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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21 Dated:10.10.2022

Notification

Sub:- Syllabus and Examination Pattern of Chemistry(UG) (III & IV Semester) with effective from the Academic year 2022-23 as per NEP-2020.

Ref:- 1. Decision of Board of Studies in of Chemistry (UG) meeting held on 29-08-2022.
2. Decision of the Faculty of Science & Technology Meeting held on 15-09-2022.
3. Decision of the Academic Council meeting held on 23-09-2022.

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The Board of Studies in Chemistry (UG) which met on 29-08-2022 has recommended & approved the syllabus and pattern of Examination of Chemistry Course (III & IV Semester) with effective from the Academic year 2022-23 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 15-09-2022 and 23-09-2022 respectively has also approved the above said syllabus and hence it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

Draft Approved by the Registrar

10/10

DeputyRegistrar(Academic)

Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

To:-

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Chemistry, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Earth Science, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy.

University of Mysore

B.Sc. (Honors) Degree Programme in Chemistry

SYLLABI OF III and IV SEMESTERS

NATIONAL EDUCATION POLICY (NEP)-2020

Choice Based Credit System (CBCS) with Multiple Entry and Exit Options

2022-23 (Batch onwards)

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1. measurements.
2. Determine the transport numbers.

Unit-I:

Separation methods:

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version.

3 Hrs.

Paper chromatography: Theory and applications

Thin layer chromatography (TLC): Mechanism, Rf value, efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications. **4 Hrs**.

Solvent Extraction: Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper. **4 Hrs**.

Ion exchange chromatography: resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion- exchange chromatography (softening of hard water, separation of lanthanides, industrial applications). **3 Hrs**.

Unit-II:

Structure and Bonding-I: The ionic bond: Structures of ionic solids. Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number 6 (octahedral), Close packing. **3 Hrs**.

Classification of ionic structures:

Ionic compounds of the type AX (ZnS, NaCl, CsCI), Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure Layer structures CdI_2, Cadmium iodide structure. Limitations of radius ratio concept

2 Hrs.

Lattice energy and Born-Haber cycle, Derivation of Born-Lande equation and its drawbacks, Kapustinskii equation, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications. Numerical problems

5 Hrs.

Covalent bond: Valence bond theory, The Lewis theory, The octet rule, Exceptions to the octet rule, Sidgwick- Powell theory. Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^-, NH_3 and NH_4^+, H_2O, PCl_5, CIF_3, SF_4, I_3^- and I_3^+, SF_6, and IF_7. Limitations of VSEPR. **7Hrs**.

Unit-III:

Reaction Intermediates: Generation, structure, stability and reactions involving;

i. **Carbocations**: Dienone-phenol and Pinacol-Pinacolone Rearrangement.
ii. **Carbanions**: Perkin Reaction, Aldol condensation, Claisen-Schmitt condensation.
iii. **Free Radicals**: Chlorination of methane, formation of gammaxene (lindane).
iv. **Carbenes**: Singlet and triplet states, their relative stability. Riemer-Tieman, and Wolff rearrangement.
v. **Nitrenes**: Singlet and triplet states, their relative stability. Hoffman and Curtius reactions.
vi. **Arynes**: Formation, detection. Bromobenzene to aniline, (4+2) cycloaddition reaction.

8 Hrs.

Methods for Identifying Reaction Mechanism: Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies. **6 Hrs.**

Unit-IV:

Chemical Kinetics: Introduction, rate of reaction, order and molecularity with examples. Rate constant-definition and explanation. Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction (a=b and a ≠ b), Problems on rate constant (a=b), Methods of determination of order of a reaction (half-life method, isolation method), temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. **7 Hrs.**

Electrochemistry – I: Introduction, strong and weak electrolytes, definition with examples. Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel-Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods.

Applications of conductance measurement: (i) Degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems. **7 Hrs.**

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DSC-3: Chemistry-III Practical

(L:T:P = 0:0:2) Contact Hours: 56 Credits: 2 Workload: 4Hours/Week

Course objectives: To attain practical knowledge about:

1. Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
2. The methods of determining rates of chemical reactions.
3. Designing electrochemical cells and making measurements related to it.
4. Determination of physical characteristics of electrolytes using conductivity measurements in solution.
5. Adsorption phenomenon, mechanism and basic models to explain adsorption.
6. Simple techniques like conductometry to obtain physicochemical parameters of electrolytes.

