmatropic rearrangements:** definition of sigmatropic rearrangements. Suprafacial and antaracial rearrangements. Stereo chemical rules for sigmatropic rearrangements. Cope, Claisen and Stevens rearrangements and their mechanisms.

Unit V Applications of spectroscopy

5.1. **Fundamentals:** definition and various types of spectroscopy and their inferences.

5.2. **UV and Visible spectroscopy:** possible electronic transitions in an organic compound. Selection rules. Solvent effect. Chromophores and auxochromes. Various types of shifts in λ max. and in εmax.. Calculation of λ max of an organic compound. Applications of UV &Visible spectroscopy in organic chemistry.

5.3. **Infra red (IR) spectroscopy:** various types of vibrations and number of Vibrational degrees of freedom. Selection rule. Solvent effect. Effect of hydrogen bond. Finger print region. The characteristic ranges of absorption of IR radiation of various functional groups.

5.4. **Spin resonance spectroscopy:** NMR active nuclei. Equivalent and non-equivalent protons and number of signals. Reference compound (TMS). Relative signal intensities and number of hydrogens. Chemical shift and various factors influencing chemical shift. Spin – spin splitting, splitting constant. NMR spectrum of simple molecules.

5.5. identification of compound from the UV – Visible. IR and NMR spectral dataset.

Text Books:

1. Organic chemistry – PL. Soni
2. Organic Chemistry – Sharma
3. Organic Chemistry – Morrison & Boyd
4. Organic Chemistry – I.L. Finar (Vol. I & II)

Books for Reference:

1. Organic Chemistry – Mc Muray 7th edition
2. Organic Chemistry – L. G. Wade 6th edition
3. Organic Chemistry – J. Clayden 7th edition
4. Organic Chemistry – Y. Paula 4th edition
5. Organic Chemistry- Jerry March

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III YEAR – VI SEMESTER
COURSE CODE: 7BCH6P2

CORE COURSE – XV – APPLIED CHEMISTRY PRACTICAL -V

1. Determination of total, temporary and permanent hardness of a water sample by EDTA method.
2. Determination of percentage of available chlorine in the supplied sample of bleaching powder.
3. Determination of Biological oxygen demand (BOD) of a given sample of water.
4. Determination of coefficient of viscosity of the given liquid by Ostwald's Viscometer method.
5. Determination of Molecular weight of a polymer by viscometric method.
6. Determination of Acid value of an oil.
7. Determination of Saponification value of an oil.
8. Determination of the amount of Cu in the copper ore.
9. Determination of half cell potential of Zn, Cu and Ni electrodes at various concentration of electrolyte and calculation of EMF of Daniel cell.
10. To study the Adsorption of acetic acid on active charcoal and to verify the Freundlich and Langmuir isotherm.
11. Identification of adulterations in food materials

Distribution of marks

Record	10 marks
Viva – voce	10 marks
Procedure	10 marks
Experiment	30 marks
	60 Marks

III YEAR – VI SEMESTER
COURSE CODE: 7BCHE3A

ELECTIVE COURSE - III (A) – POLYMER CHEMISTRY

Unit I

Introduction: Monomer – Polymer – Functionality of monomers and its significance – degree of polymerization – Natural and Synthetic polymers – classification of polymers – addition and condensation polymers.

General methods of preparation of polymers – stepwise polymerization – chain growth polymerization and polymerization through ring opening – Polymerisation techniques: Bulk, solution, suspension and emulsion polymerization.

Mechanism: Free-radical, cationic and anionic polymerization reactions

Unit II

Polymer structure: Linear, branched and cross-linked polymers

Properties of polymers: The glassy state and the glass transition temperature – thermal analysis of polymers – poly degradation: Thermal, mechanical, unsaturated oxidative and hydrolytic degradation.

Molecular weight of polymers: Number average molecular weight and weight average molecular weight.

Unit III

Copolymerisation: Definitions : homo polymer and copolymer – Block and Graft copolymers.Kinetics of polymerization: Free-radical polymerization – cationic polymerization. Degree of polymerisaton – Inhibition. Synthesis of reactants and intermediates: Adipic acid, sebacic acid, hexamethylene diamine, caprolactum, vinyl acetate, acrylonitrile and methyl methacrylate.

Unit IV

Polyolefins: Preparation and uses of polyethylene, PTFE, PVC, PVA, polypropylene and polystyrene.

