PG and Research Department of ChemistryPoompuhar College
(Autonomous) Melaiyur-609107

M.Sc., Chemistry

CHOICE BASED CREDIT SYSTEMSYLLABUS
2019- 2020 0NWARDS

POOMPUHAR COLLEGE (AUTONOMOUS), MELAIYUR – 609 107
Course Structure under CBCS
M.Sc., Chemistry
(for the candidates admitted from the academic year 2019 - 2020 onwards)

SEMESTER	COURSE	TITLE	INSTRU HOURS/WEEK	CREDIT	EXAM Hrs	MARKS INTERNAL	MARKS EXTERNAL	TOTAL
I	Core Course – I (CC)	Organic Chemistry - I	6	4	3	25	75	100
	Core Course – II (CC)	Inorganic Chemistry - I	6	4	3	25	75	100
	Elective Course – I	Analytical Chemistry	6	4	3	25	75	100
	Core Course – III (CC)	Organic Practical - I	6	5	*	40	60	100
	Core Course – IV (CC)	Inorganic Practical - I	6	5	*	40	60	100
		Total	30	22				500
II	Core Course – V (CC)	Physical Chemistry - I	6	4	3	25	75	100
	Core Course – VI (CC)	Inorganic Chemistry - II	6	5	3	25	75	100
	Core Course – VII (CC)	Physical Methods in Chemistry - I	6	5	3	25	75	100
	Core Course – VIII (CC)	Organic Practical - II	6	5	*	40	60	100
	Core Course – IX (CC)	Inorganic Practical - II	6	4	*	40	60	100
		Total	30	23				500
III	Core Course – X (CC)	Organic Chemistry - II	6	5	3	25	75	100
	Core Course – XI (CC)	Inorganic Chemistry - III	6	5	3	25	75	100
	Core Course – XII (CC)	Physical Chemistry Practical - I	6	4	**	40	60	100
	Elective Course - II	Polymer Chemistry	6	4	3	25	75	100
	Elective Course - III	Green and Environmental Chemistry	6	4	3	25	75	100
		Total	30	22				500
IV	Core Course – XIII (CC)	Physical Chemistry - II	6	5	3	25	75	100
	Core Course – XIV (CC)	Physical Chemistry Practical – II	6	4	**	40	60	100
	Elective Course - IV	Industrial Chemistry	6	4	3	25	75	100
	Elective Course - V	Chemistry of Nano Science and Nano Technology	6	4	3	25	75	100
	Project work	Project work	6	6				100
		Total	30	23				500
		Grand Total		**90**				**2000**

* Practical examination for Organic Practicals I & II and Inorganic Chemistry Practicals I & II will be conducted at the end of second semester – 6 Hrs duration.

** Practical examination for Physical Chemistry Practicals I & II will be conducted at the end of the fourth semester – 6 Hrs duration.

Programme Outcomes: Upon successful completion **of M.Sc. programme**, the student will be able to

PO1: Problem Solving & Decision Making Skill

Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. Foster analytical and critical thinking abilities for data-based decision-making.

PO2: Ethical Value

Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.

PO3: Individual and Team Leadership Skill

Capability to lead themselves and the team to achieve organizational goals.

PO4: Employability & Entrepreneurial Skill

Inculcate contemporary business practices to enhance employability skills in the competitive environment. Equip with skills and competencies to become an entrepreneur.

PO5: Contribution to Society

Succeed in career endeavors and contribute significantly to society.

Programme Specific Outcomes (PSOs)

Upon successful completion **of M.Sc. Chemistry programme**, the student will be able to

PSO 1:
Acquire understanding of fundamental concepts and applications of chemical and various scientific theories. Appreciate the importance of various elements in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of molecules /complexes using theories and experimental techniques.
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PSO 2:
Understand the background of organic /inorganic reaction mechanisms, chemical structures, experimental methods of chemical analysis, organic synthesis, molecular
rearrangements and separation techniques.

PSO 3:
Gather deep understanding about the physical aspects of atomic structure, quantum theory, molecular spectroscopy, thermodynamics, kinetics, catalysis, chemical equilibrium, reaction pathways with respect to time, various energy transformations, molecular assembly at surface level, significance of electrochemistry, and molecular segregation using their symmetry.

PSO 4:
Use technologies/instrumentation to acquire and analyze data of chemical systems in a sophisticated laboratory environment to secure challenging positions in industry, academics and government sectors by learning various analytical techniques such as UV, IR, NMR, MS, Chromatography etc and their applications. Develop analytical skills and problem solving skills requiring to develop new applications of chemistry.

PSO 5:
Gain knowledge in recent and advanced developments in the area of Nanochemistry, Medicinal Chemistry, Green Chemistry, Natural Products Chemistry, Bioinorganic Chemistry. Apply appropriate techniques for the qualitative and quantitative analysis of chemical system and carry out experiments in the area of organic / inorganic/ physical analysis -estimation, separation, derivative process, semi-micro analysis, preparation, conductometric / potentiometric methods.

SEMESTER - I **CORE COURSE – I**

ORGANIC CHEMISTRY -I

UNIT-I NOMENCLATURE, REACTIVE INTERMEDIATES AND DETERMINATION OF REACTION MECHANISM

Nomenclature of alicylic, bicyclic and tricyclic compounds, [Basic skeletal strucures only with one or without substituent. Nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen, and sulphur.

Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions and free radicals.

Thermodynamic and Kinetic controlled reactions, Energy profile diagram, Intermediate Vs Transition state,Non kinetic methods determination of presence of intermediate – isolation, detection, trapping – cross over experiment – isotopic labelic. Product analysis and its importance, Kinetic methods, Stereochemical studies, Isotopic and substituent effects.

UNIT II AROMATICITY AND HETEROCYCLES

Aromatic character - Five-, six-, seven-, and eight-membered rings – other systems with aromatic sextets – Huckel's theory of aromaticity, concept of homoaromaticity and antiaromaticity.

Electron occupancy in MO's and aromaticity – NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electrons, systems of more than 10 electrons (annulenes).

Bonding properties of systems with (4n+2) π-electrons and 4nπ-electrons, alternant and non-alternant hydrocarbons (azulene type) – aromaticity in heteroaromatic molecules, sydnones and fullerenes.

Synthesis, reactivity and applications of the following heterocycles - Oxazoles, Pyridazines, Pyrimidine and Pyrazines

UNIT III STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS

Stereoisomerism – Optical Isomerism - symmetry – enantiomers and diastereomers –

Conversions used in stereochemistry. Newman, Sawhorse and Fischer notations and interconversions and representations. *R* and *S* nomenclature – optical activity and chirality – types of molecules exhibitingoptical activity – absolute configuration – chirality in molecules with noncarbonstereocenters (N, S and P) – molecules with more than one chiral centre – atropisomerism.