Course Specific outcomes: At the end of the course student would be able to;

1. Understand the chemical reactions involved in the detection of cations and anions.
2. Explain basic principles involved in classification of ions into groups in semi-micro qualitative analysis of salt mixture
3. Carryout the separation of cations into groups and understand the concept of common ion effect.
4. Understand the choice of group reagents used in the analysis.
5. Analyze a simple inorganic salt mixture containing two anions and cations
6. Use instruments like conductivity meter to obtain various physicochemical parameters.
7. Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
8. Learn about the reaction mechanisms.
9. Interpret the behavior of interfaces, the phenomena of physisorption and chemisorption's and their applications in chemical and industrial processes.
10. Learn to fit experimental data with theoretical models and interpret the data

Part A: **Inorganic Chemistry Practicals**

Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of different reactions.

The following cations and anions are suggested.

Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu2+, Al^{3+}, Fe^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, Na^+, K^+ and Li^+.

Anions: CO_3^{2-}, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^- , BO_3^{3-} , SO_4^{2-}, $C_2O_4^{2-}$ and PO_4^{3-}.

Spot tests and flame tests to be carried out wherever possible.

Part B: **Physical Chemistry Practicals**

1. Determination of the enthalpy of neutralization of a strong acid with strong base.
2. Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.
3. The study of kinetics of potassium persulphate and potassium iodide volumetrically.

4. Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate volumetrically.
5. Determination of velocity constant for the saponification of ethyl acetate (a = b) volumetrically.
6. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation using meter bridge.
7. Determination of dissociation constant of weak acid by conductivity method using meter bridge.
8. Conductometric titration of strong acid and strong base.
9. Conductometric titration of weak acid and strong base.
10. Determination of the hydrolysis constant of aniline hydrochloride by conductometric method.
11. Determination of solubility product of sparingly soluble salt by conductometric method.

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IV SEMESTER

DSC-4: Chemistry-IV

(L:T:P = 4:0:0) Contact Hours: 56 Credits: 4 Workload:4Hours/Week

Course Objectives:

1. Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught.
2. Principle, types and applications of solvent extraction will be taught.
3. Concept of stereochemistry and its importance will be taught.
4. The various projection formulae and the techniques of designating the molecules in to R, S, D, L will be taught taking proper examples.
5. The theory and concept of Cis-, Trans- isomerism and its importance and the techniques to differentiate between them will be taught taking examples.
6. The structures of molecules/compounds/ions based on different models/theories.
7. Properties of compounds based on bonding and structure.
8. The fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.
9. The concepts of surface chemistry, catalysis and their applications.

Course Specific Outcomes: After the completion of this course, the student would be able to;

1. Understand the importance of fundamental law and validation parameters in chemical analysis.
2. Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidimetric methods.
3. Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.
4. Predict the configuration of an organic molecule and able to designate it.

5. Identify the chiral molecules and predict its actual configuration.
6. Write the M.O. energy diagrams for simple molecules.
7. Differentiate bonding in metals from their compounds.
8. Learn important laws of thermodynamics and their applications to various thermodynamic systems.
9. Understand adsorption processes and their mechanisms and the function and purpose of a catalyst.
10. Apply adsorption as a versatile method for waste water purification.

Unit-I:

Quantitative analysis-Instrumental methods: Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and PO_4^{3-}) and numerical problems on application of Beer's law. **10 Hrs**.

Nephelometry and Turbidimetry: Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry & turbidimetry (determination of $S0_4^{2-}$ and PO_4^{3-}). **4 Hrs.**

Unit-II:

Structure and Bonding -II:

Concept of resonance, resonance energy, hybridization, types of hybridization, sp, sp^2, sp^3 dsp^2, dsp^3, d^2sp^3, sp^3d^2 with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory. **3 Hrs.**

Molecular Orbital theory: LCAO concept: s-s, s-p, p-p, p-d and d-d combinations of orbitals, bonding, nonbonding and antibonding molecular orbitals, non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals.

