| SHSB1102 | GENERAL ENGLISH I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

## COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues.
- To prepare the students to effectively communicate by applying reflective thinking practices
- To provide an opportunity to the students to improve their vocabulary.

**UNIT 1** **9 Hrs.**

Listening to identify vocabularies- Self Introduction - Developing dialogue between characters -Talking about neighbours, family members, likes and dislikes, Reading Comprehension strategies- Parts of Speech- Kinds of Sentences Connectives and Discourse markers - Rearranging the Jumbled sentences, E-Mail Writing.

**UNIT 2** **9 Hrs.**

Listening for Inference- Just a Minute speech- Types of words- Compound words, abbreviations and acronyms, Word Association- Tenses and its Types- Voice- Impersonal Passive- Rules of Passive voice formation - Transcoding - Encoding and Decoding- Bar chart, Pie Chart.

**UNIT 3** **9 Hrs.**

Listening to telephonic talk to fill blanks- Giving information- travel, hotel booking, making enquiries about availability of seats for admission, asking about courses - Question Tags – Open ended and Close ended questions, Concord, Single - Line Definition - Note Making - Preparing checklists.

**UNIT 4** **9 Hrs.**

Listening to summarise the information- Reading and identifying the topic sentence, - Editing - Punctuation- Error Corrections, 'If 'Conditionals, Idioms & Phrases, Instructions & Recommendations – Drafting a brochure/Advertisement.

**UNIT 5** **9 Hrs.**

Listening to Movie reviews and book reviews, Listening and summarizing- Giving impromptu talks - Reading and Summarizing -Types of words- Homonyms, Homophones, eponyms, acronyms- Writing a Paragraph, Descriptive Essay, Dialogue Writing.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On the completion of the course, the student will be able to

**CO1 -** Remember knowledge of linking words related to both spoken and written discourse.
**CO2 -** Understand collocations, words to express one's point of view in both writing and speaking.
**CO3 -** Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given.
**CO4 -** Analyse critical thinking skills by framing questions related to elements of reasoning.
**CO5 -** Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation.
**CO6 -** Equip the students with the required Professional Skills.

## TEXT / REFERENCE BOOKS

- Sen S, Mahendra etal. (2015) Communication and Language Skills. Foundation books. Chennai.

## REFERENCES

1. Strunk, William Jr., and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
2. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2012.
3. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 1986.
4. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
5. O'Conner, Patricia T. Woe is I: The Grammarphobe's Guide to Better English in Plain English. Riverhead Books, 2019.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

| SCYB1103 | GENERAL CHEMISTRY I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concepts of atomic structure and Quantum mechanics.
- To study the basic concepts of ionic bonding and covalent bonding for formation of molecules
- To study the postulates of gas laws and its applications

**UNIT 1 ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS 9 Hrs.**

Rutherford's and Bohr's model an atom- Bohr's theory and origin of hydrogen spectrum-Electromagnetic radiation- definitions for $\lambda$, $\upsilon$ and velocity-Dualism of light -Particle nature of radiation-black body radiation and Planck's quantum theory, photoelectric effect and Compton effect of matter-De Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrodinger wave equation (Derivation not needed). Physical significance of $\Psi$ and $\Psi^2$.

**UNIT 2 IONIC BOND 9 Hrs.**

General characteristic of ionic bonding, Energy considerations in ionic bonding, Lattice energy and Solvation energy and their importance in the context of stability and solubility of ionic compounds.Statement of Born-Lande equation for calculation of Lattice energy, Born – Haber cycle and its applications, polarizing power and polarisibility.Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**UNIT 3 COVALENT BOND 9 Hrs.**

Valance Bond theory-arrangement of electrons in molecules, Hybridization and geometry. VSEPR model- $BeF_2$, $BF_3$, $PF_5$, $SF_6$, $IF_7$, $H_2O$, $NH_3$, $IF_5$, $XeF_2$, $XeF_4$, $XeF_6$ and $XeOF_4$.Effect of bonding and nonbonding electrons on the structure of molecules.MO theory: LCAO method-criteria of orbital overlap, types of molecular orbitals, qualitative MO energy level diagram of homo and hetero diatomic molecules, and their magnetic properties, bond length, bond energy, bond order and stability of molecules.

**UNIT 4 CLASSIFICATION AND PROPERTIES OF ORGANIC COMPOUNDS 9 Hrs.**

IUPAC Nomenclature (Monofunctional and polyfunctional) –Shapes of simple molecules - Bond energy, bond length and bond angle - Bond polarity – dipole moment –Bond dissociation energy - Isomerism – Structural and Stereoisomerism – types of isomerism with suitable examples - Concept of hybridization - Structure of organic molecules based on $sp^3$, $sp^2$ and sp hybridization – Energy requirements of a reaction – Activation Energy – Transition state – Intermediate – Effect of catalyst on energy of activation.

**UNIT 5 KINETIC THEORY AND GASEOUS STATE 9 Hrs.**

Postulates of kinetic theory of gases-derivation of gas laws from the kinetic gas equation. Kinetic energy and temperature-Degrees of freedom of a molecule-Principle of equipartition of energy: Average translational kinetic energy and its calculation-Maxwell's distribution of molecular velocities (no derivation)-mean, root mean square and most probable velocity-Collision diameter, collision number, collision frequency, mean free path. Transport properties: viscosity, thermal conductivity, diffusion.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Apply the laws of radiation and principles of quantum mechanics to the particle matter.
**CO2 -** Assess the stability of ionic bonding in molecules.
**CO3 -** Examine the hybridization and geometry of chemical bonding in molecules.
**CO4 -** Apply the concept of bond energies tothe structure and formation of organic compounds.
**CO5 -** Analyze the postulates of kinetic theory of gases for the determination of kinetic energy and molecular velocities.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCE BOOKS

1. R. K. Prasad, Quantum Chemistry, New Age International Publishers, Revised thd Edition, 2020.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
5. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
6. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

| SMTB1110 | ANCILLARY MATHEMATICS I FOR BASIC SCIENCES (Common to B.Sc.Physics & B.Sc.Chemistry) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVE**

- The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgements. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

**UNIT 1** **9 Hrs.**

Polynomial equations – Imaginary and Irrational roots – relation between roots and coefficients of equations Symmetric functions of roots interms of coefficients of third degree equation -problems.

**UNIT 2 MATRICES** **9 Hrs.**

Characteristic Equation of a square matrix - Eigen values, Eigen vectors of a real matrix, Properties of Eigen values and Eigen vectors. Cayley Hamilton Theorem (without proof) Verification - Finding inverse and power of a matrix.

**UNIT 3 DIFFERENTIATION** **9 Hrs.**

Differentiation of all standard functions (without proof): Product rule, quotient rule, functions of a function rule, logarithmic differentiation, differentiation of implicit function. Applications of differentiation: maxima, minima of a curve.

**UNIT 4 INTEGRATION** **9 Hrs.**

Methods of Integration - Integration by parts-Bernoulli's formula- Definite Integrals - Properties of Definite Integrals-Simple problems.

**UNIT 5 ORDINARY DIFFERENTIAL EQUATIONS** **9 Hrs.**

Formation of ODE - Solving higher order linear differential equations with constant coefficients: Particular integral for $e^{ax}, \sin ax, \cos ax, x^n, x^n e^{ax}, e^{ax}\sin bx, e^{ax}\cos bx$.

**COURSE OUTCOMES**

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

**CO1 -** Identify using Cayley Hamilton theorem, the power and the inverse of the matrix.
**CO2 -** Understand the concept of derivatives to find maxima and minima of a curve.
**CO3 -** Solve problems involving the various methods of integration
**CO4 -** Point out the complementary function and particular integral of ODE.
**CO5 -** Apply the concept of probability to solve the problems.
**CO6 -** Produce the conditional probability problems using Baye's theorem.

**TEXT / REFERENCE BOOKS**

1. T.K.Manickavachagam Pillai, Matrices, S.Viswanathan Printers & Publishers, 2012.
2. Dipak Chatterjee, Integral Calculus and differential equations, TATA McGraw S Hill Publishing Company Ltd., 2000.
3. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. I, S. Viswanathan Printers Pvt. Limited, 2007.
4. P. R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2002.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | |
|---|---|
| **PART A:** 10 Questions of 2 marks each-No choice | **20 Marks** |
| **PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks | **80 Marks** |

| SCYB2103 | ENVIRONMENTAL CHEMISTRY LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

## COURSE OBJECTIVES

- To understand the basics of environmental chemistry through water analysis
- To understand and correlate the theoretical environmental issues with fundamental experiments
- To understand the basic knowledge in environmental samples

## LIST OF EXPERIMENTS

1. Determination of $p^H$ and $p^{OH}$ of a water sampleby $p^H$ metry
2. Determination of alkalinity of a water sample using acid base indicators
3. Estimation of Temporary, Permanent and Total hardness of a water sample by EDTA method
4. Estimation of available chlorine in a water sample by iodometry method
5. Determination of COD of a waste water sample
6. Estimation of Total Dissolved Solids and Total Suspended Solids in a water sample
7. Estimation of Sulphate content of a water sample by gravimetry
8. Estimation of Ferrous ion by Photocolorimetry

## COURSE OUTCOMES

On successful completion of the course, student will be able to

**CO1 -** Explain the principle behind acidic and basic character of a water sample.
**CO2 -** Analyze the concept of using indicators in estimating alkalinity of water.
**CO3 -** Categorize water sample based on hardness.
**CO4 -** Identify quality of water sample through chlorine content, oxygen demand and dissolved salts.
**CO5 -** Illustrate the application of basic instrumentation in waste water treatment.
**CO6 -** Examine the role of metal complexation in water analysis.

## TEXT / REFERENCES BOOKS

1. A Laboratory Manual for Environmental Chemistry, I.K. International Publishing, R. Gopalan, Amirtha Anand, and R. Wilgred Sugumar, 2008..
2. Water Analysis Handbook, (2nd Edition), Hach Co., Loveland, 1992.
3. Drinking Water Chemistry: A Laboratory Manual, B.A. Haauser, Lewis publishers, Boca Raton, 2001

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB2104 | VOLUMETRIC & PREPARATORY INORGANIC CHEMISTRY LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

## COURSE OBJECTIVES

- To bridge the conceptual ideas with practical experiments.
- To promote analytical skills in volumetric analysis.
- To introduce the preparative skills involved in the synthesis of inorganic complexes.

## VOLUMETRIC ANALYSIS

1. Laboratory safety and Hygiene
2. Preparations of Reagents and Standard Solutions
3. Calibration of volumetric apparatus: Burette, pipette and standard flasks.
4. Determination of Mean, Standard Deviation, Co-efficient of Variations of given sample.
5. Acid – base titrations: Estimation of oxalic acid.
6. Redox titrations: Estimation of Ferrous ammonium sulphates (Permanganometry).
7. Determination of Copper by Iodometry

## INORGANIC PREPARATIONS

1. Preparation of Tetra amine copper(II) sulphate and record the λmax for the prepared complex
2. Preparation of Potassium trisoxalato chromate (III) trihydrate and record the λmax for the prepared complex
3. Preparation of Potassium trisoxalato aluminate (III) trihydrate and record the λmax for the prepared complex
4. Preparation of $[Ni(en)_3]Cl_2$ complex and record the λmax for the prepared complex.
5. Preparation of tristhio urea Copper(I) sulphate dihydrate and record the λmax for the prepared complex.

## COURSE OUTCOMES

On successful completion of the course, student will be able to

**CO1 -** Apply safety protocols in chemistry laboratory
**CO2 -** Interpret the statistical parameters in quantitative analysis
**CO3 -** Quantitative skills in volumetric analysis..
**CO4 -** Outline the techniques in preparatory inorganic chemistry
**CO5 -** Assess the absorption maxima of the given sample
**CO6 -** Validate the composition of the inorganic complexes.

## TEXT / REFERENCE BOOKS

1. S. Sundaram and K. Raghavan, Practical Chemistry, S. Viswanathan Co. Pvt., 1996.
2. N. S. Ganapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S.Viswanathan Co. Pvt., 2002.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry.5th ed., Pearson Education, 2005.

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | **25 Marks** | **50 Marks** |
| | Model practical exam | **25 Marks** | |
| **ESE** | End Semester Practical exam | | **50 Marks** |

| SHSB1201 | GENERAL ENGLISH II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | |

## COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues through texts that present themes and topics that are familiar, insightful and informative.
- To provide an opportunity to the students to improve their vocabulary
- To develop skills relating to creative writing.

**UNIT 1** **9 Hrs.**

Listening for details, Speaking - making a presentation, reading for details and Global Comprehension Vocabulary Binomials, Types of Words- Synonyms, Antonyms that describe people, things and their actions - Paired Expressions -Letter Writing - Informal Letters- Letter to a Friend / Family Members - Creating blogs to post written materials.

**UNIT 2** **9 Hrs.**

Listening for details - Speaking: Giving Interview, Public Speech based on specific topics given. Reading for Comprehension and for overall idea - Vocabulary: phrases - Sentence Pattern – Contextual guessing of words– Singular, Plural– Letter writing- Formal letters- Inviting dignitary for a function, Application for job with resume.

**UNIT 3** **9 Hrs.**

Listening for details - Telephonic conversation – Speaking: Narrating a Story - Vocabulary: positive and negative connotations - Language Focus: Adjective- Degrees of Comparison, Direct and Indirect Speech - Types of Sentences (simple, compound, complex) - Collocations -Letter to the Editor (Social Issues) – Hints Development.

**UNIT 4** **9 Hrs.**

Listening for Overall information - Making requests and suggestions - Speaking: Group Discussion - Vocabulary: Homonyms and Homophones - Language Focus: Transitive and Intransitive verbs - Writing: Precis writing, Story Writing - Process description (Flow chart).