Molecular chirality – allenes, spiranes, biphenyls. Geometrical isomerim- *E* and *Z* nomenclature – determination of configuration of geometrical isomers – stereochemistry of addition and elimination reactions – stereospecific and stereoselective synthesis [elementary examples].

Basic concepts of conformational analysis – conformations of cyclohexane, cyclohexene and decalin.

UNIT IV ORGANIC PHOTOCHEMISTRY

Organic Photochemistry - Fundamental concepts - Jablonski diagram - Energy transfer. Characteristics of photo reactions, Photo reduction and photo oxidation and photosensitization.

Photo reactions of ketones and enones - Norrish type I and II reactions. Parterno-Buchi reaction, Photo chemistry of alkenes, dienes and aromatic compounds - rearrangement.

Reactions of unactivated centers - Photolytic cycloadditions and photolytic rearrangements. Di-π-methane , Photo additions - Barton reaction.

UNIT V REAGENTS AND NAME REACTIONS IN ORGANIC SYNTHESIS

Oxidation, Jacobsen epoxidation, Jones reagent, PCC, IBX, DMP, Swern oxidation, Sommelet reaction.

Reduction- palladium / nickel based heterogeneous catalysts for hydrogenation, Wilkinson's catalyst, reductions using Li/Na/Ca in liquid ammonia. Hydride transfer reagents –LiAlH4, $NaBH_4$ and $NaCNBH_3$.

Bamford - Stevens reaction – Baylis - Hillman reaction – Enamines and selective mono- and dialkylation via enamine reactions – Mitsunobu reaction – Mukaiyama-Aldol addition – Peterson olefination – Prevost reaction – Ugi reaction – Weinreb ketone synthesis – Palladium based reactions - Heck reaction –

Sonogashira coupling – Stille coupling – Suzuki coupling.

REFERENCES

1. J. March and M. B. Smith, March's Advanced Organic Chemistry- Reactions, Mechanisms, and Structure- 7th Ed., Wiley, New York, 2013.
2. I. L. Finar, Organic Chemistry- Vol.II, 7th Ed., Pearson education Ltd, New Delhi, 2009.
3. R. K. Bansal, Organic Reaction Mechanisms- 11th Ed., Tata McGraw Hill, Noida, 2006.
4. R. T. Morrison and R. N. Boyd, Organic Chemistry, 7th Ed., Pearson, New Delhi, 2011.
5. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry- Parts A and B, 5th Ed., Springer, Germany, 2007.
6. P. S. Kalsi, Stereochemistry- Wiley eastern limited- New Delhi, 1993.
7. D. Nasipuri, Stereochemistry of Organic Compounds - Principles and Applications- 2nd Ed., New Age International, NewDelhi, 1994.
8. E. L. Eliel, and S. H. Wilen, Stereochemistry of Organic Compounds- John Wiley, New York, 1994.
9. J. D. Coyle, Organic Photochemistry- Wiley, New York, 1998.
10. G. R. Chatwal, Organic Phtochemistry- 1st Ed., Himalaya Publications house, Bangalore, 1998

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CO5	3	2	3	3	3

FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - I CORE COURSE – II
INORGANIC CHEMISTRY - I

UNIT I MAIN GROUP CHEMISTRY

Chemistry of Boron – Borane, higher boranes, Carboranes, Borazines and boron nitrides. Chemistry of silicon – silanes, higher silanes, multiple bonded systems.Disilanes, silicon nitrides, siloxanes and silicates, P-N compounds, Cyclophospazanes, Cyclophosphazenes, S-N compounds - S_4N_4 $(SN)_x$..

Ionic Model - Lattice energy, Bornhober Cycle - Born-Lande Equation - kapustinskii equation - Application of Latice Energy, High Tc Superconductors - Band theory of Solids - Schotty, Frenckel defects, Fcenter.

UNIT II PRINCIPLES OF COORDINATION CHEMISTRY

Studies of coordination compounds in solution - detection of complex formation in solution - Stereo and optical isomerism in coordination complexes. Stability constants - Stepwise and overall formation constants.

Simple methods of determining the formation constants – (Jobs continuous method of variation, mole-ratio method, polarographic methods).

Factors affecting stability - Statistical and chelate effects - Forced configurations.

UNIT III THEORIES OF METAL – LIGAND BOND

Crystal field theory (CFT) - Splitting of d orbitals under various geometries - Factors affecting splitting - Crystal Field Stabilisation Energy(CFSE) and evidence for CFSE (Structural and thermodynamic effects).

Spectrochemical series - John Teller distortion - Spectral and magnetic properties of complexes - Site preferences.

Limitations of CFT - ligand field theory - MO theory - Sigma and Pi bonding in complexes. Nephelauxetic effect.

UNIT IV REACTION MECHANISM IN COORDINATION CHEMISTRY

Kinetics and mechanism of reactions in solution - labile and inert complexes - ligand displacement reactions in octahedral and square planar complexes - acid hydrolysis, base hydrolysis and anation reactions – trans effect - theory and application.

Electron transfer reactions - electron exchange reactions - complementary and non- complementary types - inner sphere and outer sphere process - Application of electron transfer reactions in inorganic - isomerisation andracemisation reactions of complexes.

Molecular rearrangements of Reactions of four and six coordinate complexes - interconversionof stereoisomers - Reactions of coordinated ligands - template effect and its application.

UNIT V INORGANIC PHOTOCHEMISTRY

Electronic transitions in metal complexes, metal-centered and charge- transfer transitions – various photophysical and photochemical processes of coordination compounds.

Unimolecular charge-transfer photochemistry of cobalt(III) complexes – mechanism of Charge Transfer To Metals(CTTM), photoreduction – ligand- field photochemistry of chromium(III) complexes – Adamson's rules, photoactive excited states, V-C model – photophysics and photochemistry of ruthenium polypyridine complexes, emission and redox properties.

Photochemistry of organometallic and metal carbonyl compounds – compounds with metal-metal bonding – Reinecke's salt chemical actinometer.

REFERENCES

1.M. C. Day, J. Selbin and H. H. Sisler, Theoretical Inorganic Chemistry- Literary Licensing (LLC), Montana, 2012.

2.F. A. Cotton and G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry- 6th Ed., A Wiley - Interscience Publications, John Wiley and Sons, USA, 1999.

3.J. E. Huheey, Inorganic Chemistry- 4th Ed., Harper and Row publisher,

Singapore, 2006.

4.A. W. Adamson, Concept of Inorganic Photochemistry- John Wiley and Sons, New York, 1975.

5.S. F. A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum- Academic Publishers, Oxford University Press, New York, 1996.

6. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry-
R. E. Krieger Pubs, Florida, 1984.

7.J. Ferraudi, Elements of Inorganic Photochemistry- Wiley, New York, 1988.