Examples of molecular orbital treatment for homonuclear diatomic molecules: H_2 molecule, H_2^+ molecule ion, He_2 molecule, He_2^+ molecule ion, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule, N_2^+ molecule ion, O_2 molecule, O_2^- and O_2^{2-} molecule ions.

M.O. Energy diagrams of heteronuclear diatomic molecules with examples (NO, NO_+, CO and HCl). Calculation of bond order, relationship between bond order, bond energy, and bond length, magnetic properties based on MOT. **7 Hrs.**

Metallic Bonding: General properties of metals-conductivity, lustre, malleability and cohesive force. Crystal structures of metals and Bond lengths.

Theories of bonding in metals: Free electron theory, valence bond theory, molecular orbital or band theory of solids. Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory. **4 Hrs.**

Unit-III:

Structure and Stereochemistry of Organic Compounds:

Concept of isomerism, types of isomerism. Projection formulae of chiral molecules- Fischer (glyceric acid), Newman (2,3-dibromobutane), Sawhorse (2,3-dibromobutane) and Fly-wedge (glyceric acid) projection formulae. Interconversion of projection formulae: Conversion of; Fisher into Sawhorse projection (tartaric acid), Sawhorse into Fisher projection (2,3-dibromobutane), Sawhorse to Newman to Fisher projection (3-amino-3-bromo-2-chlorobutan-2-ol), Fisher to Newman to Sawhorse (3-chloro-2,4-dihydroxybutanal), Fisher into Fly-wedge formula and vice- versa (2-bromo propanoic acid), **4 Hrs**.

Geometrical isomerism: Cause of geometrical isomerism. Cis-trans isomerism (cinnamic acid, but-2-enedioic acid) and syn-anti isomerism (benzaldoxime, ethyl methyl ketoxime), E/Z notations with examples following C.I.P rules.

Optical Isomerism: Optical activity, conditions for optical activity-Elements of symmetry (plane, centre, C_2-axis, rotation-reflection with examples). Specific rotation, Chirality/Asymmetry, Enantiomers-definition with examples, properties, Molecules with two or more chiral centres, Diasteroisomers-definition with examples (threo and erytho isomers), properties. Meso compounds- definition with examples. optical isomerism in tartaric acid, and biphenyls. Asymmetric synthesis, Walden inversion. Racemic modification- Definition with examples. Resolution-definition with examples, chemical and biochemical methods of resolution, Relative and absolute configuration, D/L convention, limitations, and R/S designations-CIP rules with examples. **10 Hrs**.

Unit-IV:

First Law of Thermodynamics: Introduction, system, surroundings, types of systems. Thermodynamic Processes (isothermal, adiabatic, isochoric, isobaric and cyclic), Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule - Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters.

Second law of Thermodynamics: Limitations of first law of thermodynamics. Reversible and Irreversible Processes, Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation.

Third Law of Thermodynamics: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. **10 Hrs.**

Surface Chemistry Adsorption: Introduction, types of adsorptions with examples. Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis: Types of Catalysis (positive, negative, auto and induced), characteristics of catalysis, and theories with examples (intermediate compound theory and adsorption

theory), Theory of acid base catalysis, Michaelis-Menten mechanism. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements. **4 Hrs.**

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DSC-4: Chemistry-IV Practical

(L:T:P = 0:0:2) Contact Hours: 56 Credits: 2 Workload:4Hours/Week

Course objectives:

1. To impart skills related to preparation of stock and working solutions and handling of instrumental methods.
2. To know the principle of colorimetric analysis and construction of calibration plot.
3. To understand the chemistry involved in colorimetric determination of metal ions and anions.
4. To determine Rf values of different metal ions present in a mixture.
5. To impart knowledge on the importance of functional groups in organic compounds.
6. Techniques to identify the functional groups in a compound by performing physical and chemical tests.
7. To record its melting point/boiling point.
8. To prepare suitable derivative for that compound and to characterize it.