**UNIT 5** **9 Hrs.**

Listening for specific details - Speaking using imagination. Reading to identify facts - Language focus: Modal Auxiliary Verbs Writing: Imaginative writing by predicting, Argumentative Essay, Writing a Book or Film review. Vocabulary: Countable and Uncountable Nouns, foreign nouns and framing of plurals.

## COURSE OUTCOMES

At the end of the course the students will be able to:

**CO1 -** Remember knowledge of linking words related to both spoken and written discourse
**CO2 -** Understand collocations, words to express one's point of view in both writing and speaking
**CO3 -** Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given
**CO4 -** Analyse critical thinking skills by framing questions related to elements of reasoning
**CO5 -** Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
**CO6 -** Equip the students with the required Professional Skills

## TEXT / REFERENCE BOOKS

- Sen S, Mahendra etal. (2015) *Communication and Language Skills*. Foundation books. Chennai

## REFERENCES

1. Strunk Jr., William, and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
2. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2019.
3. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 2013.
4. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
5. Swan, Michael. Practical English Usage. Oxford University Press, 2016.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1202 | GENERAL CHEMISTRY II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | |

**COURSE OBJECTIVES**

- To understand the properties of solid state, liquid state and liquid crystal states.
- To study the structure of atoms and periodic properties of elements
- To understand the structure and reactivity of organic molecules

**UNIT 1 LIQUID STATES 9 Hrs.**

Intermolecular forces in liquids- vapour pressure of a liquid- surface tension of a liquid– surface active agents-capillary rise method for determining surface tension-Parachor– viscosity-Poiseulle's equation-molar refractivity-optical exaltation. Liquid Crystals: Types of liquid crystals –Applications of liquid crystals.

**UNIT 2 PERIODIC TABLE AND PERIODIC PROPERTIES 9 Hrs.**

**.**Periodicity-Periodic law and arrangement of elements in the periodic table, IUPAC nomenclature and group number.Horizontal, vertical and diagonal relationships in the periodic table.Properties of atoms-Size of atoms and ions-atomic radii, ionic radii, covalent radii, trend in ionic radii, ionization potential, electron affinity, electronegativity - Simple problems.-Pauling, Mulliken-Jaffe, Allred-Rochow definitions, oxidation states and variable valency, isoelectronic relationship, inert-pair effect. Atomic, molecular and equivalent weights, Avagadro's principle and mass-volume relationship.

**UNIT 3 STRUCTURE AND REACTIVITY OF ORGANIC COMPOUNDS 9 Hrs.**

Types of organic reactions - Cleavage of bonds - Homolytic and Heterolytic bond fission -Reactive intermediates - carbocation, carbanion, and free radicals - Structure, shape, stability and reactivity - Carbenes, nitrenes and arynes - Factors affecting stability of the reaction intermediates - Electron displacement effects - Inductive effect, electromeric, mesomeric, resonance, hyperconjugation-Hydrogen bonding - Tautomerism – Keto-enoltautomerism.

**UNIT 4 ALKANES AND CYCLOALKANES 9 Hrs.**

Structure – Nomenclature – General methods of preparing alkanes - Preparation by Wurtz reaction and Kolbe's method – Physical and Chemical properties – Substitution: Halogenation, nitration, sulphonation, oxidation, pyrolysis, aromatization with mechanism - Cycloalkanes – Nomenclature – Preparation by Wurtz reaction, Dieckmann's ring closure, Clemmensen's reduction - Physical and Chemical Properties - Mechanism of substitution and ring opening reactions – Baeyer's strain theory.

**UNIT 5 SOLID STATES 9 Hrs.**

Classification of solids- Isotropic and anisotropic crystals- elements of symmetry basic seven crystal systems- laws of crystallography- representation of planes miller indices, space lattice and unit cell. Semiconductor: Band theory of solids-Intrinsic and Extrinsic semiconductors-n-type and p-type conductors-doping of semiconductors. Superconductors: Definition-characteristics-copper and iron-based superconductors-applications of superconductors.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1 -** Examine the properties of liquid state and liquid crystal for the application in surface active agents and LCD displays

**CO2 -** Analyze the periodic properties of elements of periodic table.

**CO3 -** Assess the relationship between the structure and reactivity of organic molecules.

**CO4 -** Apply the substitution and ring opening mechanism to the alkane and cycloalkane reactions.

**CO5 -** Apply the principles of band theory to the conduction mechanism in solids and superconductors.

**CO6 -** Evaluate the basic concept of chemistry to real world applications.

**TEXT / REFERENCE BOOKS**

1. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
5. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
6. J. March and M Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2001.
7. B. R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SMTB1208 | ANCILLARY MATHEMATICS II FOR BASIC SCIENCES (Common to B.Sc.Physics & B.Sc.Chemistry) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

## COURSE OBJECTIVE

- The ability to identify, reflect upon, evaluate and apply different types of information and knowledge to form independent judgements. Analytical, logical thinking and conclusions based on quantitative information will be the main objective of learning this subject.

## UNIT 1 TRIGONOMETRY 9 Hrs.

DeMoivre's Theorem-Expansion of $\sin n\theta$, $\cos n\theta$, $\sin^n\theta$, $\cos^n\theta$, $\sin\theta$, $\cos\theta$- Hyperbolic functions, Inverse Hyperbolic functions, Relation between Circular and Hyperbolic Functions - Separating into Real and Imaginary parts.

## UNIT 2 PARTIAL DIFFERENTIAL EQUATIONS 9 Hrs.

Formation of PDE by eliminating constants and functions - Solution of linear homogeneous PDE of higher order with constant coefficients.

## UNIT 3 NUMERICAL METHODS FOR SOLVING EQUATIONS 9 Hrs.

Solution of algebraic equation and transcendental equation: Regula Falsi Method, Newton Raphson Method– Solution of simultaneous linear algebraic equations: Gauss Elimination Method, Gauss Jacobi and Gauss Seidel Method.

## UNIT 4 NUMERICAL INTERPOLATION 9 Hrs.

Difference operators-Relation between the operators-Interpolation: Newton's forward and backward difference interpolation formula (equal interval) - Lagrange's interpolation formula (unequal interval).

## UNIT 5 INTRODUCTION TO PROBABILITY 9 Hrs.

Definitions: Sample Space, Events – Addition Law of probability – Multiplication law of probability – Conditional probability – Baye's theorem (without proof) – problems on Baye's theorem.

**Max. 45 Hrs.**

## COURSE OUTCOMES

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

**CO1 -** Identify the trigonometric functions and the relation between circular and hyperbolic functions
**CO2 -** Understand the concept of formation of PDE and solving them.
**CO3 -** Use Gauss method to solve system of linear equations.
**CO4 -** Discuss the problems on the numerical interpolation methods.
**CO5 -** Apply the concept of probability to solve the problems.
**CO6 -** Produce the conditional probability problems using Baye's theorem.

## TEXT / REFERENCE BOOKS

1. Narayanan. S, Manicavachagom Pillay. T.K, Trigonometry, S.Viswanathan Printers & Publishers 1980.
2. S. Arumugam& Others, Trigonometry, New Gamma Publications, Revised Edition, 1985.
3. Kandasamy P, Thilagavathy. K and G. Gunawathy, Numerical Methods, S.Chand & Sons, 3rd Revised Edition, 2013.
4. Balagurusamy. E, Numerical Methods, Tata Mcgraw Hill Publishing Company, 3rd Edition, 2000.
5. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. I, S. Viswanathan Printers Pvt. Limited, 2007.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB2201 | ORGANIC QUALITATIVE ANALYSIS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To develop the students to understand the basic mechanism involved in functional group analysis.
- To elaborate the student to develop the analytical skill in organic quantitative analysis.
- To determine the melting point for the prepared organic derivatives.

**IDENTIFICATION OF FUNCTIONAL GROUP OF A GIVEN ORGANIC SUBSTANCE**

Identification of acidic, phenolic, basic and neutral organic substances.

Detection of N, S and halogens. Test for aliphatic and aromatic nature of substances. Test for saturation and unsaturation.

Identification of functional groups – Acid – Phenol – Ester - Aldehydes – Ketones – Carbohydrates – Amines – Amide – Anilide - Nitro compound – Thiourea – Halogen compound

Preparation of derivatives for the functional groups and determination of melting point of the derivative.

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Identify qualitatively the acidic, phenolic, basic and neutral organic substances.
**CO2 -** Develop the skill in analyzing the special elements present in the organic substances.
**CO3 -** Discuss the aliphatic and aromatic nature of the organic substances.
**CO4 -** Determine the different functional group present in the organic substances.
**CO5 -** Develop the derivates of the functional group for a given organic substance.
**CO6 -** Determine the melting point of the prepared organic derivates.

**TEXT / REFERENCE BOOKS**

1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt., 2002.
2. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry. 5th ed., Pearson Education, 2005.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB2202 | GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATIONS LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To understanding the concept of gravimetric analysis
- To learn the chemistry of various organic preparations
- To create new road map for organic synthesis.

**LIST OF EXPERIMENTS**

1. Estimation of Barium as Barium Chromate.
2. Estimation of Lead as Lead Chromate.
3. Estimation of Nickel as Ni-DMG.
4. Estimation of Calcium as Calcium oxalate.
5. Estimation of Copper in an alloy.

**ORGANIC PREPARATIONS**

**SINGLE STAGE ORGANIC PREPARATIONS**

1. Oxidation-Benzaldehyde to benzoic acid.
2. Hydrolysis-Methyl salicylate or ethyl benzoate to the acid.
3. Nitration- Meta dinitrobenzene or picric acid.
4. Halogenation- parabromoacetanilide from acetanilide.

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Estimate the amount of analyte by gravimetric analysis.
**CO2 -** Understand the principles of Ligand to Metal interaction
**CO3 -** Examine the types of organic reactions in real samples
**CO4 -** Understand the principles of single stage Organic preparation techniques
**CO5 -** Apply the mechanism pathway for the single stage synthesis of simple organic compounds
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part III), S. Viswanathan Co. Pvt., 1996.
2. Vogel's Text Book of Quantitative Chemical Analysis. 5th Edi., ELBS/Longman England, 1989.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB1301 | GENERAL CHEMISTRY III | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn the chemical reactions and theories of acids and bases, and dilute solutions.
- To understand the properties and chemical reactions of s-block elements and their compounds.
- To learn the preparation, nomenclature and structure of halogen compounds, dienes and alkynes.

**UNIT 1 ACIDS AND BASES 9 Hrs.**

Types of chemical reactions- Acid-base, oxidation-reduction, electron transfer and double decomposition reactions. Balancing chemical reactions by oxidation number and ion electron method. Theories of acids and bases- Arrhenius theory - Bronsted-Lowry theory - Lewis theory - solvent system - Lux-Flood definition and Usanovich definition, HSAB concept.

**UNIT 2 s-BLOCK ELEMENTS 9 Hrs.**

Chemical properties of the group metals: reaction with water, air, nitrogen; uses of *s*-block metals and their ompounds. Compounds of *s*-block metals: oxides, hydroxides, peroxides, superoxides - preparation and properties; oxo salts - carbonates, bicarbonates, nitrates; halides and polyhalides; anomalous behavior of Li, Be and B, extraction of beryllium. Complexes of *s*-block metals: complexes with crown ethers, biological importance of sodium and potassium.

**UNIT 3 ALKENES, DIENES AND CYCLOALKENES 9 Hrs.**

Structure and Nomenclature-Methods of Preparation-Dehydration of alcohols, dehydrohalogenation of alkyl halides-Elimination reactions- Hoffmann and Saytzeff rules- dehalogenation-Physical and Chemical Properties-Addition of hydrogen, halogen, hydrohalogenation(Markovnikov's and Anti-Markovnikov's rule)- Epoxidation, Ozonolysis, Polymerization-.Dienes-Conjugated, Non-conjugated dienes, cumulative dienes-Structure-1, 3-butadiene-Preparation and properties-Diels Alder reaction.Cycloalkenes- Structure and Nomenclature- Methods of preparation-Physical and chemical properties cyclopentadiene and cyclohexene.

**UNIT 4 ALKYNES 9 Hrs.**

Nomenclature- Preparation- Dehydrohalogenation, Dehalogenation, alkylation of acetylene-Physical properties, Chemical properties- Electrophilic addition Addition of halogen, halogen acids- Nucleophilic addition: Addition of HCN, $NH_3$, acids and alcohols- Oxidation- Hydroboration- Reduction- Metal-ammonia reactions-Formation of sodium or lithium alkynide.

**UNIT 5 SOLUTIONS 9 Hrs.**

Types of solutions- Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law-Ieal and non-ideal solutions-Binary solutions: fractional distillation–Azeotropic mixture–immiscible liquids–steam distillation–partially miscible liquids–critical solution temperature–phenol-water system–aniline-hexane system–Nicotine-water system. Dilute solutions: Colligative properties, relative lowering of vapour pressure, osmosis, Law and osmotic pressure, Thermodynamic derivation of elevation of boiling point and depression in freezing point. Determination of molecular masses using the above properties.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Examine the mechanism involved in various theories of acids and bases
**CO2 -** Assess the structure and reactivity of s-block elements
**CO3 -** Examine the physical and chemical properties of alkenes, dienes and cycloalkenes
**CO4 -** Apply the electrophilic and nucleophilic addition mechanism to the alkyne reactions
**CO5 -** Apply the laws of solutions to determine the colligative properties for dilute solutions and critical solution temperature for binary solutions
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
5. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
6. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
7. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1302 | BIOCHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVE**

- To give an insight into the chemical aspects of biological macromolecules and their importance.
- To create solid foundation in biochemical processes.
- To Provide basic concepts of biochemistry and its nature of interdisciplinary importance.

**UNIT 1 CARBOHYDRATES 9 Hrs.**

Carbohydrates: Classification, Monosaccharides: -linear and ring forms (Haworth's formula), Structures, Stereoisomers and structural isomers, mutarotation, and chemical properties. Dissaccharides-structure and importance of sucrose, Lactose, maltose, Polysaccharides: - Structure and significance of homopolysaccharides and heteropolysaccharides.