8.F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions- 2nd Ed., John Wiley, New York, 1967.

9.R. K. Sharma, Inorganic Reactions Mechanism- Discovery Publishing House, New Delhi, 2000.

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CO5	2	3	3	3	2

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SEMESTER - I **CORE COURSE – III**

ANALYTICAL CHEMISTRY

UNIT I INSTRUMENTAL METHODS OF ANALYSIS

Principles and applications of extended X-ray absorption fine structure(EXAFS) - surface extended X-ray absorption (SEXAFS).

Atomic absorption spectroscopy (AAS) -flame emission spectroscopy (FES) – turbidimetry and nephelometry - theory and applications.

UNIT II DATA AND ERROR ANALYSIS

Various types of error – sources and minimisation - accuracy, precision, significant figures - describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, repeatability and reproducibility of measurements.

Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, paired t-Test - Analysis of Variance (ANOVA)
- correlation and regression.

Curve fitting, fitting of linear equations, simple linear case, weighted linear case, analysis of residuals- general polynomial equation fitting.

UNIT III CHROMATOGRAPHY

Solvent extraction - principles of ion exchange, paper, thin-layer and column chromatographic techniques.Columns, absorbents, methods, R_f values, McReynolds constants and their uses.

HPLTC, HPLC techniques - absorbents, columns, detection methods, estimations, preparative column - GC - MS techniques, principle and uses.

UNIT IV THERMOANALYTICAL METHODS AND FLUORESCENCE SPECTROSCOPY

Principles and applications of Thermogravimetryanalysis (TGA), Differential thermal analysis (DTA) and Differential scanning calorimetry (DSC)– Thermometric titrations - types -advantages.

Basic aspects of synchronous fluorescence spectroscopy.

UNIT V ELECTROANALYTICAL TECHNIQUES

Electrochemical sensors, ion sensitive electrodes, glass - membrane electrodes - solid liquid membrane electrodes, ion-selective field effect transistors(ISFETs) - sensors for the analysis of gases in solution Amperometric titrations - principle instrumental – techniques - applications. Fluorimetry, Phosporimetry - Instrumentation and its applications.

REFERENCES

1. D. B. Hibbert and J. J. Gooding, Data Analysis for Chemistry- Oxford University Press, UK, 2006.
2. J. Topping, Errors of Observation and Their Treatment- 4th Ed., Chapman Hall,London, 1984.
3. A. Braithwaite and J. F. Smith, Chromatographic Methods- 5th Ed., Springer,Germany- 1995.
4. V. K. Srivastava and K. K. Srivastava, Introduction to Chromatography- 2ndEd., Holden Day, New York, 1985.
5. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methodsof Analysis- 6th Ed., CBS Publishers and Distributors, Chennai, 1986.
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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER – I CORE COURSE – IV (CORE PRACTICAL - I)

ORGANIC CHEMISTRY - I (P)

OBJECTIVES

1. To perform the qualitative analysis of a given organic mixture.
2. To carry out the preparation of organic compounds.

1. **Qualitative analysis of an organic mixture containing two components** Mixtures containing two components are to be separated (pilot separation) and purified(bulk separation)

and preparation of derivatives – The physical constants are to be reported(analysis).

2. **Preparation of organic compounds (single stage)**
   1. Methyl-*m*-nitrobenzoate from methylbenzoate (nitration)
   2. Glucose pentaacetate from glucose (acetylation)
   3. Resacetophenone from resorcinol (acetylation)
   4. Benzophenoneoxime from benzophenone (addition)
   5. *o*-Chlorobenzoic acid from anthranilic acid (Sandmayer reaction)
   6. *p*-Benzoquinone from hydroquinone (oxidation)
   7. Phenylazo-2-naphthol from aniline (diazotization)

REFERENCES

1. J. Mohan, Organic Analytical Chemistry- Theory and Practice- Narosa, 2003.
2. V. K. Ahluwalia, P. Bhagat, and R. Agarwal, Laboratory Techniques inOrganic Chemistry- I. K. International, 2005.
3. N. S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual-

S.V. Printers, 1987.

4. A. I. Vogel, A. R. Tatchell, B. S. Furniss, A. J. Hannaford and P. W. G. Smith,Vogel's Textbook of Practical Organic Chemistry- 5th Ed., Prentice Hall, 1989.

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CO1	3	3	3	3	3
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CO4	3	3	3	2	3
CO5	3	3	3	3	3

FACULTY UNIVERSITY NOMINEE HOD

SEMESTER - I

CORE COURSE – V (CORE PRACTICAL - II)

INORGANIC CHEMISTRY I (P)

OBJECTIVES

1. To perform the semi-micro qualitative analysis.
2. To estimate the metal ions using colorimeter.

1. Semi-micro qualitative analysis

Mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg, NH4) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).

2. Estimation

Copper, ferric, nickel, chromium and manganese ions using photoelectriccolorimeter

REFERENCE

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis - 3rd Ed.,National Pubs, London, 1988.
2. G. Svehla, Text Book of Macro and Semimicro Qualitative Inorganic Analysis -5th Ed., Longman group Ltd, London, 1987.
3. A. I. Vogel, Text Book of Quantitative Inorganic Analysis-6th Ed., Longman, New Delhi, 2000.

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CO3	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	2	3	3
CO5	3	3	3	3	3

FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - II
CORE COURSE - VI
PHYSICAL CHEMISTRY - I

UNIT I CONCEPTS OF GROUP THEORY

Symmetry elements and operations – point groups – assignment of point groups to molecules – group postulates and types of groups – group multiplication tables, sub groups, similarity transformations – conjugate elements and classes.

Matrix representation of symmetry operations and point groups – reducible and irreducible representations – properties of irreducible representation.

The great orthogonality theorem – construction of character table – direct product – projection operators .

1.3. Hybritation concept – CH4 and BF3only. Symmetry of normal and and active mole of vibration of H2O and BF3 only. Symmetry selection rule of IR and Raman spectroscopy.

UNIT II QUANTUM CHEMISTRY - I

Inadequacy of classical mechanics – black body radiation – Planck's quantum concept – photoelectric effect – Bohr's theory of hydrogen atom – hydrogen spectra – wave-particle dualism – uncertainty principle – decline of old quantum theory. Schrodinger equation – postulates of quantum mechanics – operator algebra - linear operator, Hermitian operators, eigen functions and eigen values, angular momentum operator – commutation relations and related theorems – orthogonality and normalization.

Applications of wave mechanics to simple systems – particle in a box, one and three dimensional, particle with finite potential barrier – the quantum mechanical tunneling.

UNIT III CHEMICAL KINETICS - I

Theories of reaction rate – absolute reaction rate theory (ARRT) – transmission coefficient, reaction co ordinate – potential energy surfaces – kinetic isotope effect – Hinshelwood theory – Kassel, Rice and Ramsperger theory (KRRT) –Slater'streatment.