Course Specific outcomes: After the completion of this course, the student be able to

1. Understand the importance of instrumental methods for quantitative applications.
2. Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples.
3. Understand how functional group in a compound is responsible for its characteristic properties.
4. Learn the importance of qualitative tests in identifying functional groups.
5. Learn how to prepare a derivative for particular functional groups and how to purify it.

PART-A: Analytical Chemistry Practicals

1. Colorimetric determination of copper using ammonia solution.
2. Colorimetric determination of iron using thiocyanate solution.
3. Colorimetric determination of nickel using DMG solution.
4. Colorimetric determination of titanium using hydrogen peroxide.
5. Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent.
6. Colorimetric determination of phosphate as ammonium phosphomolybdate.
7. Determination of Rf values of two or three component systems by TLC.
8. Separation of different metal ions by paper chromatography/ Solvent extraction of iron using oxine solution (demonstration).

PART-B: Organic Chemistry Practical

Qualitative analysis of mono and bifunctional Organic compounds: Benzoic acid, Salycilic acid, *p*-Nitro benzoic acid, Anthranilic acid, p-Chloro benzoic acid, *o*-Cresol, *p*-Cresol, Resorcinol, *o*- Nitrophenol, *p*-nitophenol, *o*-Nitro aniline, *p*-Nitroaniline, *p*-Toluidine, *p*-Chloroaniline, *p*- Bromoaniline, Ethyl Salicylate, Salicylaldehyde, Acetophenone, Urea, Thiourea, Aniline, Benzldehyde, acetanilide, Naphthalene, Chlorobenzene, *p*-Dichlorobenzene, *p*-Nitro toluene, Benzamide etc. (At least 6-8 compounds to be analyzed in a semester).

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REFERENCE BOOKS:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th Ed., Saunders College Publishing, New York (2005).
2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt. Ltd. New Delhi (2009).
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd. (2007).
5. Organic Reaction Mechanism by V.K. Ahluwalia and R.K. Parashar (Narosa Publishers).
6. Organic Chemistry by S.M. Mukherji, S.P. Singh and R.K. Kapoor (Narosa Publishers).
7. Morrison R.N and Boyd R.N, Organic Chemistry, Darling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar I.L, Organic Chemistry (Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Kalsi P.S. Stereochemistry, conformation and Mechanism, New age International.
10. Eliel E.L and Wilen S.H, Stereochemistry of Organic Compounds, Wiley, (London).
11. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th Ed. Third Indian Reprint,Pearson Education Pvt. Ltd. (2007).
12. Vogel's Text Book of Qualitative Chemical Analysis, ELBS.
13. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press (2010).
14. G W Castellan, Physical Chemistry, 4th Ed., Narosa (2004).
15. R G Mortimer, Physical Chemistry 3rd Ed., Elsevier: Noida, UP (2009).
16. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
17. B S Bahl, G D Tuli and Arun Bahl, Essentials of Physical Chemistry, S Chand & Comp. Ltd.
18. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International.
19. B N Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
20. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and

Company Ltd.
21. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.
22. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
23. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
24. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, S. Chand & Co.: New Delhi (2011).
25. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
26. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

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Open Elective Course

III SEMESTER

OEC-3: Atomic Structure, Bonding and Concepts in Organic Chemistry

(L:T:P = 3:0:0) Contact Hours: 42 Credits: 3 Workload:3Hours/Week

Course Objectives:

1. To develop an understanding of principles of atomic structure.
2. To know the importance of quantum numbers, writing of electronic configurations and representation of orbitals.
3. To develop an understanding of the periodic trends.
4. To understand the nature of bonding and to predict the shapes of molecules.
5. To construct MO energy level diagrams and predict the properties of molecules.
6. To understand the formation of sigma and pi bonds and the bond strength.
7. To study the classification of organic reactions.
8. To learn nomenclature preparation and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds.