**UNIT 2 AMINO ACIDS AD PROTEINS 9 Hrs.**

Amino acids: Structures and Classifications, Essential and Non-essential amino acids, amphoteric nature, isoelectric point, zwitter ion.

Protein: Classification - shape, solubility and composition; biological functions of proteins, bonds involved in protein structure, structural levels of organization: - primary, secondary, tertiary and quaternary structures with examples.

**UNIT 3 LIPIDS AD NUCLEIC ACIDS 9 Hrs.**

Lipids: Classifications, physical and chemical properties of fats, structure and functions of saturated and unsaturated fatty acids.

Nucleic acids: Nitrogenous bases, structures of Ribonucleotides and deoxyribonucleotides, structure and functions of DNA and RNA.

**UNIT 4 ENZYMES AND METABOLIC CYCLES 9 Hrs.**

Enzymes: IUB classification of enzymes with example. Active site, enzyme units, Enzyme kinetics: - MM equation, factors affecting enzyme activity.

Metabolic cycles: Glycolysis, TCA cycle, Urea cycle

**UNIT 5 VITAMINS AND MINERALS 9 Hrs.**

Vitamins: fat soluble and water soluble vitamins. Deficiency disorders. Minerals: Micro and Macro minerals. Biological importance of vitamins and minerals.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

**CO1 -** To understand about the basic classification and biological significance of carbohydrates.
**CO2 -** To have insight on structure, classification and properties of amino acids and to study their impact on organizing the structure of proteins.
**CO3 -** To recite the categorization, structure and various functions of lipids and nucleic acids.
**CO4 -** To analyze the concept of enzyme activity.
**CO5 -** To apply the importance of enzymes in metabolism.
**CO6 -** To interpret the vital role of vitamins and minerals

**TEXT / REFERENCE BOOKS**

1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005
2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008.
3. Reginald H. Garrett and Charles M. Grisham, Biochemistry, 6th Edition, Brooks Cole publisher, 2017.
4. Harper's Illustrated Biochemistry 31st edition, by Lange Publishers, 2018

5. Biochemistry by U. Sathyanarayana & U.Chakrapani, fifth edition, Elsevier publications, 2018

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SPHB1103 | ANCILLARY PHYSICS I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To calculate youngs modulus of a materials
- To measure the thermal conductivity of a good and bad conductor.
- To understand the nature of waves

**UNIT 1 GRAVITATION 9 Hrs.**

Newton's law of Gravitation- Mass and density of earth – Determination of G (Boy‟s method) – The universal law of gravitation- Acceleration due to gravity and its variation with altitude and depth - Determination of g by compound pendulum. Gravitational potential energy; gravitational potential - Gravitational field and potential at a point inside and outside a spherical shell –Kepler's laws of planetary motion- -Escape velocity- Orbital velocity of a satellite; Geo-stationary satellites.

**UNIT 2 ELASTICITY 9 Hrs.**

Elasticity – Stress, strain – Poisson‟s ratio – Hooke‟s law –Moduli of elasticity – Young‟s modulus, Bulk modulus, rigidity modulus – Relation between elastic constants – Determination of Poisson‟s ratio – Torsional Pendulum – Determination of Coefficient of Rigidity for a wire-Bending of a beam – Bending moment – Uniform and Non uniform Bending -Expression for bending moment – Cantilever – Expression for depression – Experiment to find Young‟s Modulus.

**UNIT 3 HEAT AND THERMODYNAMICS 9 Hrs.**

Heat: Specific heat - Callender's Barne's method to determine the specific heat of a liquid-Newton's law of cooling - determination of specific heat of a liquid using Newton's law of cooling - Emissivity and Emissive power. Low Temperature: J.K. Effect - Positive effect - Negative effect - Temperature of inversion - liquefaction of air Linde's method.

Thermodynamic systems (closed and open); thermodynamic properties and equilibrium; state postulate for simple compressible substances, state diagrams, paths and processes on state diagrams; concepts of heat and work, zeroth law-first and second of thermodynamics.

**UNIT 4 OSCILLATIONS AND WAVES 9 Hrs.**

Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M.) and its equation; phase; oscillations of a spring -restoring force and force constant; energy in S.H.M. - kinetic and potential energies; Simple pendulum - derivation of expression for its time period; Free, forced and damped oscillations (qualitative), resonance.Wave motion. Longitudinal and transverse waves, speed of a wave. Principle of superposition of waves, reflection of waves, Standing waves in strings, fundamental mode and harmonics, Beats, Doppler effect in sound.

**UNIT 5 OPTICS 9 Hrs.**

Introduction to Optics- Reflection, Refraction and Total internal reflection- Lens and its types-Principal axis, Optical centre, Principal focus, Focal length and the power of lens-Aberration- Types of aberration (qualitative) - Spherical aberration - Chromatic aberration in lenses; Interference - Air Wedge - description - Determination of diameter of a thin wire by air wedge Diffraction: Theory of transmission grating - Determination of Wavelength of monochromatic source and Wavelength of mercury lines using a grating by normal Incidence.

**MAX. 45 Hrs.**

## COURSE OUTCOMES

**CO1 -** Examining the Rigidity modulus of a material by Torsional pendulum
**CO2 -** Categorizing the moduli of elasticity and measuring the Young's modulus of material.
**CO3 -** Detecting specific heat of a liquid by newton's law of cooling
**CO4 -** Expressing thermodynamic properties of good and bad conductor
**CO5 -** Summarizing the principle of superposition of waves.
**CO6 -** Experimenting the thickness of a wire by Air Wedge method

## TEXT BOOK / REFERENCE

1. Allied Physics - R. Murugesan S. Chand & Co. First Edition (2005)
2. Allied Physics - Dr. K. Thangaraj, Dr. D. Jayaraman Popular Book Department, Chennai.
3. Allied Physics - Prof. Dhanalakshmi and others.
4. Elements of Properties of Matter - D.S Mathur, S. Chand & Co. (1999).
5. Heat and Thermodynamics - N. Brijlal and Subramaniam S. Chand & Co.
6. A text book of Sound - by M. Narayanamoorthy and other National Publishing companies (1986).

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

| SPHB2104 | ANCILLARY PHYSICS LAB I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVE**

- To determine the rigidity modulus of wire
- To understand the concept of string
- To find the refractive index of a prism

**LIST OF EXPERIMENTS**

1. Youngs modulus of a bar - cantilever - bending - pin and microscope.
2. Youngs modulus of a bar - cantilever - bending - optic lever.
3. Rigidity modulus of a wire-Torsion pendulum.
4. Determine the value of g and K using Compound Bar Pendulum
5. Determine the coefficient of thermal conductivity of a bad conductor by Lee 's disc method.
6. Demonstration of Newton's law of cooling.
7. Determine the mass of a substance by sonometer
8. To study refraction of light by prism using a spectrometer

**COURSE OUTCOMES**

**CO1 -** Evaluating Young's modulus of bar by cantilever
**CO2 -** Understanding the basic laws and explore the fundamental concepts of physics
**CO3 -** Expressing the concepts and significance of the various physical phenomena.
**CO4 -** Experimenting to understand the laws and concepts of Physics.
**CO5 -** Appling the theories learnt and the skills acquired to solve real time problems.
**CO6 -** Acquiring a wide range of problem solving skills, both analytical and technical and to apply them.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB2301 | BIOCHEMISTRY LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVE**

- To understand and analyze various biomolecules using biochemical methods
- To understand the basic concepts of analysis of biological samples
- To understand the interpretations of real samples.

**LIST OF EXPERIMENTS**

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Amino Acids
3. Working Principle And Standardization of Colorimeter
4. Quantitative Estimation of Protein By Lowry's Method.
5. Quantitative Estimation of Urea By Dam Method.
6. Estimation of Ascorbic Acid
7. Determination of Saponification Value of Edible Oil

**COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1 -** Identify carbohydrates and amino acids in various sources
**CO2 -** Apply the principle and instrumentation of colorimeter
**CO3 -** Interpret the quantity of protein and urea in samples
**CO4 -** Apply titrimetry in analyzing vitamins like ascorbic acid
**CO5 -** Analyze the properties of lipids through their applications
**CO6 -** Choose appropriate biochemical methods to analyze various biomolecules

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB1401 | GENERAL CHEMISTRY IV | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the structure and properties of important boron,nitrogen,oxygen and carbon compounds.
- To study the concept of stereochemistry and optical isomerism.
- To learn theproperties of colloidal systems, emulsions and macromolecules.

**UNIT 1 BORON AND CARBON GROUP ELEMENTS 9 Hrs.**

Group 13 (Boron group): Extraction of B and Si - types of compounds - reactions involving Boron - Compounds of boron with oxygen - boron sesquioxide – borates – borax; Boron hydrides - reaction with ammonia, hydroboration, structure of boranes – uses of Boron hydrides – Aluminium - amphoteric behaviour - aluminates.

Group 14 (Carbon group): Catenation and heterocatenation - allotropes of carbon - graphite, diamond, fullerenes and carbon nanotubes (structural features and uses); carbides - salt-like carbides, interstitial carbides, covalent carbides; Silicates - ortho-, pyro-, cyclic-, chain-, sheet - three dimensional silicates - properties and structures - silicates in technology - alkali silicates.

**UNIT 2 NITROGEN AND OXYGEN GROUP ELEMENTS 9 Hrs.**

Group-15 (Nitrogen group): metallic and nonmetallic character - compounds of Nitrogen - $N_2H_4$, $NH_2OH$, HN3 - Phosphorous compounds - halides and oxohalides.

Group-16 (Oxygen group): Types of oxides - basic oxides, amphoteric oxides, acidic oxides, neutral oxides. Oxides of sulphur - $S_2O$, $SO_3$ - oxyacids of sulphur - thionic acid series - peroxoacid series – oxohalides - thionyl compounds (methods of preparation and properties).

**UNIT 3 STEREOCHEMISTRY I 9 Hrs.**

Geometrical Isomerism-Cis and trans, syn and anti, E and Z notations-Cis-trans interconversion-Conformational isomerism: Conformers, dihedral angle, torsional strain-Conformational analysis of ethane and n-butane, conformers of cyclohexane (Chair, boat and skew boat forms), axial-equatorial positions and their interconversions, conformers of mono and disubstitutedcyclohexanes - diaxial interactions.

**UNIT 4 STEREOCHEMISTRY II 9 Hrs.**

Optical isomerism – Chirality – Measurement of optical activity – Specific rotation – Enantiomerism and Diastereomerism - Wedge, Fischer, Newmann and Sawhorse projection formulae — Difference between Configuration and Conformation - Absolute and Relative configuration - D and L notation - Cahn-Ingold-Prelog's rules – R and S notation – Optical isomerism in compounds containing more than one carbon atom – Isomerism in tartaric acid - Racemic modification – Racemization - Resolution of racemic mixtures –Asymmetric synthesis (definition only) - Walden inversion.

**UNIT 5 COLLOIDS AND MACROMOLECULES 9 Hrs.**

Colloidal systems – classification – preparation – purification of colloids-Properties of colloids: Kinetic, optical and electrical properties. Emulsions: Types of emulsions, preparation, properties and applications, Donnan membrane equilibrium-applications of colloids. Macromolecules-Different types of polymers – classification of polymers. Molecular weight of polymers – number average and weight averages – determination of molecular weight of polymer –osmotic pressure and light scattering methods.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to:

**CO1 -** Examine the properties of boron and carbon group elements

**CO2 -** Analyze the metallic and non-metallic character of nitrogen group elements and nature of oxides of oxygen group elements

**CO3 -** Apply the concept of conformation analysis to the conformations of acyclic and cyclic compounds

**CO4 -** Apply the configurational rules for assigning the absolute and relative configuration to organic molecules

**CO5 -** Examine the properties and industrial applications of colloids and macromolecules

**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
2. Selected topics in inorganic chemistry, R D Madan, G D Tuli & Wahid U Malik, S.Chand publication, 1976.
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
4. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
5. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
6. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
7. Eliel E. L., Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
8. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chandand Co. 23rd edition, 1993.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1402 | Fundamentals of Analytical Chemistry | L | T | P | EL | Credits | Total marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of separation and purification techniques based on chromatorgraphy.
- To construct the techniques for separation of metal ions using various chromatographic methods.
- To develop the skill of selection of various thermal methods for purification and analysis.

**UNIT 1 SEPARATION AND PURIFICATION TECHIQUES 9 Hrs.**

Principles involved in the separation of precipitates, solvent extraction and electrophoresis. Purification of solid organic compounds, extraction - use of immiscible solvents, soxhlet extraction, crystallization, use of miscible solvents, fractional crystallization, sublimation. Purification of liquids, experimental techniques of distillation, fractional distillation, vacuum distillation, steam distillation, tests for purity.

**UNIT 2 CHROMATOGRAPHY I 9 Hrs.**

Principles adsorption, thin layer, partition and paper. Chromatography column chromatography, adsorbents, preparation of column, adsorption, elution, recovery of substance and applications. TLC - choice of adsorbent and solvent, preparation of chromatogram and applications, Rf value. Paper chromatography, Solvents used and principles, factors affecting Rf value, separation of aminoacid mixtures. Radial paper chromatography.

**UNIT 3 CHROMATOGRAPHY II 9 Hrs.**

Ion exchange chromatography – principle, resins, action of resins, experimental techniques, applications, separation of Zn-Mg, Co-Ni, Cd-Zn, Chloride, bromide. Gas chromatography and high pressure liquid chromatogrphy – principles, Detectors, experimental techniques, instrumentation and applications.

**UNIT 4 THERMAL ANALYSIS 9 Hrs.**

Thermal analytical methods - Principle involved in thermogravimetric analysis and differential gravimetric analysis, discussion of various components with block diagram, characteristics of TGA and DTA, factors affecting TGA and DTA curves, thermometric titrations.