Principle of microscopic reversibility – steady-state approximation – chain reactions- thermal and photochemical reactions between hydrogen and halogens –explosions and hydrogen-oxygen reactions.

UNIT IV MOLECULAR THERMODYNAMICS - II

Third law – thermodynamics – significance – Nernst heat theorem and other forms of stating the third law – thermodynamic quantities at absolute zero – apparent exceptions to the third law.

Thermodynamics of systems of variable composition – partial molar properties – chemical potential – relationship between partial molar quantities – Gibbs- Duhem equation and its applications (the experimental determination of partial molar properties not included).

Thermodynamic properties of real gases – fugacity concept – calculation of fugacity of real gas – activity and activity coefficient – concept – definition – standard states and experimental determinations of activity and activity coefficient of electrolytes.

UNIT V FAST REACTION TECHNIQUES, PHOTOCHEMISTRY ANDRADIATION CHEMISTRY

Introduction – flow methods (continuous and stopped flow methods) – relaxation methods (T and P jump methods) – pulse techniques (pulse radiolysis, flash photolysis) – shock tube method – molecular beam method– lifetime method.

Photophysical processes of electronically excited molecules –Jablonski diagram– Stern-Volmer equation and its applications – experimental techniques in photochemistry – chemical actinometers– lasers and their applications.

Differences between radiation chemistry and photochemistry – sources of high energy radiation and interaction with matter – radiolysis of water, solvated electrons – definition of G value, Curie, linear energy transfer (LET) and Rad – scavenging techniques – use of dosimetry and dosimeters in radiation chemistry – applications of radiation chemistry.

REFERENCES

1. F. A. Cotton, Chemical Applications of Group Theory- 3rd Ed., John Wileyand Sons, Singapore, 2003.
2. R. L. Flurry, Jr, Symmetry Groups- Theory and Chemical Applications- Prentice Hall, New Jersy, 1980.
3. S. F. A. Kettle, Symmetry and Structure- 2nd Ed., John Wiley and Sons, Chichester, 1995.
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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER-I **CORE COURSE - VII**

INORGANIC CHEMISTRY – II

UNIT I ACIDS AND BASES

Bronsted and lewis acids and bases, protonic acid, proton affinities - differentiating and leveling solvents - acidic behavior of the binary hydrides - strength of oxy acids - hydrolysis - amphoteric oxides - non protonic concepts of acid- base reactions - lux concept.

Liquid ammonia, acetic acid, bromine trifluoride, dinitrogen tetroxide, liquid hydrogen fluoride as solvents.

Classifications of acids and bases- hard or soft - acid - base strength and hardness and softness. E-C parameters for the strength of acids and bases.

UNIT II NUCLEAR CHEMISTRY

Radioactive decay - theories of decay process - laws of radioactivity. Detection and measurement of radiations- nuclear structure - composition of nuclei - properties of nuclei - nuclear radii and nuclear spin. Nuclear forces - itscharacteristic - meson field theory - nuclear stability - nuclear models - liquid drop, shell and collective models. Artificial radioactivity - Nuclear reactions - Transmutation - stripping and pickup, Fission products and fission yields. Fusion, spallation and fragmentation reactions- scattering reactions - nuclear cross section - Q value. Nuclear reactors - charged particle accelerators - neutron sources - gamma ray and X-ray sources. Radioactive techniques - tracer technique – neutron activation and isotopic dilution analysis.

Application of nuclear science in agriculture and biology, radiation risks and medical benefits - natural and man made isotopes.

UNIT III BIO- INORGANIC CHEMISTRY

Metallo proteins - Iron containing proteins: Metalloporphyrins-Haemoglobin and myoglobin – Structures and work functions – synthetic oxygen carriers – Cytochrome – structure and work function. Non heme oxygen carriers – Electron carrier proteins – Iron sulphur proteins. Magnesium containing proteins: Chlorophyll – structure – photosynthetic sequence. Copper containing proteins: Classification – blue copper

proteins – structure of blue copper electron transferases – copper protein as oxidases – cytochrome c oxidase – mechanistic studies of cytochrome c oxidase.

Metallo enzymes: Carboxy peptidase A – structure and function ; Carbonic anhydrase – inhibition and poisoning – Corrin ring system – Vitamin B_{12} (cyanocobalamin) and B_{12} coenzymes – In vivo and In vitro nitrogen fixation.

Metals in medicine: Anti arthritis drugs – Au Anti cancer drug – cisplatin and its of action – Au and metallocenes in anti cancer drugs- Molecular mechanism of iron transport across the membrane – sodium and potassium ion pumps.

UNIT IV ORGANOMETALLICS

Types of ligands – Hapticity – 18 electron rule and its limitation – Structure and bonding in metal carboryls – metal nitrosyls (bent and linear) – metalolefin(Zeises salt).

Dinitrogen complexes – metallocene (Ferrocene)- metal carbenes – Isolobal concept and its applications.

UNIT V REACTIONS AND CATALYSIS BY ORGANOMETALLICS

Organometallic reactions – ligand association and dissociation – oxidativeaddition and reductive elimination – migratory insertion reactions.

Reactions of coordinated ligands in organometallics – hydrogenation,hydroformylation(oxoprocess), epoxidation, olefin metathesis.

Polymerization of olefins, olefin oxidation(Wacker process) and carbonylation of methanol(monsanto process).

REFERENCES

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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER – II **CORE COURSE – VIII**

PHYSICAL METHODS IN CHEMISTRY - I

UNIT I PRINCIPLES OF MOLECULAR SPECTROSCOPY

1.1 +Interaction of electromagnetic radiation with molecular systems. Microwave spectroscopy – rotational spectra of diatomic molecules, rigid and non-rigid rotors – intensity of spectral lines – effects of isotopic substitution – microwave spectra of polyatomic molecules – linear and symmetric top molecules.

1.3 Infrared spectroscopy – diatomic molecules, simple harmonic and anharmonic oscillators – diatomic vibrating rotator rotation – vibration spectrum of carbon monoxide – interaction of rotation and vibration (breakdown of Born-Oppenheimer approximation) – influence of the rotation on the spectrum of polyatomic molecules, linear and symmetric top molecules, parallel and perpendicular vib rations – influence of nuclear spin Infrared spectroscopy – instrumentation, sampling techniques –factors influencing group frequencies – quantitative studies – hydrogen bonding (intermolecular and intramolecular).

UNIT II UV-VISIBLE AND ORD SPECTROSCOPY

Raman spectra – rotational Raman spectra of linear and symmetric top molecules – vibrational Raman spectra – rotational fine structure – electronic spectra of diatomic molecules – vibrational coarse structure – intensity of vibrational lines in electronic spectra – rotational fine structure
– fortrat diagram.