Course Specific Outcomes: On completion of the course the student will learn and be able to understand/explain;

1. The concept of atomic structure, significance of quantum numbers, filling of electrons of atoms/ions in various orbitals as per rules.
2. The trends in periodic properties.
3. The structures of ionic solids, applications of B-H cycle, solubility of compounds and consequences of polarization of ions.
4. The shapes of molecules/ions based on VSEPR theory.
5. The construction of MO energy level diagrams and prediction of properties of molecules/ions like bond order, bond energies, bond lengths and magnetic properties.
6. The formation of sigma and pi bonds and the bond strength.
7. The classification of organic reactions.

8. Nomenclature preparation, and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds.

Unit I: Atomic Structure and Periodic Properties

History of an atom. Idea of de Broglie matter waves. Heisenberg uncertainty principle. Schrödinger wave equation, significance of wave functions, Bohr's model of hydrogen atom and its limitations. Quantum numbers and their importance, atomic orbitals and shapes of s, p, d orbitals, multi-electron atoms, Aufbau and Pauli exclusion principle and Hund's multiplicity rule- Electronic configurations of the elements (atomic no. up to 30), effective nuclear charge and shielding. **8 Hrs.**

Periodic Properties: Atomic radius, Covalent, ionic and van der Waal radii-explanation with examples. Definition and periodicity of the following properties - ionic radii, ionization potential, electron affinity and electronegativity, methods of determination of electronegativity. Factors affecting the values of ionization energy. **6 Hrs.**

Unit II: Chemical Bonding:

Ionic Solids– Ionic structures (NaCl, CsCl, TiO_2, ZnS), radius ratio rule and coordination number, limitation of radius ratio rule, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule and their consequences. **4 Hrs.**

Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization with examples and shapes of simple inorganic molecules and ions. Shapes of NH_3, I_3^+, I_3^- , SF_4, ClF_3, IF_5, ICl_2^- and H_2O using valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals, physical picture of bonding and antibonding wave functions. Applications of MO theory to explain the stability of homo dinuclear (He_2, N_2, O_2, F_2, C_2) and hetero dinuclear (NO and CO) molecules. Comparison of M.O. and V.B. Models. **7 Hrs.**

Metallic bond-free electron, Band theory-electrical properties of metals, semiconductors and insulators. Weak interactions – Hydrogen bonding and its consequences, van der Waals forces. **3 Hrs.**

Unit III: Bonding and molecular structure and hydrocarbons

Bonding and molecular structure: Introduction to organic chemistry, atomic orbitals, sigma and pi bond formation-molecular orbital [MO] method, sp, sp^2 and sp^3 hybridization, bond length, bond dissociation energies and bond angles (open chain and cyclic compounds). Electronegativity and polarity of the bonds. Classification and reactions of organic compounds (with examples).

7 Hrs.

Alkanes, Alkenes and Alkynes: Definition, Nomenclature, preparations (any two methods). Reactions: Electrophilic, nucleophilic and free radical addition reactions.

Alicyclic compounds: Nomenclature, preparation and stability of cyclopropane, cyclobutane, cyclopentane and cyclohexane. **7 Hrs.**

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REFERENCE BOOKS:

1. Concise Inorganic Chemistry, J. D. Lee, ELBS, 1996.
2. Inorganic Chemistry, A. K. Das.
3. Inorganic Chemistry: Principles of Structure and Reactivity, Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Pearson Education India, 2006.
4. Inorganic Chemistry, Shriver, D.F. & Atkins, P.W. Oxford University Press.
5. Schaum's Outline Series Theory and Problems of Organic Chemistry.SI (metric) Ed Herbert Meislich, Howard Nechamkin and Jacob Sharefkin.
6. Organic chemistry. Robert T. Morrison Robert N. Boyd, 6th Ed.
7. Organic Chemistry Volume-1, I.L. Finar.

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IV SEMESTER

OEC-4: Electrochemistry, Corrosion and Metallurgy

(L:T:P = 3:0:0) Contact Hours: 42 Credits: 3 Workload:3Hours/Week

Course Objectives: This course will deal with

1. Types of conductance, concept of electrolytes, electrolysis, redox reactions and EMF.
2. Concept of different types of electrochemical cells, Types of electrodes and electrode potential. Application of electrochemical series.
3. Basic principles and applications of conductometric, potentiometric and pH titrations.
4. Different types of Batteries their principle construction and working - lead-acid storage and lithium ion battery. Study of Fuels cells.
5. Concept of corrosion, types of corrosion and its prevention by different methods. Introduction to electroplating.
6. Introduction to ores and minerals, extraction of metals from their ores, and purification. Eg., Manganese, Titanium and Uranium. Study of alloys, classification, production and uses of alloys.