**UNIT 5 POLAROGRAPHY 9 Hrs.**

Principle, concentration polarization, dropping mercury electrode, advantages and disadvantages, convection, migration and diffusion currents, ilkovic equation (derivation not required) and significance, experimental assembly, electrodes, capillary solutions, current voltage curve, oxygen wave, influence of temperature and agitation on diffusion layer, polarography as an analytical tool in quantitative and qualitative analysis. Amperornetry - basic principles and uses. Polarimetry principle – instrumentation, comparison of strengths of acids, estimation of glucose.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to:

**CO1 -** Apply the principles of separation to miscible and immiscible systems
**CO2 -** Outline the principles of adsorption in paper and thin layer chromatography
**CO3 -** Apply the principles of chromatography for the GC and HPLC separation techniques
**CO4 -** Explain thermal methods of analysis involved in TGA/DTA and Thermometric titrations
**CO5 -** Apply the polarization principles to the polarography and polarimetry techniques
**CO6 -** Evaluate the basic concept of chemistry to real world applications

## TEXT / REFERENCE BOOKS

1. Concise Inorganic Chemistry – J.D. Lee – 3rd Edition, Von Nostrand
2. Inorganic Chemistry – P. L. Soni – Sultan Chand
3. Inorganic Chemistry – Pun and Sharma Nagin
4. Inorganic Chemistry – Modan S. Chand
5. Advanced Inorganic Chemistry – Cotton and Wilkinson
6. A Textbook of Inorganic Chemistry – A.K. De – New Age
7. Industrial Chemistry- B.K. Sharma – Goel Publications
8. General and Inorganic Chemistry Part I Sarkar, Books and Allied (P) Ltd
9. General and Inorganic Chemistry Part II Sarkar, Books and Allied (P) Ltd
10. Chemical Methods for Environmental Analysis Ramesh and Anbu, Macmillan

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 Marks each-No choice 2**0 Marks**
**PART B:** 2 Questions from each unit of internal choice, each carrying 16 Marks. 8**0 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SPHB1202 | ANCILLARY PHYSICS II | L | T | P | EL | Credits | Total marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To make the students aware of the fundamental concepts behind materials and their applications
- To understand the concepts of de Broglie waves
- To understand the crystal structure

**UNIT 1 WAVE MECHANICS 9 Hrs.**

Wave Mechanics - De Broglie Waves -Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; particle nature of light.-Experimental study of matter waves -wave nature of particle, de Broglie relation-Davisson and Germer's experiment - Heisenberg's uncertainty Principle - The position and momentum of a particle- Application of Heisenberg's Uncertainty Principle.

**UNIT 2 CRYSTALLOGRAPHY 9 Hrs.**

Crystallography: The crystal structure - Unit cell - Miller indices - Reciprocal lattice vectors-properties of Reciprocal Lattice-Bragg's law-Types of bonding in crystal-crystal packing-Atomic packing factor for SC,FCC and BCC- examples of simple structures like NaCl, CaCl and Diomand.

**UNIT 3 ELECTRICITY AND MAGNETISM 9 Hrs.**

Electricity: charge, potential, electric field, Gauss law; Potentiometer - Principle - Calibration of low range voltmeter - Measurement of internal resistance of cell - measurement of an unknown resistance-Kirchhoff's laws and their applications. Wheatstone bridge, Metre Bridge.

Magnetism :Moment and pole strength of a magnet - Deflection magnetometer - Tan C position - Vibration magnetometer Theory - period of oscillation - Determination of M and BH using the deflection magnetometer in Tan C position and the vibration magnet.

**UNIT 4 ENERGY PHYSICS 9 Hrs.**

Sources of conventional energy - Need for non-conventional energy - resources - solar energy utilization - solar water heater - solar drier - conversion of light into electrical energy - solar cell - merits and demerits of solar energy - wind energy - its conversion systems - energy from Bio mass - Bio gas generation - Industrial and space application.

**UNIT 5 ELECTRONICS 9 Hrs.**

Electronics: pn junction diode- forward and reverse bias,Zener diode - Characteristics - Voltage regulation using zener diode; BJT and characteristics graph of CB, CC, CE. Digital electronics: AND, OR NOT, NAND and NOR gates - NAND and NOR as universal building blocks - elementary ideas of Integrated circuits-Fabrication of Integrated circuits by monolithic technology - Advantages and limitations of an integrated circuit – Flexible Electronics-merits and demerits.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

**CO1 -** Comparing the nature of waves and collating study of matter waves.
**CO2 -** Appraising and grading the atomic packing factor for different crystal structure.
**CO3 -** Measuring internal resistance of cell using galvanometer method.
**CO4 -** Expressing the concept of solar cell and constructing solar water heater.
**CO5 -** Interpreting the concept of wind energy and its conversion system.
**CO6 -** Inferring the function of Logic gates and fabrication of ICs.

## TEXT BOOK / REFERENCE

1. Allied Physics - R. Murugesan S. Chand & Co. First Edition (2005)
2. Allied Physics - Dr. K. Thangaraj, Dr. D. Jayaraman Popular Book Department, Chennai.
3. Allied Physics - Prof. Dhanalakshmi and others.
4. Modern Physics - R. Murugesan S. Chand & Co.(2004)
5. Electronic Principles and applications - A. B. Bhattacharya, New Central Book Agency, Culcutta.
6. Introduction to Solid state Physics - C. Kittel, 5th Edition Wiley Eastern Ltd.
7. Renewable & sustainable energy sources - Agarwal

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SPHB2203 | ANCILLARY PHYSICS LAB II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVE**

- To understand the concept of sonometer
- To calculate the refractive index of liquid
- To measure the potential of zener diode

**LIST OF EXPERIMENTS**

1. Ultrasonic Interferrometer- Determination of velocity of a liquid
2. Sonometer - frequency of the tuning fork.
3. Determine a Low Resistance by Carey Foster's Bridge
4. Multimeter for measuring (a) Resistances, (b)AC and DC Voltages, (c)DC Current, and (d) checking Electrical fuses.
5. Determine the refractive index of the given liquid forming liquid prism.
6. Diffraction grating and hence to determine the wavelength of mercury spectral lines by normal incidence method using spectrometer.
7. Determination of wave length of laser- Laser Experiment
8. Characteristics of Zener diode.
9. Magnetic susceptibility of a liquid using Quinck's method.
10. Band gap of a semiconductor diode.

**COUSE OUTCOME**

**CO1 -** Evaluating ultrasonic velocity of a liquid by interferometer.
**CO2 -** Detecting the frequenzy of turing fork by sono meter
**CO3 -** Calculating resistence by carey Foster bridge
**CO4 -** Determining the refractive index of a glass materials by spectrometer
**CO5 -** Characterizing zener diode by I-V curve.
**CO6 -** Calculating energy band gap of diode.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | |
|---|---|---|
| **CAE** | Evaluation of Regular Lab class<br>Model practical exam | **50 Marks** |
| **ESE** | University Practical exam | **50 Marks** |

| SCYB2401 | PHYSICAL CHEMISTRY LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To improve the analytical skills of the students in quantitative analysis.
- To gain familiarity with a variety of physico-chemical measurement techniques.
- To develop laboratory skills and the ability to work independently.

**LIST OF EXPERIMENTS**

1. Kinetics of acid catalyzed hydrolysis of methyl acetate.
2. Determination of molecular weight by Rast's method (using nephthalein, or biphenyl as solvenet and acetanilide, p–dichlorobenzene as solute).
3. Critical solution temperature: Phenol-water system. Effect of impurities on CST
4. Phase diagram of a simple eutectic system and determination of unknown composition.
5. Conductometry: Acid – base titration.
6. Potentiometry: Redox titration of ferrous *vs* dichromate.
7. pH metry: Acid – base titration
8. Verification of Beer-Lambert's law and determination of concentration of metal ions spectrophotometrically.
9. Determination of partition coefficient of iodine between water and carbon tetrachloride.
10. Determination of equivalent conductance of an electrolyte.

**COURSE OUTCOMES:** On successful completion of the course, student will be able to

**CO1 -** Estimate the molecular weight of the unknown solute.
**CO2 -** Determine the Critical Solution Temperature of the organic compounds.
**CO3 -** Estimate the amount of metals ion present in unknown solution using photocolorimetry.
**CO4 -** Understand the concept of partition coefficient of solutes between different solvents.
**CO5 -** Estimate the concentration of substances using conductometry, potentiometry and pH metry.
**CO6 -** Apply the physical parameters measured to real time problems.

**TEXT / REFERENCES BOOKS**

1. J.N. Gurthu and R. Kapoor: Advanced Experimental Chemistry, S. Chand and Co., 1987.
2. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler: Experiments in Physical Chemistry, 5th Ed. McGraw- Hill Book company, 1989
3. W. G. Palmer: Experimental physical chemistry, Cambridge University Press.
4. J. B. Yadav: Advanced Practical Physical Chemistry, Goel Publishing House.
5. R. C. Das and B. Behra: Experiments in Physical Chemistry, Tata McGraw hill.
6. K. K. Sharma : An Introduction of Practical Chemistry, Vikas Publishing House, New Delhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | |
|---|---|---|
| **CAE** | Evaluation of Regular Lab class<br>Model practical exam | **50 Marks** |
| **ESE** | University Practical exam | **50 Marks** |

| SCYB1501 | INORGANIC CHEMISTRY I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the properties and chemical reactions of d-block elements and their compounds
- To explain the chelate effect, types of isomerism and the theories related to coordination complexes.
- To study the structure, properties of organometallic and inorganic compounds.

**UNIT 1 d-BLOCK ELEMENTS 9 Hrs.**

First, second and third transition series, general characteristics, metallic character, atomic and ionic radii, standard reduction potentials, variable oxidation states and stabilization, colour, complex formation, catalytic and magnetic properties. Origin of magnetism, measurements by Gouy's balance method, Electroneutrality principle, coordination numbers, coordination numbers from 1 – 10 with examples, Kepert model.

**UNIT 2 COORDINATION CHEMISTRY I 9 Hrs.**

Introduction- Types of ligands, coordination number, IUPAC nomenclature, chelate effect - Isomerism-linkage, ionization, hydrate, coordination, coordination position isomerism. Stereoisomerism-geometrical (cis-/trans- and fac-/mer-), optical isomerism in 4 and 6 coordinated complexes. Theories of coordination compounds-Werner's and Sidgwick's EAN concept.Pauling's valence bond theory, Electroneutrality principle, Pi bonding concept, Inner and outer orbital complexes-Merits and Demerits.

**UNIT 3 COORDINATION CHEMISTRY II 9 Hrs.**

Valence bond theory-applications and limitations, hybridization, geometry and magnetic properties of tetrahedral and octahedral complexes. Crystal field theory- splitting of 'd' metal orbitals in octahedral, tetrahedral and square planar complexes-factors influencing the magnitude of crytal field splitting, low-spin and high-spin complexes, Jahn Teller distortion, explanation of colour and magnetic properties, comparison of VBT and CFT, spectrochemical series.

**UNIT 4 ORGANOMETALLIC COMPOUNDS 9 Hrs.**

Definition, Types of organometallic compounds, Classification of ligands, EAN and Nomenclature of organometallic compounds. Preparation, reaction and structure of ferrocene, metal-olefins and metal - alkynes complexes. Carbonyl compounds of transition metals, structure of mono and polynuclear carbonyls.

**UNIT 5 INORGANIC COMPOUNDS 9 Hrs.**

Preparation, properties, uses and structures of $Ti(NO_3)_4$, $TiO_2$, $VOCl_2$, $K_2CrO_4$, $K_2Cr_2O_7$, Chromyl chloride, Manganese dioxide, Potassium permanganate, potassium ferrocyanide, potassium ferricyanide, Prussian blue, sodium nitroprusside, Lithuimaluminium hydride, aluminium chloride, hexamine cobalt(III) chloride, Cuprous chloride.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1 -** Examine the properties of the first, second and third transition metals in the formation of metal complexes

**CO2 -** Apply the theories of coordination chemistry to inner and outer orbital complexes

**CO3 -** Apply CFT to the formation of Th, Oh and Sq.Pl. complexes.

**CO4 -** Examine the structure and properties of organometallic compounds based on EAN rule.

**CO5 -** Assess the properties and applications of various inorganic compounds.

**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, Wiley Eastern Private Limited 1992.
2. Inorganic Chemistry: Principles of Structure and Reactivity, J.E. Huheey, E.A. Keiter and R.I.Keiter, Addison-Wiley Publication Company, 1993.
3. Inorganic Chemistry, D.F. Shriver, P.W. Atkins, C.H. Longford, Oxford University Press,1996
4. Concise Coordination Chemistry, R. Gopalan and V. Ramalingam, Vikas Publishing House Private Limited, 2001.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1502 | ORGANIC CHEMISTRY I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To learn the structure of benzene and reactivity of benzene compounT
- To study the chemical reactions involving alkyl and aryl halides, alcohols, phenol, ether and epoxides.
- To understand the mechanism for substitution, elimination and addition reactions in carbonyl compounds.

**UNIT 1 BENZENE AND POLYAROMATIC COMPOUNDS 9 Hrs.**

Structure of Benzene –Stability of the benzene ring – Resonance hybrid - Molecular Orbital picture – Aromaticity – Huckel's rule for benzenoid and non-benzenoid compounds –General methods of preparation– Physical and Chemical Properties – Electrophilic substitution – nitration, sulphonation, halogenation, FriedelCrafts alkylation and acylation with mechanism – Orientation in aromatic disubstitution– orientation and reactivity. Polynuclear aromatic hydrocarbons – Preparation and properties of naphthalene – Structure of anthracene and phenanthrene.