UV-Visible spectroscopy – introduction – instrumentation, sampling techniques – Woodward-Fieser and Scott's rules for conjugated dienes and polymers, ketones, aldehydes, α, β-unsaturated acids, esters, nitriles, and amides – differentiation of geometrical isomers and positional isomers – disubsitituted benzene derivatives – study of steric effect in aromaticity.

Optical rotatory dispersion and circular dichroism– introduction to theory and terminology – cotton effect – ORD curves – axial haloketone rule and its applications – the octant rule – its applications – applications of ORD to determine absolute configuration of monocyclic ketones – comparison between ORD and CD – their inter

relationships.

UNIT III NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

^{1}H NMR Spectroscopy – multiplicity – coupling constant – spin-spin splitting – vicinal and geminal coupling constants – Karplus equation – long rangecoupling constants, influence of stereochemical factors on chemical shift of protons.

– Simplification of complex spectra – double resonance techniques, shift reagents chemical spin decoupling of rapidly exchangeable protons (OH, SH,COOH, NH, NH2) – an elementary treatment of NOE phenomenon.

^{13}C NMR Spectroscopy – broad band decoupling – off resonance decoupling –chemical shifts of common functional groups – FT NMR and its importance– DEPT spectra – identification of small compounds based on NMR data – 2D techniques- 1H–1H COSY, ^{1}H–^{13}C HETCOSY – NOESY.

UNIT IV MASSBAUER SPECTROSCOPY

.**Mössbauer spectroscopy –** Introduction, principle, instrumentation, recoil energy, Doppler effect, number of MB signals, isomer shift, quadrupole splitting,magnetic hyperfine splitting-applications to ^{57}Fe, ^{119}Sn and ^{129}I compounds.

NQR spectroscopy – characteristics of quadrupolar nucleus – effects of fieldgradient and magnetic field upon quadrupolar energy levels – NQR transitions – applications of NQR Spectroscopy

UNIT V MASS SPECTROSCOPY

Mass Spectrometry – instrumentation – resolution – ESI, EI, CI and FAB methods – base peak, isotopic peaks, metastable peaks – importance of metastable peaks, parent peak, recognition of molecular ion peak – fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement – nitrogen rule. Application of UV, IR, NMR strand Mass Spectroscopy – Structural elucidation of organic molecules – Minimum 20 problems.

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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - II CORE COURSE – IX (CORE PRATICAL - III)

ORGANIC CHEMISTRY - II (P)

OBJECTIVES

1. To carry out the qualitative analysis of an organic mixture.
2. To perform the preparation of organic compounds.

1. Quantitative analysis of organic compounds

Estimation of phenol, aniline, ketone, glucose, saponification value of an oiland iodine value of oil.

2. Preparation of organic compounds (double stage)

1. *p*-Bromoacetanilide from aniline (acetylation and bromination)
2. Acetylsalicylic acid from methyl salicylate (hydrolysis and acetylation)
3. 1,3,5-Tribromobenzene from aniline (bromination, diazotization and
4. hydrolysis)
5. *p*-Nitroaniline from acetanilide (nitration and hydrolysis)
6. Benzilic acid from benzoin (rearrangement)
7. *p*-Aminobenzoic acid from p-nitrotoluene (oxidation and reduction)
8. Benzanilide from benzophenone (rearrangement)
9. *p*-Bromoaniline from acetanilide (bromination and hydrolysis)
10. *m*-Nitroaniline from nitrobenzene (nitration and reduction)
11. 1,2,4-Triacetoxy benzene from hydroquinone (oxidation and acylation)

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FACULTY UNIVERSITY NOMINEE HOD

SEMESTER - II CORE COURSE – X (CORE PRACTICAL - IV)

INORGANIC CHEMISTRY II (P)

OBJECTIVES

1. To carry out the titrimetric and gravimetric analyses.
2. To perform the preparation of compounds.

1. Titrimetry and Gravimetry

A mixture of solution(s) should be given forestimation Cu (V) and Ni (G) Cu (V) and Zn (G)

Fe (V) and Zn (G)

Fe (V) and Ni (G)

Zn (C) and Cu (G)

2. Preparation of complexes

1. Tris(thiourea)copper(I) chloride
2. Tetraamminecopper(II) sulphate
3. Potassium trioxalatoferrate
4. Potassium trioxalatoaluminate(III)
5. Potassium trioxalatochromate(III)
6. Tris(thiourea)copper(I) sulphate

sREFERENCE

1. A. I. Vogel, Text Book of Quantitative Inorganic Analysis- 6th Ed.,Longman, New Delhi, 2000.

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FACULTY UNIVERSITY NOMINEE HOD

SEMESTER - III CORE COURSE – XI

ORGANIC CHEMISTRY - II

UNIT I NUCLEOPHILIC SUBSTITUTION REACTIONS

Aliphatic nucleophilic substitution – mechanisms – SN1, SN2, SNi– ion-pair in SN1 mechanisms – neighbouring group participation - substitutions at allylic and vinylic carbons.

Correlation of structure with reactivity - solvent effects.

Rearrangements involving carbocations – Wagner-Meerwein and dienone- phenol rearrangements.

Aromatic nucleophilic substitutions – SN1, SNAr, Benzyne mechanism – reactivity orientation – Ullmann, Sandmeyer and Chichibabin reaction – rearrangements involving nucleophilic substitution – Stevens – von-Richter rearrangements.

UNIT II ELECTROPHILIC SUBSTITUTION REACTIONS

Aromatic electrophilic substitution reaction – orientation, reactivity and mechanisms based on transition state theory with suitable reactions – substitutions in thiophene and pyridine – N-oxide.

Quantitative treatment of the structural effects on reactivity - Substituent effects – origin of Hammett equation – principles of Hammett correlation – effect of structure on reaction mechanisms - Hammett parameters –σ and ρ, modified forms of Hammett equation, Taft Equation.

Aliphatic electrophilic substitution – SE2, SEi and SE1 mechanisms – diazonium coupling reactions – metals as electrophile in substitution reactions and decomposition of diazonium salts.

UNIT III ADDITION AND ELIMINATION REACTIONS

Addition to carbon-carbon multiple bonds – electrophilic, nucleophilic and free radical additions – orientation of the addition – stereochemical factors influencing the addition of bromine and hydrogen bromide, hydroxylation – hydroboration leading to formation of alcohols.

Addition to carbonyl and conjugated carbonyl systems – mechanism – Grignard

reagents – 1,2- and 1,4-additions (dimethylcuprate) – addition to carbon-oxygen double bond – Benzoin, Knoevenagel, Stobbe, Darzens glycidicester condensation and Reformatsky reactions.