Course Specific Outcomes: Upon completion of the course students will be able to;

1. Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.
2. Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.
3. Apply conductometric, potentiometric and pH titrations.
4. Know the principle, construction and working of batteries.
5. Understand different types of corrosion and its prevention by different methods.
6. Learn the methods of extraction of metals from their ores and purification.

Unit I: Electrochemistry: Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution.

Oxidation -reduction reactions, electrode potential, EMF of an electrochemical cell, cell

reaction, Daniel cell, dry Cells - electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, Electrochemical series and its importance. Types of Electrodes.
Basic Principles of (i) Conductometric titrations- HCl Vs NaOH, CH_3COOH Vs NaOH
Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs $K_2Cr_2O_7$) Determination of PH using glass electrode. **12Hrs.**

Batteries- Primary and Secondary batteries, Battery components and their role. Working of the following Batteries- Lead acid, Lithium Storage, Batteries, Fuel cells. **2 Hrs.**

Unit II: Corrosion: Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, nature of corrosion product. Environmental Factors-Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity of the medium, velocity of the medium, concentration of the medium.
Prevention of Corrosion: Material selection - Metals and alloys, metal purification, non-metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating.
Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electro less plating: Introduction, distinction between electroplating and electroless plating processes. Electroless plating of copper. **14 Hrs.**

Unit III: Metallurgy: Introduction: Ore, minerals, important ores of some common elements in India, General Principles of pyrometallurgy, roasting, Calcination, Gangue, Smelting, Flux, Gravity separation, Froth flotation process, leaching. Techniques employed for Purification of metal (Distillation process, Bessemerization, Electro-refining, Van Arkel and De Boer's Filament. **7 Hrs.**
Extraction of metals: Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium. **4 Hrs.**
Alloys: Introduction, Classification of alloys, commercially important alloys, gold karats, **Production of Ferro alloys**; Ferrochrome, Ferro Manganese, Uses of alloys.
4Hrs.

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REFERENCE BOOKS:

1. Barrow. G.M, Physical Chemistry, Tata McGraw-Hill, (2007).
2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi, (1942).
3. Text book of physical chemistry, Samuel Glasstone, 2ndEdition, Mac Millan India Ltd, (1991).
4. Principles and applications of Electrochemistry, D. R. Crow, 3rd edition, Chapman Hall London, (1988).
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger, Wiley Interscience Publications, New York, (1998).

6. Engineering Chemistry, V R Kulkarni and K Ramakrishna Reddy, New Age International, (2015).
7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (india) Pvt. Ltd., (2004).
8. Principles and Prevention of Corrosion, D. A. Jones, Macmillan Publ. Co., (1996).
9. Essential of Materials Science and Engineering, Donald R. Askeland, Thomson Learning, 5th Edition, (2006).
10. Introduction to Engineering Materials, B. K. Agarwal, Tata McGraw Hill, 1st Edition.
11. Material Science and Engineering, V. Raghavan, PHI Learning, 5th Edition.
12. Engineering Materials and Metallurgy, R. K. Rajput, S. Chand - 1st Edition, (2011).

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Scheme of Examination for DSC-3 and DSC-4 (III and IV Semesters): Credits (4:0:0)

Continuous Internal Assessment	Marks		
	Assignment	Test	Total
C1	10	10	20
C2	10	10	20
Semester End Examination	**Duration: 02 Hours**		
C3			60
		Total Marks	100

Question Paper pattern for DSC-3 and DSC-4 (III and IV Semesters)