**UNIT 2 ALKYL AND ARYL HALIDES 9 Hrs.**

Structure and Nomenclature– General methods of Preparation– Sandmeyer and Gattermann reactions -Physical and Chemical properties – Nucleophilic substitution reactions ($S_N1$, $S_N2$, $S_Ni$ and $S_NAr$), Reduction, Eliminations: E1 and E2 mechanisms – Mechanism – Formation of Grignard reagents, addition -Williamson's ether synthesis.

**UNIT 3 ALCOHOLS AND PHENOLS 9 Hrs.**

Alcohols –Structure, nomenclature and classification – Methods of preparation - hydration, hydrolysis, reduction of carbonyl compounds, from Grignard reagents – Physical and chemical properties – Reactions involving OH bond –Glycol, glycerols and thiols. Phenols – Structure and nomenclature - Preparation from diazonium salts and sulphonic acid, hydrolysis - Physical and chemical properties – reactions involving OH group, acidity, ether formation, esterification – reactions involving the benzene ring, electrophilic substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, coupling reactions, Kolbe's reaction and Riemer-Tiemann reaction.

**UNIT 4 ETHERS AND EPOXIDES 9 Hrs.**

Structure and nomenclature - Preparation by Williamson's synthesis and by dehydration of alcohols - Physical and Chemical properties – Halogenation, formation of peroxides, hydrolysis, cleavage of C-O bond.Thioethers – Structure – Preparation and Properties - Crown ethers - Preparation and reactions of epoxides.

**UNIT 5 CARBONYL COMPOUNDS 9 Hrs.**

Structure and nomenclature– General methods of preparation of aldehydes and ketones – oxidation, dehydrogenation, from Grignard reagents, Rosenmund reduction, Gattermann-Koch reaction - Physical and Chemical properties –Reactivity of carbonyl group and acidity of alpha hydrogen - Nucleophilic addition reactions – Mechanism of Aldol, Perkin, Knoevenagel, Claisen, Wittig, Cannizarro, Reformatsky and Benzoin reactions – Oxidation and Reduction reactions –Clemmensen and Wolf-Kishner reduction – Electrophilic substitution reactions of aromatic aldehydes and ketones.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Analyze the structure and reactivity of aromatic and polynuclear aromatic hydrocarbon
**CO2 -** Apply the nucleophilic substitution and elimination mechanism of alkyl and aryl halides
**CO3 -** Relate the structure and reactivity of alcohols and phenols
**CO4 -** Examine the physical and chemical properties of ethers and epoxides
**CO5 -** Apply the nucleophilic addition and electrophilic substitution mechanism to reactions involving carbonyl compounds
**CO6 -** Evaluate the basic concept of chemistry to real world applications

## TEXT / REFERENCE BOOKS

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
3. S. H. Pine, Organic Chemistry, 5th ed., McGraw Hill International Edition, Chemistry Series, New York, 1987.
4. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
5. I. L. Finar, Organic Chemistry, Vol-2, 6th ed., Pearson Education Asia. 2004.
6. J. March and M Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2001.
7. Agarwal O. P., Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, 1997.
8. Jain J. L., Jain S., and Jain N., Fundamentals of Biochemistry, S. Chand, 2007

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1503 | PHYSICAL CHEMISTRY I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concepts of First law and second law of thermodynamics and Thermochemistry.
- To learn the concepts and applications of electrolytic conductance.
- To study the concept of order, rate and rate constant and theories of adsorption.

**UNIT 1 THERMODYNAMICS I 9 Hrs.**

Definitions- system and surrounding- isolated, closed and open system- state of the system- Intensive and extensive variables. Thermodynamic processes-reversible and irreversible, isothermal and adiabatic processes- state and path functions-Work of expansion at constant pressure and at constant volume. First law of thermodynamics- statement- definition of internal energy (E), enthalpy (H) and heat capacity. Relationship between Cp and Cv-Calculation of w, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes. Thermochemistry- relationship between enthalpy of reaction at constant volume (qv) and at constant pressure (qp)- temperature dependence of heat of reaction. Kirchoff's equation- bond energy and its calculation from thermochemical data integral and differential heats of solution and dilution.

**UNIT 2 THERMODYNAMICS II 9 Hrs.**

Second Law of Thermo Dynamics – Need of the law – Different statements of the law — Thermodynamic scale of temperature – Concept of Entropy – Definition and physical significance of entropy – Entropy as a function of P, V and T-Entropy changes during phase changes – Entropy of mixing-Entropy criterion for spontaneous and equilibrium processes in isolated systems – Gibb's free energy (G) and Helmholtz free energy (A) – Variation of A and G with P, V and T – Gibb's Helmholtz equation and its applications – Thermodynamic equation of state – Maxwell's relations.

**UNIT 3 ELECTROCHEMISTRY I 9 Hrs.**

Conductance in metal and in electrolytic solution- specific conductance and equivalent conductance. Effect of dilution on equivalent conductance and specific conductance. Kohlrausch's law and its applications. Arrhenius theory of electrolytic dissociation and its limitation. Weak and strong electrolyte according to Arrhenius theory. Ostwald's dilution law- Derivation, applications and limitation. Transport number and Hittorf's rule. Determination of transport number by Hittrof's method and moving boundary method. Application of conductance measurements- determination of degree of dissociation of weak electrolytes -determination of solubility product of a sparingly soluble salt. common ion effect, conductometric titrations.

**UNIT 4 CHEMICAL KINETICS I 9 Hrs.**

Rate of reaction- rate equation, order and molecularity of reaction. Rate Laws - rate constants- derivation of first order rate constant and characteristics of zero order, first order and second order reactions- derivation of time for half change ($t_{1/2}$) with examples. Methods of determination of order of reactions- experimental methods determination of rate constant of a reaction by volumetry, colorimetry and polarimetry.

**UNIT 5 ADSORPTION AND CATALYSIS 9 Hrs.**

Adsorption – Types – Chemical and physical. Characteristics of adsorption. Different types of isotherms-Adsorption of gases on solids-Adsorption of solutes from solution- Freundlich and Langmuir-Applications of adsorption. Catalyst-Definition and Characteristics - Types of catalysis-Homogeneous and heterogeneous, induced, auto, positive and negative catalysis, catalytic poisons and catalytic

promoters-Theories of catalysis- intermediate compound formation theory and adsorption theory- Enzyme catalysis – Michaelis-Menten equation and Michaelis-Menten law.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Apply the thermodynamic principles to the reversible and irreversible processes.
**CO2 -** Illustrate the isolated systems based on principles of entropy.
**CO3 -** Analyze the effect of dilution on strong and weak electrolytes
**CO4 -** Apply the concept of rate laws to determine the rate of a chemical reaction.
**CO5 -** Apply the catalytic mechanism for industrial adsorbents and enzyme catalysts
**CO6 -** Evaluate the basic concept of chemistry to real world applications

## TEXT / REFERENCE BOOKS

1. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Vishal Publishing Co, 48th edition, 2020.
2. ArunBahl, B. S. Bahl and G. D. Tuli, Essentials of Physical Chemistry, S. Chand publishing, 2012
3. P.W. Atkins, *Physical Chemistry*, 7th ed.,Oxford university press, 2001.
4. Glasston & Lewis, Physical Chemistry, 2nd Edition, McMillan publishers, 1973
5. A.S. Negi and S. C. Anand, A Textbook of Physical Chemistry, New Age International, 2004

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCHB1505 | PROCESSES AND SEPARATION IN CHEMICAL INDUSTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To equip the learners with chemical processes and separation processes followed in chemical process industries.

**UNIT 1 INTRODUCTION 9 Hrs.**

Basic principles of unit operations and unit process to common devices used in process industries - Standard symbols used for such devices, Process flow sheet for Urea, Ethanol and Soda ash.

**UNIT 2 UNIT OPERATIONS 9 Hrs.**

Basic principles, types of separation processes like distillation, extraction, absorption and drying.

**UNIT 3 UNIT PROCESSES 9 Hrs.**

Types of reaction, Reactors – order, molecularity, conversion, limiting and excess reactant. Heat capacity, sensible heat and latent heat, Standard heat of reaction, heat of formation, combustion, mixing. - Calculation of standard heat of reaction and conversion.

**UNIT 4 CHEMICAL CALCULATIONS 9 Hrs.**

Stoichiometric principles, Units and its conversion. Principles and Application of material balance in unit process –Mixing, Evaporation and Crystallisation.

**UNIT 5 HEAT AND MASS TRANSFER 9 Hrs.**

Introduction – modes of heat transfer, Fourier's law, types of heat exchangers, types of evaporators. Mass transfer – Diffusion, Fick's law, Types of diffusion.

**Max. 45 Hrs.**

**COURSE OUTCOME**

**CO1 -** Ability to explore techniques, skills necessary to solve problems in chemical industry
**CO2 -** Develop the flow sheets of process.
**CO3 -** Ability to develop material balance and conversion calculation
**CO4 -** Students gain knowledge in chemical kinetics
**CO5 -** Acquire knowledge in Heat transfer and Mass transfer operations
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. Treybal, R.E, Mass Transfer Operations, 3rd Edition, McGraw Hill, 2004.
2. McCabe and Smith, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, 2009
3. Bhatt, B.L., Vora, S.M., Stoichiometry, 4th Edition, Tata McGraw-Hill, 2004.
4. Levenspiel, O., Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York,1995.
5. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw-Hill, 2003.
6. Shreve. N., Chemical Process Industries, 8th Edition, McGraw Hill, 2004.

| SCYB2501 | INORGANIC QUALITATIVE ANALYSIS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To learn the theoretical basis of qualitative inorganic analysis.
- To understand the method of identification of group and cations using semimicro analysis.
- To analyse the mixture and identify the simple and interfering anions in the mixture.

**LIST OF EXPERIMENTS**

Semi micro qualitative analysis of inorganic salt mixtures containing one interfering acid radical
Simple anions - Carbonate, nitrate, sulphate, sulphide, sulphite, chloride and bromide
Interfering anions - Borate, fluoride, oxalate, phosphate, arsenite and chromate.

**CATIONS**

Group I cations: Lead, silver, mercurous.
Group II cations: Mercuric, copper, cadmium, bismuth, antimony,tin.
Group III cations: Aluminium, ferrous, ferric, chromium.
Group IV cations: Cobalt, nickel, manganese, zinc.
Group V cations: Barium, strontium, calcium
Group VI cations: Magnesium, ammonium.

**COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1 -** Analyze the mixture using semi micro analysis.
**CO2 -** Identify the simple anions and interfering anions in the mixture.
**CO3 -** Remove the interfering anion from the mixture.
**CO4 -** Identify the cations present in the mixture.
**CO5 -** Recognize the classification of various cations under different groups.
**CO6 -** Acquire the group separation skills.

**TEXT / REFERENCE BOOKS**

1. V.V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd ed., The National Publishing Company, Chennai, 1974.
2. Vogel's Text Book of Inorganic Qualitative Analysis, 4th ed., ELBS, London, 1974

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | |
|---|---|---|
| **CAE** | Evaluation of Regular Lab class<br>Model practical exam | **50 Marks** |
| **ESE** | University Practical exam | **50 Marks** |

| SCHB2502 | CHEMICAL PROCESS AND SEPARATION LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**OBJECTIVE OF THE COURSE**

- The ability to identify, evaluate and apply different types Chemical processes and separation process followed in chemical industries.

**LIST OF EXPERIMENTS**

1. Kinetics study in PFR
2. Kinetics study in Batch reactor
3. Kinetics study in CSTR
4. Non- Catalytic Heterogenous reaction
5. Synthesis of Acetyl Salicylic acid by Alkylation
6. Synthesis of Benzoic acid by Hydrolysis
7. Separation of liquid mixtures by using simple distillation
8. Separation of Acetic acid from acetic acid water mixture using extraction
9. Separation of Sodium carbonate from solid mixture using leaching
10. Absorption studies
11. Adsorption studies

**COURSE OUTCOMES**

**CO1 -** Ability to analyze chemical reactors and reaction systems
**CO2 -** Designing experiments involving chemical reactors
**CO3 -** analyzing and interpreting data
**CO4 -** Ability to solve problems of mass transfer with reaction in solid catalyzed reactions
**CO5 -** Design and sizing on the basis of kinetic data obtained at lab scale

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | |
|---|---|---|
| **CAE** | Evaluation of Regular Lab class<br>Model practical exam | **50 Marks** |
| **ESE** | University Practical exam | **50 Marks** |

| S03BPT | SUMMER INTERNSHIP / COMMUNITY INTERNSHIP | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 6 | 2 | 100 |

**COURSE OBJECTIVES**

- To make our student to prepare for industry ready

**INTERNSHIP REPORT: 60 Marks**

About the industry, Protocol of Industry, Industry safety, R&D lab, ETP etc.,

**VIVA-VOCE: 40 Marks**

Communication

Presentation using Teaching aids

Language and diction

Interpretation of Technical data

| SCYB1601 | INORGANIC CHEMISTRY II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To learn the general characteristics, properties of halogens and interhalogen compounds and extraction of lanthanides and actinides
- To understand the importance of inorganic polymers based on phosphazines, nitrides and carboranes.
- To elaborate on the fundamental aspects of nuclear reactions, types of nuclear reactions and the measurement of radioactivity with the help of different types of counters.

**UNIT 1 HALOGENS AND INTERHALOGENS 9 Hrs.**

Group-17 (Halogens): Group discussion, anomalous behavior of F- ionic- covalent - bridging halides, reactivity of halogens, reduction of halogens by thiosulfate and application to iodo/iodimetry. Oxides and oxoacids of halogens, strength of oxoacids - Interhalogen compounds - ClF, ICl - ClF3 - BrF3 - IF3 - ClF5 - BrF5 - IF5 – structure analysis by VSEPR Model.