Elimination reactions – mechanisms- E1, E2, E1cB – stereochemistry of elimination, Hofmann and Saytzeff rules – competition between eliminationand substitution – pyrolytic *cis* elimination, Chugaev reaction – examples suchas dehydration, dehydrohalogenation, Cope elimination– Bredt's rule with examples.

UNIT IV PERICYCLIC REACTIONS

Concerted reactions –stereochemistry – orbital symmetry and concerted symmetry and correlation diagram. Frontier molecular orbital approach – Woodward and Hoffmann rules - electrocyclic reactions - cycloaddition reactions.

Sigmatropic rearrangements – selection rules and examples with simple molecules - 1,3and 1,5 -hydrogen shifts – Cope - Claisen - Sommelet- Hauser rearrangements.

UNIT V NATURAL PRODUCTS

Terpenes - classification - Structural elucidation, medicinal values and synthesis of α – pinene, camphor and zingiberene.

Alkaloids- Structural elucidation, medicinal values and synthesisof quinine, Cinchonine.

Vitamins - Physiological importance – structural elucidation of vitamins B_6, D_2.

Steroids – classification – structural elucidation and synthesis ofprogesterone and androsterone.

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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER – III CORE COURSE – XII

INORGANIC CHEMISTRY – III

UNIT I

ELECTRONIC SPECTROSCOPY

Microstates and Term symbols for transition metal ions - Possible Term symbols for p^2 and d^2.

Hund's rule - RS and j - j coupling - Selection rules - orgel diagrams for d^n, oh and Td systems. Tanabe -sugano diagram calculation of β and 10 Dq - factors affecting 10 Dq - charge transfer spectra.

UNIT II IR AND RAMAN SPECTROSCOPY

IR selection rule – Group vibration concept and its limitation. Effect of coordination of ligand vibrations - uses of group vibrations in the structural elucidation of ligand – uses of group vibration in the structural elucidation of metal complexes of urea, thiourea, cynide, thiocyanate, nitrate, sulphate and dimethylsulphoxide.

Effect of isotopic substitution on the Vibrational spectra of molecules - Vibrational spectra of metal carbonyls with references to the nature of bonding geometry and number of C-O stretching vibrations (Group theoretical treatment). combined application of IR and Raman spectroscopy in the structural elucidation of simple molecules like H2O, ClF3,NO3,ClO3.

UNIT III NMR SPECTROSCOPY

Chemical shift and coupling constants (spin – spin coupling involving different nuclei ^{1}H, ^{31}P, ^{13}C) interpretation and application to inorganic compounds. Effects of quadrupolar nuclei (^{1}H, ^{11}B, ^{10}B) on the ^{1}H NMR spectrum.

NMR paramagnetic molecules - isotopic shifts, contact and pseudo contact interactions. Lanthanide shift reagents, Stereochemistry of non-rigid molecules. Satellite spectra - Applications of ^{1}H, ^{31}P, ^{13}C NMR of inorganic molecules.

UNIT IV EPR SPECTORSCOPY AND MAGNETIC PROPERTIES

Basic principles - "g" values and its types - factors affecting "g" values - Hyperfine spiliting - zero field splitting and kramer's degeneracy – spectra of

Cu(II) complex. Applications of ESR to Free radicals and Inorganic molecules.

Magnetic properties - dia, para, ferro and antiferro magnetisms - first order and second order Zeeman effect – Temperature independent paramagnetism- magnetic properties of lanthanides and actinides.

UNIT V X-RAY CRYSTALLOGRAPHY

Solid state- difference between point group and space group - screw axis - glide planes. Crystal symmetry elements - crystal classes - crystal systems - unit cell - bravis lattices, asymmetric unit space group - equivalent positions - relations between molecular symmetry and crystallographic symmetry - basic concepts. The concept of reciprocal lattice and its applications - X ray diffraction by single crystal – structure factor - systematic absences - determination of space group - heavy atom method.

Neutron diffraction - basic principles (elementary treatment) – comparison of X-ray diffraction and electron diffraction.

REFERENCES

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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - III **CORE COURSE – XIII (CORE PRACTICAL - V)**

PHYSICAL CHEMISTRY I (P)

OBJECTIVES

To perform the various techniques of physical chemistry experiments.

Any ten experiments (to be decided by the course teacher) out of the followingexperiments.

1. Kinetics-acid hydrolysis of ester–comparison of strengths of acids.
2. Kinetics-acid hydrolysis of ester–determination of energy of activation (Ea).
3. Kinetics-saponification of ester–determination of ethyl acetateby conductometry.
4. Kinetics-persulfate-iodine reaction –determination of order, effective ofionic strength on rate constant.
5. Determination of molecular weight of substance by transition temperaturemethod.
6. Determination of molecular weight of substances by Rast method.
7. Determination of Critical Solution Temperature (CST) of phenol-water system and effect of impurity on CST.
8. Study of phase diagram of two components forming a simple eutectic.
9. Study of phase diagram of two compounds forming a compound.
10. Study of phase diagram of three components system.
11. Determination of molecular weight of substances by cryoscopy.
12. Determination of integral and differential heat of solutions by colorimetry.
13. Polymerization-rate of polymerization of acrylamide.
14. Distribution law – study of Iodine-Iodine equilibrium.
15. Distribution law – study of association of benzoic acid in benzene.
16. Adsorption – oxalic acid/acetic acid on charcoal using Freundlich isotherm.

REFERENCES

1. B. P. Levitt, Findlay's Practical Physical Chemistry- 9th Ed., Longman, 1985.
2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry- Vol. 1-Physical, S. Chand and Co., Ne.

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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - III ELECTIVE COURSE – I

POLYMER CHEMISTRY

UNIT I CLASSIFICATION AND MOLECULAR WEIGHT DETERMINATION

Basic concepts of polymer science-molecular forces and chemical bonding in polymers-classification of polymers-addition polymers, condensation polymers, biopolymers – polymer synthesis-polymerization techniques.

Molar mass and size of polymers, Number average and weight average molecular weight-methods of molecular weight determination - Osmometry, Viscosity, Light scattering, sedimentation, Ultracentrifuge -Molecular weight distribution curve.

UNIT II SYNTHESIS AND KINETICS

Kinetics of polymerization – free radical chain polymerization, cationic polymerization, anionic polymerization, copolymerization.

Degree of polymerization, Chain length, chain transfer, chain termination, stereo regular polymerization, Zeigler Natta Catalysts.

UNIT III CHARACTERIZATION

3.1 Crystalline nature-x-ray diffraction-Study of polymers, degree of crystallinity, Differential scanning calorimetry, Thermogravimetric analysis of polymers. Glass transition temperature-Factors affecting glass transition temperature, the properties associated with glass transition temperature and crystallinity and melting point-Relation to structure.