Duration: 02 Hours	**Max. Marks: 60**	
Part-A	Answer any six out of eight questions (Two questions from each unit)	6 x 2 =12
Part-B (Analytical Chemistry)	Answer any two out of three questions	2 x 6 = 12
Part-C (Inorganic Chemistry)	Answer any two out of three questions	2 x 6 = 12
Part-D (Organic Chemistry)	Answer any two out of three questions	2 x 6 = 12
Part-E (Physical Chemistry)	Answer any two out of three questions	2 x 6 = 12
Sub-questions Pattern: (3 + 3)/(4 + 2)/(2 + 2 + 2)		

Scheme of Examination for DSC-3 and DSC-4 practical (III and IV Semesters) Credits (0:0:2)

Continuous Internal Assessment	Marks			
	Test	Continuous assessment/ Attendance	Record	Total
C1	10	-	--	10
C2	--	10	05	15
Semester End Examination	Duration: 04 Hours			
C3				25
			Total Marks	50

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Scheme of valuation: Practical

III Semester: Inorganic and Physical Chemistry Practical

Part-A: Semimicro Qualitative Inorganic Analysis **13 Marks**

(Two acid radicals and two basic radicals be given, two radicals in a group be avoided)

DISTRIBUTION OF MARKS		
Preliminary tests: State, color, solubility		1 Mark
Identification of 2 anions:	Group Identification: 1 + 1 Mark	2 Mark
	Confirmatory tests: 1 + 1 Mark	2 Mark
Group Separation of cations	Group Identification: 1 + 1 Mark	2 Mark
Identification of 2 cations:	Confirmatory tests: 2 + 2 Mark	4 Mark
	Ionic equations for CT tests: 1 + 1 Mark	2 Mark

Part-B: Physical Chemistry Practical **12 Marks**

The following experiments be given, but not more than two candidates be given the same experiment.

1. The study of kinetics of potassium persulphate and potassium iodide volumetrically.
2. Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate.
3. Determination of velocity constant for the saponification of ethyl acetate (a = b) volumetrically.
4. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.
5. Determination of dissociation constant of weak acid by conductivity method.
6. Conductometric titration of strong acid and strong base.
7. Conductometric titration of weak acid and strong base.

DISTRIBUTION OF MARKS (For Experiments **1, 2** and **3**)		
k values	5 Constant values	7 Marks
	4 Constant values	6 Marks
	3 Constant values	5 Marks
	Any other values	3 Marks
Graph (straight line)		2 Marks
Unit of k		1 Mark
Calculation		2 Marks

DISTRIBUTION OF MARKS (For Experiments **4** and **5**)	
Determination of cell constant	3 Marks
Determination of specific conductance	2 Marks
Determination of equivalent conductance	3 Marks
SI unit of k and λ (1 + 1 Mark)	2 Marks
Verification of DHO **or** ka Calculations	2 Marks

DISTRIBUTION OF MARKS (For Experiments **6** and **7**)		
Deviation	± 0.2 cm^3	8 Marks
	± 0.3 cm^3	6 Marks
	± 0.4 cm^3	4 Marks
	Any other value	3 Marks
Graph		2 Marks
Calculation of Normality		1 Mark
Calculation of weight/dm^3		1 Mark

IV Semester: Analytical and Organic Chemistry Practical

Part-A: Analytical Chemistry Experiments **13 Marks**

Any one of the Colorimetric determination experiments be given, but not more than two candidates be given the same experiment.

- Colorimetric determination of copper using ammonia solution.
- Colorimetric determination of iron using thiocyanate solution.
- Colorimetric determination of nickel using DMG solution.
- Colorimetric determination of titanium using hydrogen peroxide.
- Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent.
- Colorimetric determination of phosphate as ammonium phosphomolybdate.

DISTRIBUTION OF MARKS (For all colorimetric determinations)		
Preparation of solutions		4 Marks
Determination of λmax		2 Marks
Accuracy	± 5%	5 Marks
	± 10%	3 Marks
	Any other value	2 Marks
Graph		2 Marks

Part-B: Qualitative Organic Analysis **12 Marks**

DISTRIBUTION OF MARKS	
Preliminary tests	2 Marks
Physical constant	1 Mark
Detection of elements (one each)	3 Marks
Solubility (complete chart/table)	2 Marks
Functional group tests (minimum two important tests)	3 Marks
Naming and structure	1 Mark

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