**UNIT 2 F-BLOCK ELEMENTS 9 Hrs.**

Lanthanides - Properties of lanthanides - Electronic configuration – oxidation states – ionic radii, lanthanide contraction - Colour and magnetic properties - Extraction of lanthanides - Uses of lanthanides. Actinides: Sources of actinides – preparation of transuranic elements - Electronic configuration – oxidation states – ionic radii – Colour of ions – comparison with lanthanides - Extraction of thorium and Uranium.

**UNIT 3 INORGANIC POLYMERS 9 Hrs.**

Properties of inorganic polymers, glass transition temperature, poly phosphonitrilic chlorides, poly di-alkoxy phosphazines, polymeric sulphur and sulphur nitrides, chalcogenide glasses, poly carboranes, polysiloxanes, Silicon rubber and resins.

**UNIT 4 NUCLEAR CHEMISTRY 9 Hrs.**

Fundamental particles of nucleus - concept of nuclides - representation of nuclides - unit of radioactivity - half - life period - radioactive equilibrium - radioactive displacement law - radioactive series - Measurement of radioactivity - ionization chamber, Geiger muller counter, scintillation counter - isotopes, isobars, isotones, nuclear forces, nuclear stability, structure of nucleus (shell and liquid drop model) - packing fractions - mass defect - binding energy - Q-values - artificial transmutations - nuclear reactions – spallation – nuclear fission and fusion - breeder reaction - radio isotopes and applications of radio isotopes.

**UNIT 5 STRUCTURE OF SOLIDS 9 Hrs.**

Solid state- crystalline and amorphous solids - structure and properties - laws of crystallography, Miller indices - simple cube, body centered cube and face centered cube - structure of NaCl and CsCl, diamond and graphite. Symmetry in crystals - crystal systems - crystal lattice - lattice planes and their designation - assignment of atoms/ions per unit cell in a cubic lattice - diffraction of X-rays by crystals - Bragg equation - structures of NaCl and CsCl - Avogadro number from cubic lattice dimension - closest packing - packing in ionic solids.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to:

**CO1 -** Analyze the structure of interhalogen compounds by VSEPR model
**CO2 -** Interpret the oxidation states and colour of ions of lanthanides and actinides
**CO3 -** Examine the properties of various industrial inorganic polymers
**CO4 -** Apply the basic principles of radioactivity to the applications of radioisotopes
**CO5 -** Relate the structure with properties of solid crystal systems
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1602 | ORGANIC CHEMISTRY II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To discuss the concepts and chemistry involving organo-nitrogen compounds.
- To understand the synthesis, properties and reactivity of aliphatic and aromatic carboxylic acids.
- To understand the importance of active methylene groups in organic synthesis.

**UNIT 1 CARBOXYLIC ACIDS AND THEIR DERIVATIVES 9 Hrs.**

Structure and nomenclature - General methods of preparation of carboxylic acids – acidity – Effect of substituents on acidity – Physical and Chemical properties –Hell-Volhard-Zelinsky Reaction - Dicarboxylic acids -Nomenclature- Preparation and properties of oxalic and Malonic acid – Stereospecific addition to maleic and fumaric acids – Derivatives of carboxylic acids – Acid halides, esters, anhydrides and amides – Preparation and Properties – Relative reactivity - Acid and alkaline hydrolysis of esters – trans-esterification.

**UNIT 2 AROMATIC CARBOXYLIC ACID AND THEIR DERIVATIVES 9 Hrs.**

Structure and Nomenclature- General methods of preparation- Chemical Properties- Individual members- Benzoic acid, benzamide, Benzoyl chloride- Dicarboxylic acids- Phthalic acid- Preparation and Chemical Properties- Monobasic acid in side chain- Cinnamic acid- preparation and Chemical properties-Phenolic acids-Salicylic acid- preparation and Chemical properties.

**UNIT 3 ACTIVE METHYLENE COMPOUNDS 9 Hrs.**

Preparation of malonic ester, ethyl acetoacetate and cyanoacetic ester – Physical and Chemical properties – Tautomerism in ethyl acetoacetate - Synthetic applications – preparation of synthetically important compounds from active methylene compounds - Michael addition - synthetic uses.

**UNIT 4 CHEMISTRY OF NITROGEN CONTAINING COMPOUNDS 9 Hrs.**

Amines – Structure, nomenclature and classification - Methods of preparation of primary, secondary and tertiary amines - Physical and chemical properties – Basicity of amines, effect of substituents on basicity of aromatic amines – Quaternary ammonium salts – Hinsberg test – Carbylamine test, Schotten-Baumann reaction. Nitrocompounds – Structure - Aliphatic and Aromatic nitro compounds – Methods of preparation - Physical and Chemical Properties – Substitution of aromatic nitro compounds. Diazo compounds- Diazotisation and its mechanism. Cyanides and isocyanides – Structure, preparation and properties.

**UNIT 5 HETEROCYCLIC COMPOUNDS 9 Hrs.**

Nomenclature - Five membered rings - Preparation of pyrrole, furan and thiophene – Molecular orbital picture – Physical and Chemical properties – Electrophilic and nucleophilic substitution mechanism – Oxidation and reduction – Six membered rings – Pyridine and Quinoline– Preparation and properties - Skraup synthesis – BischlerNapieralski synthesis – Preparation and properties of Indole.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Examine the effect of substituents on acidity of carboxylic acids and their derivatives.
**CO2 -** Relate the structure and properties of aromatic carboxylic acids and their derivatives.
**CO3 -** Analyze the significance of the presence of active methylene group in organic compounds.
**CO4 -** Assess the effect of substituents on basicity of aromatic amines and aromatic nitro compounds.
**CO5 -** Apply the electrophilic and nucleophilic substitution mechanism to heterocyclic compounds.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCE BOOKS

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th ed., Prentice-Hall of India Limited, New Delhi, 1992.
2. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., 1997.
3. V. K. Ahluwalia, Organic Reaction Mechanism, Ane Books Pvt. Ltd, 2007.
4. I. L. Finar, Organic Chemistry, Vol-1, 6th ed., Pearson Education Asia. 2004.
5. I. L. Finar, Organic Chemistry, Vol-2, 6th ed., Pearson Education Asia. 2004.
6. J. March and M Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2001.
7. O. P. Agarwal, Chemistry of Organic Natural Products,Vol 1 and 2, Goel Pub. House, 2002.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1603 | PHYSICAL CHEMISTRY II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concepts of electrode potential in laws of thermodynamics.
- To study the order, rate and temperature dependence on reaction rate.
- To learn the principles of physical photochemical processes and phase rule.

**UNIT 1 THERMODYNAMICS III 9 Hrs.**

Partial molar quantities – Chemical potential – Variation of chemical potential with T, P and X (mole fraction) – Gibb's–Duhem equation. Duhem-Margules equation-Van't Hoff's reaction isotherm – Van't Hoff's isochore – Clapeyron equation and Clausius – Clapeyron equation – Applications – Third Law of Thermodynamics: Nernst heart theorem – Statement of III law and concept of residual entropy.

**UNIT 2 ELECTROCHEMISTRY II 9 Hrs.**

Galvanic cells – Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement computation of E.M.F. Application of Gibbs Helmholtz equation. Concentration of E.M.F. Nernst equation. Types of reversible electrodes – Gas/metal ion-metal/metal ion; metal/insoluble salt/anion and Redox electrodes. Electrode reactions – Nernst equation – Derivation of cell. E.M.F. and single electrode potential standard hydrogen electrode – reference electrodes – standard electrodes potentials – sign convention – Electrochemical series and its significance. Concentration cell with and without transport. Liquid junction potential. Application of EMF concentration cells. Valency of ion, solubility product and activity co-efficient. Potentiometric titrations. Determination of pH using Hydrogen, quinhydrone and glass electrodes.

**UNIT 3 CHEMICAL KINETICS II 9 Hrs.**

Effect of temperature on reaction rate- concept of activation energy, energy barrier, Arrhenius equation. Theories of reaction rates- collision theory- derivation of rate constant of bimolecular reaction- failure of collision theory- Lindemann's theory of unimolecular reaction. Theory of absolute reaction rates – derivation of rate constant for a bimolecular reaction- significance of entropy and free energy of activation. Comparison of collision theory and absolute reaction rate theory (ARRT).

**UNIT 4 PHOTOCHEMISTRY 9 Hrs.**

Comparison between thermal and photochemical reactions-Laws of photo chemistry – Lambert-Beer's law-Grothus-Draper and Stark – Einstein. Quantum efficiency. Consequences of light absorption-Jablonski diagram- radiative and non-radiative transitions. Photosensitization and quenching. Fluorescence, phosphorescence and chemiluminescence. Laser and uses of lasers. Kinetics of $H_2$-$Cl_2$, $H_2$-$Br_2$ and $H_2$-$I_2$ reactions, comparison between thermal and photochemical reactions.

**UNIT 5 PHASE CHANGES 9 Hrs.**

Definitions of terms in the Gibb's phase rule- derivation and application to one component system – water and sulphur- supercooling, sublimation. Two-component systems-Classification of two component systems-Thermal analysis-simple eutectic system (lead-silver, bismuth-cadmium), de-silverisation of lead. Compound formation with congruent melting point (Mg-Zn) and incongruent melting point (Na-K). Solid solutions (Ag-Au)-fractional crystallization, freezing mixtures- $FeCl_3$-$H_2O$ systems, $CuSO_4$-$H_2O$ system.

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Apply the chemical potential concept in the formulation of different thermodynamic equations.
**CO2 -** Examine the concept of electrode potential for application in electrochemical cells.
**CO3 -** Apply the concept of activation energy to the temperature dependence on reaction rate of a chemical reaction.
**CO4 -** Examine the various kinetics concepts involved in the photochemical reactions.
**CO5 -** Apply the phase rule to alloy systems for optimizing mechanical and thermal properties.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCE BOOKS

1. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Vishal Publishing Co, 48th edition, 2020.
2. ArunBahl, B. S. Bahl and G. D. Tuli, Essentials of Physical Chemistry, S. Chand publishing, 2012
3. P.W. Atkins, *Physical Chemistry*, 7th ed., Oxford university press, 2001.
4. Glasston & Lewis, Physical Chemistry, 2nd Edition, McMillan publishers, 1973
5. A.S. Negi and S. C. Anand, A Textbook of Physical Chemistry, New Age International, 2004

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| S03BPROJ | PROJECT WORK | L | T | P | EL | Credits | Max. Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 36 | 12 | 100 |

**OBJECTIVES**

- To make the student to understand and present a research finding on a topic in the subject related to Chemistry under the guidance of a department staff.

**PROJECT REPORT: 60 Marks**

Literature review
Problem Identification
Experimental / Results and Discussion
Originality, Technical and logical development
Summary and references

**VIVA-VOCE: 40 Marks**

Communication
Presentation using Teaching aids
Language and diction
Interpretation of Technical data

| SCYB5101 | ORGANIC REACTIONS AND REAGENTS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn the various types of bonding and conjugation in organic compounds.
- To apply the concept of Huckel rule to determine the aromaticity of compounds.
- To understand the mechanism of nucleophilic and electrophilic substitution reactions.

**UNIT 1 NATURE OF BONDING IN ORGANIC MOLECULES 12 Hrs.**

Nature of Bonding in Organic Molecules, Delocalized chemical bonding – Conjugation, cross-conjugation, hyperconjugation and hydrogen bonding. Aromaticity. Benzenoid and nonbenzenoid compounds. Huckel and Craig rules. Application of Huckel's rule for annulenes, heteroannulenes, fullerenes, cyclopropenium cation, cyclopentadienyl anion, cycloheptadienyl cation, Homo-and antiaromaticity, Ψ-aromaticity Energy levels of $\pi$ molecular orbitals, FMO approach.

**UNIT 2 SUBSTITUTION REACTIONS 12 Hrs.**

Aliphatic Nucleophilic substitution: Types of nucleophiles – attacking nucleophile, ambident nucleophiles, hard and soft Nucleophiles. $S_N1$, $S_N2$ and $S_Ni$ mechanisms. Neighbouring group participation, anchimeric assistance. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon. Nucleophilicity and solvent effects, Competition between nucleophilicity and basicity, leaving group effects, steric substituent effects on substitution.

Aliphatic Electrophilic substitution**:** Mechanisms - $S_E2$ and $S_Ei$, $S_E1$, Substitution by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Aromatic Electrophilic Substitution reactions - The arenium ion mechanism, orientation and reactivity, Ortho/para ratio, ipso attack, orientation in naphthalene ring systems. Diazonium coupling, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution: Mechanisms: $S_NAr$, $S_N1$ mechanisms. - Reactivity, Effect of structure, leaving group and attacking nucleophile. Typical reactions: O and S-nucleophiles, Bucherer reaction and Rosenmund reduction and Smiles rearrangements.

**UNIT 3 ADDITION AND ELIMINATION REACTIONS 12 Hrs.**

Addition to C-C Multiple Bond**:** Mechanism of addition of HX (X=Halo, OH) to alkenes and alkynes – Micheal addition Addition to Carbon-Hetero Atoms Multiple Bonds **–**Nucleophilic addition of carbonyl compounds. Addition - Elimination Reactions of Ketones and Aldehydes, Reactivity of carbonyl compounds towards Addition. Elimination Reactions: EI, E1CB and E2 mechanism, Syn elimination, Orientation Effects in Elimination. Reactions - Pyrolytic eliminations, Chugaev reaction.

**UNIT 4 OXIDATION REAGENTS 12 Hrs.**

Oxidation reagents: Potassium permanganate, $HIO_4$, $OsO_4$, $MnO_2$ – Alcohol to carbonyls: Cr (VI) oxidants, PCC, PDC, Jone's Reagent, 1,3-dithiane – Swern oxidation, Silver carbonate, Prevost and Woodward oxidation, Oxidation of allylic – C-H bonds: DDQ, $SeO_2$.