Rubber: Natural and synthetic rubbers – isoprene rule – preparation and uses of butyl, buna, buna-s, buna-N, neoprene, Thiocol, Polyurethane and silicone rubbers – Compounding of rubber – reclaim rubber, spongy rubber and foam rubber

Unit V

Plastics and Resins: Definition: Thermoplastics and thermosetting resins – constituents of plastics – fillers, dye pigments, plasticizers, lubricants and catalysts.

Important thermoplastic resins: cellulose derivatives – cellulose acetate and cellulose nitrate. Important thermosetting resins: phenolic resins, amine resins, epoxy resins and silicone resins.

Textile Fibres: Definition: Fibres: fibre polyamides: preparation and uses of Nylon 6 and Nylon 66 – polyesters: preparation and uses of terylene and Viscose rayon.

Books for Reference:

1. V.R.Gowarikar, N.V.Viswanathan, Polymerscience, Wiley Eastern Limited, New Delhi 1986.
2. F.W.Billmeyer, A Text book of Polymer Chemistry, John wiley & sons, Singapore, 1994.
3. R.B.Seymour, Introduction to Polymer Chemistry, Mc Graw Hill, New York, 1971.
4. A.Ravve, Organic chemistry of macromolecules, Marcel Dekker, New York 1967.

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III YEAR – VI SEMESTER
COURSE CODE: 7BCHE3B

ELECTIVE COURSE - III (B) – MATERIAL CHEMISTRY & NANO-SCIENCE

Unit I Ionic Conductivity and Solid Electrolytes

Types of ionic crystals – alkali halides – silver chloride – alkali earth fluorides – simple stoichiometric oxides.

Types of Ionic conductors – halide ion conductors – oxide ion conductors – solid electrolytes and its applications.

Electrochemical cell: Principle, batteries sensors and fuel cells. Crystal defects in solids: Line and plane defects – point defects – Schottky and Frenkel defects – electronic properties and band theory: metals, semiconductors. Inorganic solids, colour, magnetic properties, optical properties, luminescence and lasers.

Unit II Alloys and its Importance

Definition: Alloys – purpose of making alloys – composition and uses of alloys of iron, copper, aluminium, lead, nickel and titanium.

Ferrous alloys: Fe-C phase transformation in ferrous alloys – carbon and ferrous alloys – Properties and uses of various types of carbon steels – stainless steel.

Non-ferrous alloys: Properties and applications.

Unit III Glass, Ceramics and Composites

Glassy state, glass formers and glass modifiers and their applications.

Ceramic structure – mechanical properties – clay products – refractories – characterisation – properties and applications.

Microscopic composites, dispersion – strengthened and particle reinforced, fibre reinforced composites, macroscopic composites. Nano-crystalline phase: Preparation, properties and applications.

Unit IV Synthetic Organic Metals

Conducting organics, organic super conductors, magnetism in organic materials. Electrically conducting organic solids – organic metals – Preparation and applications of conjugated polymers: Doped polyacetylene, polyparaphenylene, polyaniline and polypyrrole.

Blends and composites of polymer materials – Organic charge-transfer complexes and new superconductors: Fullerenes – doped fullerenes as superconductors – Nanocarbon and its applications

Unit V Nanomaterials – Synthesis and Characterisation

Preparative method for nanoparticles: Sol-gel thermolysis, combustion method, solvothermal method and microemulsion method

Thinfilm deposition techniques: Physical methods – vaccum evaporation, sputtering, Pulse laser deposition, chemical methods, CVD, chemical solution deposition, electrochemical deposition, spray pyrolysis deposition.

Materials Characterization Techniques: Physical characterization techniques: XRD, XPS, Laser Raman spectroscopy. Microscopic techniques: SEM, AFM and TEM.

Books for Reference:

1. Solid state chemistry and its application; Anthony.R. West, John Wiley & Sons (1989)
2. Materials Science; R.S.Khurmi and R.S.Sedha, S.Chand & Company Ltd (2000)
3. Materials Science and Engineering, V.Raghavan, Prentice – Hall of India Pvt. Ltd., (2001)
4. K.I.Chopra and I.Kaur, Thin film Devices and Their Applications, Plenum Press, New York, 1983.
5. J.P.Sibilia, A Guide to Materials Characterisation, VCH Publishers Inc., New York 1998.

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III YEAR - VI SEMESTER
COURSE CODE: 7BCHEPR

ELECTIVE COURSE - III (C) - PROJECT

Dissertation Report presentation - 60 marks
Viva- Voce - 40 marks

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