UNIT IV CHEMICAL REACTIONS

Hydrolysis, Acidolysis, Hydrogenation, Addition and Substitution reactions-Cyclization, Cross Linking-Vulcanization, Graft and Block Copolymers.

Types of Degradation- Thermal, Mechanical, Oxidative, Hydrolytic and photo degradation

UNIT V PHYSICAL PROPERTIES AND APPLICATIONS

Mechanical – stress - strain measurements- electrical - conducting polymers - polyacetylene, polyaniline. industry important polymers - natural and

synthetic rubber, polyesters, polytetrafluoroethylene (PTFE), polystyrene, ion exchange resins, nafion, polyacylonitrile – carbon fibres, polyvinyl chloride and poly acrylates.

REFERENCES

1. V.R Gowariker et al, Science Wiley Eastern, 1986.
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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER – III CORE COURSE – XIV

SELECTED TOPICS IN ORGANIC CHEMISTRY

UNIT I INTRODUCTION TO GREEN CHEMISTRY

1.1 Green chemistry - relevance and goals, Anastastwelve principles of green chemistry - tools of green chemistry - Alternative starting materials, reagents, catalyst, solvents and process with suitable examples.

1.2 Microwave mediated organic synthesis (MAOS),Explosive - Specific effects of microwave – Heat reaction - Solid support reactions.

1.3 Typical reactions - Hydrolysis, Saponification, Acetolysis - Principle, Instrumentation and advantages.

UNIT II IONIC LIQUID AND PTC

Introduction - Synthesis of ionic liquids - Physical properties - application in alkylation, Diels – alder reactions - Phase transfer catalyst - Synthesis - Applications.

Support catalysts and Biocatalysts for green chemistry - Introduction - the concept of atom economy - supported metal catalyst, meson porous silica - the use of bio Catalysts for green chemistry, alternative synthesis reagents and reaction conditions.

A Photochemical alternative to Friedel – Crafts reactions - Dimethyl Carbonate as a ethylating agent - the design and applications of green super critical carbon dioxide for synthetic chemistry.

UNIT III RETERO SYNTHESIS

Disconnection approach - Synthon - Synthetic Equivalent - C-X - C-C disconnections. Diels alder reactions, Michael reaction, FGI involving aldehyde and aldehyde. Protecting Groups, C-OH, C-NH_2, C-COOH.

Asymmetric synthesis – basic principles – stereoselective and stereospecific reactions – reagents, catalysts and their applications (wherever applicable) in alkylation and hydrogenation – Jacobsen's catalyst – Evan's catalyst.

UNIT IV BIOMOLECULES (ANTIBIOTICS AND VITAMINS)

Antibiotics: A detailed study of structure, stereochemistry and synthesis of penicillin, cephalosporin.

Vitamins: Chemistry and physiological action of ascorbic acid, thiamin, riboflavin and pyridoxine – Elementary aspect of vitamin A, E, K and B_{12}.

UNIT V ENZYMES AND COFACTORS

Chemical nature of enzymes – characteristics of enzymes – colloidal nature,catalytic nature - Fischer's lock and key model – regulation of enzyme activity.

Structure and biological functions of coenzyme A, NAD+ and FAD.

Nucleic Acid – definition – nucleosides and nucleotides – deoxyribonucleic acid (DNA) – internucleotides linkages – base composition – double helical structure.

REFERENCES

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2. Green chemistry - Designing chemistry for the environment - edited by Paul T. Anastas& Tracy C.Williamson, Second Edition (1998)
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FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER – IV SCORE COURSE – XV

PHYSICAL CHEMISTRY - IIUNIT I QUANTUM CHEMISTRY - II

Application of wave mechanics, the rigid rotator, harmonic oscillator- hydrogen atom solution - shapes and nodal properties of orbitals - space quantization - electron spin - many electron atoms-one electron orbital - Pauli principle - determinantal form of wave function ,helium atom and effective nuclear charge- approximation method - Variation methods, application to Hydrogen and Helium atoms-Perturbation method for non degenerate systems.

Angular momentum in many electron systems-Spin orbit interaction L-S and j- j coupling schemes.

Atomic Structure calculation –Self consistent method for atoms - Hartree and Hartree Fock method for atoms.

Vibrational spectra- symmetry properties of normal molecules - Symmetry co-ordinates - Selection rules for fundamental Vibrational transition - IR and Raman activity of fundamentals in CO_2,H_2O,N_2F_2. The rule of mutual exclusion and Fermi resonance

UNIT II ELECTROCHEMISTRY - I

Electrolytic conductance, Debye – Huckel – Onsager theory - Debye Falkenhagen and Wien effect. Electrode – Electrolyte equilibrium, Electrode Potential - concentration cells - liquid junction potentials.

Process at electrode - The rate of charge transfer - Current density - Butler - Volmer equation - Tafel equation - Electrical double layer potential - theory of multiple layers at electrode - electrolyte interfaces - Double layer capacity - Electro kinetic phenomena , Applications - Fuel cells and power storage like rechargeable batteries (Lead acid, Ni-Cd and Li-ion)

UNIT III ELECTROCHEMISTRY – II

Principles and applications of Polarography - instrumentation, Types of cells, Advantages of dropping mercury electrode, interpretation of current voltage curves, tests for reversibility, determination of n values (usefulness of illkovic equation), Polarographic maxima, current time curves.

Modern developments, Oscillographic polarography, AC polarography, Cyclic voltammetry, Advantages over Polarographic techniques - test of reversibility of electron transfer reactions - Chronopotentiometry - apparatus used, advantages over polarography - controlled potential coulometry.

UNIT IV SURFACE CHEMISTRY AND CHEMICAL KINETICS - II

Surface phenomena – Gibbs adsorption isotherm – solid-liquid interfaces –

contact angle and wetting – solid-gas interface – physisorption and chemisorption – Langmuir, BET isotherms – surface area determination.Kinetics of surface reactions involving adsorbed species – Langmuir- Hinshelwood mechanism, Langmuir-Rideal mechanism – Rideal-Eley mechanism – some interfacial aspects on micelles, reverse micelles, microemulsions and membranes.

Application of ARRT to solution kinetics – effect of solvent and ionic strength, influence of pressure on rates in solution – enzyme catalysis – mechanism of single substrate reactions – Michaelis-Menten law – acidity functions – kineticsof processes in micellar and reverse micellar systems.

UNIT V STATISTICAL THERMODYNAMICS

Thermodynamic probability – probability theorems – relation between entropy and probability (Boltzmann-Planck equation), ensembles, phase space, Ergodic hypothesis, microstates and macrostates, Maxwell- Boltzmann distribution law– partition functions – translational, rotational, vibrational and electronic partition functions. Relationship between partition functions and thermodynamic properties – calculation of equilibrium constants from partition functions – heat capacities of mono atomic crystals – Einstein theory and Debye theory.