Reducing reagents: LAH, $NaBH_4$, DIBAL, Red Aluminium, Electrophilic metal hydrides: $BH_3$, $AlH_3$. Functional group transformations: Use of organo-lithium compounds – Lithium diisopropyl amide (LDA)

Protecting groups – Protection of hydroxyl, carboxylic acid, amine and carbonyl compounds by protecting groups.

**UNIT 5 ORGANO METALLIC REAGENTS 12 Hrs.**

Organo magnesium reagents, organo-lithium, Organo Zinc reagents, Organo cadmium Reagents, Organo Copper reagents, Organo Lead reagents, Organo silicon compounds. Tri-N-butyltinhydride

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the nature of bonding,conjugation, aromaticity, anti-aromaticity and non-aromaticity in organic molecules

**CO2 -** Formulate the mechanism of aliphatic nucleophilic and electrophilic substitution reactions.

**CO3 -** Evaluate the mechanism of aromatic nucleophilic and electrophilic substitutions reactions.

**CO4 -** Illustrate the mechanism of addition and elimination reactions.

**CO5 -** Interpret the products in organic chemical reactions involving oxidizing and reducing reagents.

**CO6 -** Predict the products in organic reactions.

**TEXT / REFERENCE BOOKS**

1. March J., and Smith M., Advanced Organic Chemistry, 5th Edition, John-Wiley and Son, 2001.
2. Gould E. S., Mechanism and Structure in Organic Chemistry Holt, Rinehart and Winston Inc., 1959.
3. Carey A. Francis, and Sundberg J Richard., Part A and Part B Advanced Organic chemistry, 5th edition, Springer, 2007.
4. Jonathan Clayden, Nick Greeves and Stuart Warren., Organic Chemstry, 2nd Edition, Oxford Publishers, 2012.
5. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
6. House H.O., Modern Synthetic Reactions, W.A. Benjamin Inc, 1972.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100 Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5102 | COORDINATION CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To know the nature of metal-ligand bonding in coordination compounds and quantification of the bonding parameters.
- Learn the various bonding theories in coordination chemistry and their application in understanding spectra and magnetism.
- Understand Reaction Mechanism and interpret the spectrum of the metal complexes Coordination Chemistry.

**UNIT 1 THEORIES OF COORDINATION COMPOUNDS I 12 Hrs.**

Introduction to Werner's Coordination theory and its postulates, Defects of Werner's theory, Problems based on Werner's theory, Sidgwick's electronic concept of coordination, EAN rule, Defects of Sidgwick's theory, problems based on Sidgwick's theory. Valence bond theory, Spin-only magnetic moment, Hybridization schemes for the bonding frameworks of different geometrical configurations of ligand donor atoms, Defects of the VBT. Problems based on VBT.

Isomerism in coordination complexes - Optical isomerism in coordination complexes. Circular dichroism and optical rotatory dispersion. Racemization in coordination complexes: Ray-Dutt twist and Bailor twist mechanisms. HSAB-principle.

**UNIT 2 THEORIES OF COORDINATION COMPOUNDS II 12 Hrs.**

Crystal Field Theory and its postulates, shapes of d-orbitals, crystal field splitting of d-orbitals in different geometries like octahedral – Square planar – Square pyramidal – Trigonal bipyramidal-Pentagonal bipyramidal, Square antiprismatic and tetrahedral complexes. Measurement of 10Dq. Factors affecting the magnitude of 10 Dq. Determination of CFSE, consequences of CF splitting, calculations of crystal field stabilisation energy for $d^1$ to $d^{10}$ Oh systems – Pairing energy – Low-spin and high-spin complexes and magnetic properties. Effect of ligand field on color of the complexes, Jahn-Teller distortions and its consequences with copper system as example. Limitations of crystal field theory. Molecular orbital MO diagrams with and without metal–ligand π bonding in an octahedral and tetrahedral complex.

**UNIT 3 SPECTRAL AND MAGNETIC PROPERTIES OF COORDINATION COMPOUNDS 12 Hrs.**

Introduction, types of absorption spectra, Quantum numbers, Spin-spin coupling, orbit-orbit coupling, spin-orbit coupling, Ground state term Symbols for $d^{1-10}$ electron systems, selection rules for electronic transitions in complexes, spin selection rule, Laporte selection rule, Micro states, Correlation diagrams – Orgel and Tanabe –Sugano diagrams for Oh complexes, The nephelauxetic effect, Racah parameters, Electronic spectrum of $d^{1-10}$ systems of Oh and Td complexes, Charge transfer spectra of L to M and vice versa. Magnetic properties of metal complexes and spin only formula, determination of magnetic susceptibility – Gouy method, spin and orbital contribution to magnetic moments, The effects of temperature on $\mu_{eff}$, and spin crossover.

**UNIT 4 REACTIONS MECHANISMS OF COORDINATION COMPOUNDS 12 Hrs.**

Labile and Inert complexes, VBT explanations of lability and Inertness, Ligand substitution reaction, $SN^1$ – Dissociative mechanism, $SN^2$ – Associative mechanism, $SN^1$ Conjugate base mechanism anation reaction, electron transfer reactions, Outer-sphere – Tunnelling mechanism, Inner-sphere mechanism, Isomerisation reactions –involving Geometrical and optical isomers. Substitution reaction

in square planar complexes, Trans effect series, applications of trans effect. Problems based on Trans effect.

**UNIT 5 STABILITY OF COORDINATION COMPOUNDS 12 Hrs.**

Thermodynamic stability and kinetic stability, step-wise stability constants and overall stability constants and its relationship, trend in K values, Irving – Williams series, Factors affecting the stability of coordination compounds – Charge and size of central metal ion, Nature of ligand, Basicity and chelating ability of the ligands, steric effect, stereochemical requirements of ligands. Determination of stability constants – solubility method, Ion-exchange method, electrochemical method, spectrophotometric method.

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the structure, isomerism and bonding in coordination complexes.
**CO2 -** Deduce the crystal field splitting diagram for different geometries.
**CO3 -** Characterize the electronic spectra of metal complexes based on correlations diagrams.
**CO4 -** Evaluate the mechanistic pathway of metal complexes.
**CO5 -** Determine the stability of metal complexes using conventional methods.
**CO6 -** Interpret the spectrum of different metal complexes with different geometries.

**TEXT / REFERENCE BOOKS**

1. Catherine E.House Croft and Alan G.Sharpe, Inorganic Chemistry, Pearson, 5th Edition, 2012.
2. Gopalan R., Ramalingam V., Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd.,2017.
3. Huheey J. E., Keiter E. A., and Keiter R. L., Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education, 2006.
4. Atkins P. W., Overton T., Rourke J., Weller M., and Armstrong F., Shriver & Atkins: Inorganic Chemistry, 4th Edition, Oxford University Press, 2006.
5. Cotton F. A., Wilkinson G., Murillo C. A., and Bochmann M., Advanced Inorganic Chemistry, 6th Edition, Wiley, 1999.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100 Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5103 | THERMODYNAMICS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To construct second law of thermodynamics, concept of entropy and Carnot cycle.
- To understand the partition function for distinguishable and indistinguishable molecules.
- To learn the Onsager theory and applications of irreversible thermodynamics to biological and non-linear systems.

**UNIT 1 CLASSICAL THERMODYNAMICS I 12 Hrs.**

Need for the second law – Concept of entropy – Carnot cycle – Gibbs function – Gibbs – Helmholtz equation – Clausius – Clapeyron equation – Thermodynamics of systems of variable compositions – Partial molar quantities, partial molar volume – Chemical potential, Gibbs – Duhem equation –Third law of thermodynamics. Ellingham diagram and its significance.

**UNIT 2 CLASSICAL THERMODYNAMICS II 12 Hrs.**

Thermodynamics of real gases and real solutions: Fugacity: Methods of determination. Dependence on temperature, pressure and composition. Activity and activity coefficient – Determination of activity and activity coefficient of non-electrolytes and electrolytes. Solubility of ionic solids in water – Solubility curves – Ternary system involving water and two soluble ionic solids – Formation of double salts.

**UNIT 3 STATISTICAL THERMODYNAMICS I 12 Hrs.**

Phase space – Ensembles: Different types of ensembles – Micro canonical, canonical and grand canonical – Distinguishable and indistinguishable molecules – Maxwel-Boltzmann statistic – Partition function and thermodynamic functions – Separation of partition function – Translational, rotational, vibrational and electronic partition functions. Statistical approach to thermodynamic properties - Internal energy, entropy, enthalpy, Helmholtz function, pressure, Gibbs function, residual entropy, equilibrium constant.

**UNIT 4 STATISTICAL THERMODYNAMICS II 12 Hrs.**

Quantum Statistics Bose-Einstein statistics – Fermi-Dirac statistics – Free energy function Heat capacity of mono and diatomic gases. Ortho- and para hydrogen and mixture of the two viz., ortho $H_2$ and para $H_2$ – Heat capacity of solids – Einstein and Debye models – Sackur-Tetrode equation.

**UNIT 5 NON EQUILIBRIUM THERMODYNAMICS 12 Hrs.**

Near equilibrium process: General theory – Conservation of mass and energy – Entropy production in open system by (i) heat (ii) matter and (iii) current flow – Onsager theory: Validity and verification – Application of irreversible thermodynamics to biological and non-linear systems.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Construct the Second law of thermodynamics for explaining the concept of entropy and to derive Carnot cycle and various Gibbs functions.

**CO2 -** Determine the methods for fugacity, activity and activity coefficient of electrolytes and non-electrolytes.

**CO3 -** Derive the various partition functions in statistical approach.

**CO4 -** Discuss the Bose-Einstein and Fermi-Dirac statistics and heat capacity of solids.

**CO5 -** Explain the conservation of mass and energy and entropy production in open systems.

**CO6 -** Discuss the Onsager theory validity and verification.

## TEXT / REFERENCE BOOKS

1. P. R. Rastogi and R. R Misra, An Introduction to Chemical Thermodynamics, 6th Revised Edition, Vikas Publishing House Ltd., 2009.
2. P. W. Atkins, Physical Chemistry, Oxford University Press, 1978.
3. S. Glasstone, Thermodynamics for Chemists, Affiliated East-West Press, 1974.
4. I. M.Klotz and R. M. Rosenberg, Chemical Thermodynamics: Basic Theory and Methods, 18th Edition, Benjamin/Cummings Pub. Co., 1986.
5. R. P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing House Ltd.,1990.
6. J. Rajaram and J. C. Kuriakose, Thermodynamics, 3rd Edition, S. Chand & Co., 1999.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5104 | ANALYTICAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To study the concepts of various spectrometric analytical techniques
- To gain knowledge about working principle of separation & electroanalytical techniques
- To understand the basic concepts of TGA/DSC as thermal methods of analysis

**UNIT 1 ABSORPTION SPECTROSCOPY 12 Hrs.**

Atomic absorption spectroscopy - Theory, instrumentation (flame and flameless atomization), Interferences - spectral and chemical - determination of calcium and magnesium in water, estimation of tin in canned food, applications of AAS, Flame Spectrometry - Principle, instrumentation and interferences, determination of alkali metals, applications.

**UNIT 2 CHROMATOGRAPHIC TECHNIQUES 12 Hrs.**

General aspects of Chromatography - Gas chromatography: Principle – Types – nature and selection of stationary and mobile phases – solid supports – sampling methods - instrumentation – Detectors: FID – TCD and ECD – qualitative and quantitative applications of GC-MS - Liquid Chromatography: Types – Applications - HPLC: Principle – Theory and equipments – types of pumps and their choice – types of columns – choice of column materials – detectors and applications. Electrophoresis: Principle – Instrumentation – Capillary and Gel electrophoresis.

**UNIT 3 THERMAL METHODS OF ANALYSIS 12 Hrs.**

Introduction: TG and DTG – Instrumentation – Thermogram – Factors affecting thermograms – Thermal decomposition study of $CaC_2O_4.H_2O$ and $CuSO_4.5H_2O$ - Applications of thermogravimetry. Differential thermal analysis: Theory – DTA curves – Factors affecting DTA curves – Instrumentation – Applications of DTA - Correlation of DTA and TGA data with examples –– DSC: Principle – Instrumentation - Applications of DSC.

**UNIT 4 ELECTROANALYTICAL METHODS 12 Hrs.**

Electrogravimetry: Theory – electronegativity – order of deposition – over potential – polarization curves – constant potential and consecutive deposition – selective deposition – constant current deposition and deposition of complex ions - estimation of copper. Coulometry: Principle, Faraday's laws – types of coulometers – coulometric titrations – internal and external generation – coulogravimetry and applications.

Potentiometry: Principle, standard and formal potemtials – types of electrodes – Glass membrane and ion-selective electrodes - potentiometric titration based on $Fe^{2+}$ - $Ce^{4+}$ system - Biochemical electrodes.

**UNIT 5 SPECTROMETRY 12 Hrs.**

Spectrophotometry: Introduction - Beer Lambert's law - significance of molar extinction coefficient, UV-visible spectrophotometry -photometric titration – Determination Fe(III) involving EDTA as ligand, determination of Fe (III) in the presence of aluminium.

Turbidimetry and Nephelometry: Principle - instrumentation - applications

Fluorimetry: Principles of fluorescence - factors affecting fluorescence emission - instrumentation - applications.