Quantum statistics – Bose-Einstein (B.E.) and Fermi-Dirac (F.D.) distribution equations – comparison of B.E. and F.D. statistics with Boltzmann statistics – applications of quantum statistics to liquid helium, electrons in metals and Planck’s radiation law – concept of negative Kelvin temperature.

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	PO1	PO3	PO3	PO4	PO5
CO1	3	3	3	3	2
CO3	3	3	2	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

FACULTY **UNIVERSITY NOMINEE** **HOD**

SEMESTER - IV **CORE COURSE – XVI (CORE PRACTICAL - VI)**

PHYSICAL CHEMISTRY - II (P)

OBJECTIVES

To perform the various electrical experiments.

Any ten experiments (to be decided by the course teacher) out of the followingexperiments.

1. Conductometry– acid-alkali titrations.
2. Conductometry– precipitation titrations.
3. Conductometry– displacement titrations.
4. Conductometry– determination of dissociation constant of weak acids.
5. Conductometry– solubility product of sparingly soluble silver salts.
6. Verification of Onsager equation - conductivity method.
7. Determination of degree of hydrolysis and hydrolysis constant ofa substance.
8. Potentiometric titrations – acid alkali titrations.
9. Potentiometric titrations – precipitation titrations.
10. Potentiometric titrations – redox titrations.
11. Potentiometry– determination of dissociation constant of weak acids.
12. Potentiometry– determination of solubility of silver salts.
13. Potentiometry– determination of activity and activity coefficient of ions.
14. pH Titration of *ortho*-phosphoric acid.
15. To determine the relative strength of two acids byconductance measurements.
16. To determine the pH of a buffer solution using a quinhydrone electrode.

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CO1	3	3	3	3	3
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CO4	3	3	3	2	3
CO5	3	3	3	3	2

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SEMESTER - IV ELECTIVE COURSE – II

INDUSTRIAL CHEMISTRY

UNIT I

1.1 Basic idea about unit operation – Flow charts – Chemical conversion - Batch versus continuous processing - Chemical process selection – design chemical process control.

1.2 Chemical process economics – Market evaluation - plant location - management for productivity and creativity - Research and development and its role in chemical industries.

UNIT II FUELS

2.1 Fossil fuels - classification and unique features - Coal, Petroleum, natural gas, Biofuels - Biomass - Biodiesel, Nuclear fuels - for various types of nuclear reactors. Hydrogen as fuel in the future, hydrogen storage materials. Fuel extinguisher, fire retardant materials - Fire retarding wood - procedures for handling toxic chemicals.

UNIT III OILS, FATS, WAXES AND SOAPS

3.1 Introduction - Distinction between oils and fats - properties and its classifications - animal fats and oils - difference between animal, Vegetable and mineral oils - isolation of essential oils and their uses - Saponification value, Ester value, Acid value, iodide value - Wijs method - Reichert meissel value - Consideration in soap making - manufacture of toilet and transparent soaps - oil to be used for soap manufacturing - cleaning action of soap.

UNIT IV PULP AND PAPER

4.1 Introduction - manufacture of pulp - Sulphite (or)Kraft pulp - soda pulp - sulphate pulp - Reg pulp - beating, refining, filling, sizing and colouring - Manufacture of paper – Calendaring - uses - Ecological problems of Indian pulp and paper inducting.

UNIT V PAINTS, PIGMENTS AND VARNISHES

Introduction - composition of pigments, white pigments - White lead, Zinc oxide, Lithophone, titanium dioxide. Blue pigments - Ultra marine blue, Cobalt blue, and iron blue. Red pigments - Red lead. Green pigments - Chrome green, guignets green, reinmann's green. Block pigments - Yellow pigments - Toners - metallic powders as pigments. Paints - classification of paints - Distempers - Constituents of paints - manufacture of paints - setting of the paints -requirements of the good pains – emulsion paints - constituents of emulsion paints – advantages - chemical action of emulsion paints, Luminescent paints - Fire retardant paints - special application of paints.

Varnishes - Raw materials - manufacture of varnishes - Enamels (or) gloss finisher - Lacquers - solvents and thinners - oils.

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FACULTY UNIVERSITY NOMINEE HOD

SEMESTER – IV
ELECTIVE COURSE – III
CHEMISTRY OF NANOSCIENCE AND NANOTECHNOLOGY

UNIT I SYNTHESIS OF NANO MATERIALS

Definition of nanodimensional materials – historical milestones – uniqueproperties due to nanosize, quantum dots, classification of nanomaterials.

General methods of synthesis of nanomaterials – hydrothermal synthesis, solvothermal synthesis – microwave irradiation– sol-gel and precipitation technologies – combustion flame – chemical vapour condensation process – gas- phase condensation synthesis – reverse micelle synthesis – polymer- mediated synthesis – protein microtubule-mediated synthesis – synthesis of nanomaterials using microorganisms and other biological agents – sonochemical synthesis – hydrodynamic cavitation.

Inorganic nanomaterials – typical examples – nano TiO_2/ZnO/CdO/CdS, organic nanomaterials – examples – rotaxanes and catenanes

UNIT II CHARACTERISATION OF NANOSCALE MATERIALS

Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy(TEM).

Resolution and Scanning Transmission Electron Microscopy (STEM) – Scanning Tunneling Microscopy (STM) – Scanning Nearfield Optical Microscopy (SNOM).

Scanning ion conductance microscope, scanning thermal microscope, scanningprobe microscopes and surface plasmon spectroscopy.

UNIT III REACTIONS IN NANOPARTICLES

Reactions in nanospace – nanoconfinement – nanocapsules

Cavitands, cucurbiturils, zeolites, M.O.Fs, porous silicon, nanocatalysis, Rotaxanes and catenanes

UNIT IV CARBON CLUSTERS AND NANOSTRUCTURES

Nature of carbon bond − new carbon structures − carbon clusters – discoveryof C60−alkali doped C60−superconductivity in C60−larger and smaller fullerenes.

Carbon nanotubes – synthesis − single walled carbon nanotubes − structure

and characterization − mechanism of formation − chemically modified carbon nanotubes − doping − functionalizing nanotubes − applications of carbon nanotubes.

Nanowires −synthetic strategies − gas phase and solution phase growth – growth control − properties.

UNIT V NANO TECHNOLOGY AND NANODEVICES

Application of nanotechnology - agriculture, medicine, sensors, solar energy, fuel cells, food industry, nuclear power plant and - environmental pollution. Protein nano array, nanopipettes, molecular diodes, self assemblednano transistors, nanoparticle mediated transfection.

Protein nanoarray, nanopipettes molecular diodes, self-assemblednanotransistors, nanoparticle mediated transfection.

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