## COURSE OUTCOME

On successful completion of the course, student will be able to

**CO1 -** Explain the principle, instrumentation and working of AAS and Flame photometry.
**CO2 -** Understand the basic concepts of Chromatographic techniques.
**CO3 -** Analysis and interpretation of TGA/DSC curves
**CO4 -** Understand the basic principles and interpretations of electroanalytical techniques.
**CO5 -** Apply the principles of Beer's law for the determination of ions.
**CO6 -** Understand the basic concepts of analytical techniques

## TEXT / REFERENCE BOOKS

1. J. M. Hollas, Modern Spectroscopy, John Wiley & sons, 4th Edition, 2004.
2. H. H. Willard, L. L. Merritt, J. A. Dean and A. F. Settle, Instrumental methods of analysis, 6th Edition, Van Nostrand, 1984.
3. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, Wadsworth Publishing Co. Inc., 9th Edition, 2012.
4. R. D. Braun, Introduction to Instrumental Analysis, McGraw-Hill, 1987.
5. J. H. Kennedy, Analytical Chemistry Principles, Saunders College Publishing, New York, II Edition,1990.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5105 | QUANTUM CHEMISTRY AND GROUP THEORY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the physical and mathematical aspects of quantum mechanics
- To study the concepts of quantum chemistry of particle in 1D & 3D box, SHO and rigid rotor
- To apply the various approximation methods to Hydrogen molecule ion and Helium atom

**UNIT 1 BASICS OF QUANTUM MECHANICS 12 Hrs.**

Black-body radiation – Planck's law of radiation – Photoelectric effect – Compton effect – wave particle duality – de-Broglie's hypothesis – Heisenberg's uncertainty principle – Bohr's theory and its limitations – Classical waves and wave equation for electrons. Operators – Linear operators, Commutator algebra – Evaluation of commutators, Hermitian operators and its properties – Eigen value and Eigen function – Momentum – Hamiltonian operator – Postulates of quantum mechanics.

Case Study:

a) Prove that if two operators A and B are Hermitian, then their product (AB) is also Hermitian if and only if A and B commute.

b) Show that the operator Px for linear momentum is Hermitian.

**UNIT 2 APPLICATION OF QUANTUM MECHANICS 12 Hrs.**

Derivation of Schrodinger wave equation – Orthogonality and normalization of wave functions – Characteristics of wave function. Application of SWE to free particle, particle in one dimensional box and three-dimensional box – Simple harmonic oscillator – Rigid rotor – ladder operator – Angular momentum operator. Schrodinger equation for hydrogen atom– Significance of quantum numbers – shapes of atomic orbitals – spin angular momentum.

Case Study:

a) Calculate the energy of 3D box of length $L_x=L_y=L_z$ = L(say) and when the length of $L_x$ is increased to $L_x$+dx for a distorted 3D box.

b) If Ψ1 and Ψ2 be two normalized eigen functions corresponding to two eigenvalues E1 and E2 of particle in 1D box show that they are orthogonal to each other.

**UNIT 3 APPROXIMATION METHODS 12 Hrs.**

Need for approximation methods – Approximation methods - perturbation and variation methods and their application to Helium atom – Born - Oppenheimer approximation – Hydrogen molecule ion – Huckel-π-electron theory and its applications to ethylene and butadiene.

Case Study:

a) Apply the Huckel-π-electron theory to deduce the energy of benzene molecule.

b) Apply the variation method to deduce the trial wavefunction and energy of hydrogen atom

**UNIT 4 GROUP THEORY 12 Hrs.**

Group and Subgroup –Symmetry elements and operations – Determination of point groups of representative molecules/complexes - Symmetry point groups – Vector and matrix algebra – Matrix representation of Symmetry operations – Reducible and irreducible representations – Great orthogonality theorem – Characters – Construction of a character tables– $C_{2V}$, $C_{3V}$, $C_{2h}$.

Case Study:

a) Identify the symmetry elements in the following molecules: $PCl_5$, $SF_6$, $CH_3Cl$, $CH_2Cl_2$ (Cis), $C_6H_6$, $H_2$, $CO_2$, $CCl_4$, $CH_2Cl_2$ (trans), $[Pt(NH_3)_4]^{2+}$

b) Identify the symmetry elements of ethene molecule and deduce the point group, irreducible representations and construct the character table of it using Orthogonality theorem.

**UNIT 5 APPLICATION OF GROUP THEORY 12 Hrs.**

Determination of representation of vibrational modes in non- linear molecules such as $H_2O$, $CH_4$ and $NH_3$ – symmetry of Hybrid orbitals in non- linear molecule ($H_2O$, $NH_3$) – Symmetry selection rules of infra-red and Raman spectra – application of group theory for the electronic spectra of formaldehyde.

Case Study:

a) Deduce the symmetry of molecular orbitals and electronic states of ethylene molecule and formulate the electronic transitions in ethylene molecule using Group theory.

b) Determine the hybridization involved in $BF_3$ and $CH_4$ molecules using Group theory.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Apply the quantum mechanical treatment to derive the various quantum mechanical operators.
**CO2 -** Determine the wave function and energy of quantum mechanical systems.
**CO3 -** Apply the Approximation methods to energy calculations in multi-electron systems.
**CO4 -** Construct the character table of point groups of molecules using the Great Orthogonality theorem
**CO5 -** Demonstrate the hybridization of molecules using symmetry of hybrid orbitals.
**CO6 -** Evaluate the Vibrational modes of molecules in IR and Raman spectra of molecules.

**TEXT / REFERENCE BOOKS**

1. A. K. Chandra, Introductory Quantum Chemistry, Tata Mc Graw Hill Publishing Co., 4th Edition 1994.
2. R. K. Prasad, Quantum Chemistry, New Age International Publishers, Revised 3rd Edition, 2006.
3. H. L. Strauss, Quantum Mechanics, Prentice Hall, 1972.
4. P. W. Atkins and R. S. Friedman, Molecular Quantum Mechanics, Oxford University Press, 5th Edition, 2010.
5. H. Eyring, J. Walter and G. E. Kimball, Quantum Chemistry, John Wiley & Sons, 1944
6. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 3rd Edition, 1999.
7. K. V. Raman, Group Theory and its Applications to Chemistry, Tata McGraw-Hill, 3rd Edition, 1990.
8. V. Ramakrishnan and Gopinath, Group Theory in Chemistry, Vishal Publications, 2nd Edition 2013.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100 Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB6101 | PHYSICAL CHEMISTRY LAB I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 0 | 2 | 100 |

**COURSE OBJECTIVES:**

- To know about the practical applications of UV-Visible and fluroscence spectrophotometer.
- To understand the construction binary and ternary phase diagrams.
- To gain practical knowledge in electroanalytical techniques.

**The list of probable experiments is mentioned below, which delineates the experiment to be performed in a semester. Any seven experiments can be selected from the list.**

**List of Experiments**

1. Study of Solvatochromism effect of coumarin.
2. Verification of Ostwald dilution law and determination of dissociation constant of weak acids.
3. Solubility curves and phase diagram for a ternary system (e.g. Chloroform-acetic acid-water, ethanol-benzene-water, ethanol-ethylacetate- water, acetic acid-benzene-water).
4. Study of Redox reactions for understanding the reversibility of the reaction using cyclic voltammetry.
5. Determination of the PI of an amino acid using pH meter.
6. Determination of Stern-Volmer constant of an Iodine quenching reaction by fluorimetric method.
7. Determination of the formation constant of iron(III) salicylate complex (UV spectroscopy).
8. Verification of the Freundlich and Langmuir adsorption isotherms for adsorption of acetic acid/oxalic acid on activated charcoal.
9. Determination of relative viscosities of given organic liquids.
10. Potentiometric filtration of a solution of chloride ion with a solution of silver nitrate.
11. Determination of Cell constant - conductometry.

**COURSE OUTCOME**

**CO1 -** Estimation of the equilibrium constant using distribution coefficient.
**CO2 -** Acquire the knowledge of uv-visible and fluroscence spectrophotometer.
**CO3 -** Interpretation and construction of phase diagram of binary system and ternary system.
**CO4 -** Elucidation of practical knowledge of cyclic voltammetry.
**CO5 -** Execution of relative viscosities of given organic liquids.
**CO6 -** Determination of Cell constant.

**TEXT / REFERENCE BOOKS**

1. Carl Garland, Joseph Nibler and Schoemaker, Experiments in Physical Chemistry, Mcgraw-Hill College, 7th Edition, 2003.
2. D.V. Jahagirdan, Experiments in Chemistry, Himalaya Publishers House, 2003.
3. Arthuer, Halpem and George McBane, Experimental Physical Chemistry, Freeman, 2006.
4. Yadav, Advanced Practical Physical Chemistry, Goel Pub, 1994.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | **25 Marks** | **50 Marks** |
| | Model practical exam | **25 Marks** | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB6102 | INORGANIC CHEMISTRY LAB I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To improve the skill in quantitative estimation of metal ions.
- To identify the methodology for the quantitative separation and estimation of mixture of metal ions.
- To improve the skill in preparation of metal complexes in good yield under suitable conditions with appropriate starting materials.

**COURSE CONTENTS**

**ESTIMATION**

Estimation of Cu-Zn
Estimation of Fe-Mg
Estimation of Fe-Ni
Estimation of Cu-Ni

**PREPARATION OF COMPLEXES**

Thiourea copper(I)sulphate
Dioxalato diaquachromate(III)
Tris (thiourea)copper(I)chloride
Hexamine nickel(II)chloride
Bis (acetylacetonato) copper(II)sulphate

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Quantitatively estimate metal ions in the presence of other ions by titration and gravimetric methods.
**CO2 -** Identify the qualitative method for the quantitative separation of metal ions from a mixture of metal ions.
**CO3 -** Develop skill in preparation of inorganic metal complexes by the selection of suitable starting materials in good percentage yield.
**CO4 -** Understand the mechanism and structural details of the prepared complexes.
**CO5 -** Characterization of some of the prepared complexes by spectroscopic analysis.
**CO6 -** Assessment of purity of the prepared complexes from the spectroscopic data.

**TEXT / REFERENCE BOOKS**

1. Jeffery G. H., Bassett J., Mendham J., and Denney R. C.,, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearsons Education, 2004.
2. Kolthoff I. M., and Sandell E. B., Text Book of Qualitative Inorganic Analysis, 3rd Edition, The Macmillan Company; 1956.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB5201 | CHEMISTRY OF THE MAIN GROUP ELEMENTS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To study the structure and bonding in polyhedral boranes
- To understand the chemistry of Silicon, Sulphur, Phosphorus and F-block elements
- To discuss the synthesis and reactivity of organometallic reagents and macrocycles.

**UNIT 1 CHEMISTRY OF BORANES 12 Hrs.**

Structure and bonding in boranes and boron cage compounds- Closo, nido, arachno and carboranes – Styx notation – Wade's rule – Electron count in polyhedral boranes – Synthesis of polyhedral boranes – Isolobal analogy between main group and transition metal fragments– Boron halides – Phosphine-Boron heterocycles – Borazine.

**UNIT 2 NON-TRANSITION METAL CHEMISTRY 12 Hrs.**

Silanes, silicon halides, silicates, germenes and stannenes – Phosphorous halides, oxyacids of phosphorous, phosphazenes – Sulphur halides, oxo acids of sulphur – Structural features and reactivity of reactivity of S-N heterocycles.

Interhalogen compounds: Structure and properties of interhalogen compounds [ClF, ICl, $ClF_3$, $BrF_3$, $IF_3$, $ClF_5$, $BrF_5$, $IF_5$] poly halides - pseudohalogens [cyanide, thiocyanate and azide] and Xenon compounds.

**UNIT 3 ORGANOMETALLIC REAGENTS AND MACROCYCLES 12 Hrs.**

Synthesis and reactivity of organo-lithium, beryllium and magnesium compounds.

Macrocyclic Ligands: Calixarenes, cryptands and crown ethers-structure and applications in complexation chemistry.

**UNIT 4 ORGANYLS 12 Hrs.**

Preparation and reactivity of aluminium organyls – Carbalumination, hydroalumination – Chemistry of Ga(I) and In(I) – Reduction of Al, Ga and In organyls – Germanium, tin and lead organyls.

**UNIT 5 LANTHANIDES AND ACTINIDES 12 Hrs.**

Lanthanides: Lanthanide series, abundance and natural isotopes - lanthanide contraction, similarity in properties, occurrence, oxidation states - chemical properties of Ln(III) cations - magnetic properties, colour and electronic spectra of lanthanide compounds - separation of lanthanides, solvent extraction, ion exchange method.

Actinides: actinide series, abundance and natural isotopes, occurrence, preparation of actinides - oxidation states - general properties, the later actinide elements, uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides - complexes of lanthanides and actinides - term symbols.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able,

**CO1 -** To explain the structure and bonding in polyhedral boranes and borazines and the concept of Styx notation, Wade's rule.

**CO2 -** To discuss the structural features and reactivity of Silicon, Sulphur, Phosphorous and S-N heterocycles.

**CO3 -** To determine the synthesis and reactivity of organo lithium,Be and Mg compounds and complexation in calixarines, cryptand and crown ethers.

**CO4 -** To illustrate the preparation and properties of various organyls and its reduction reactions.

**CO5 -** To discuss the magnetic and optical properties of lanthanides and actinides.
**CO6 -** To determine the coordination chemistry of lanthanides and actinides and its applications.

**TEXT / REFERENCE BOOKS**

1. D. F. Shriver, P. W. Atkins and C.H. Langford, Inorganic Chemistry, Oxford University Press, 1990.
2. J. E. Huheey, E. A. Keiter and R. I. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education, 2004.
3. F. A. Carey, G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Interscience, 2003.
4. C. E. Housecroft and A. G. Sharpe, Inorganic Chemistry, Prentice Hall, 2005.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5202 | CHEMICAL KINETICS AND CATALYSIS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To evaluate the use of chemical kinetics in understanding reaction mechanisms.
- To estimate the kinetics of fast reactions and effect of temperature on the rate of reaction
- To compile the learners to understand the importance and significance of heterogeneous catalysis.

**UNIT 1 ADVANCED CHEMICAL KINETICS 12 Hrs.**

Thermodynamic formulation of activated complex theory – Theories of unimolecular reactions: Lindemann mechanism – Hinshelwood mechanism RRKM and Slater treatment, Application of absolute reaction rate theory (ARRT) to simple bimolecular process, chain reactions, general characteristics, study of kinetics of chain reaction in inorganic reactions (ozone decomposition, $H_2$-$Br_2$ reaction), organic reactions (decomposition of acetaldehyde and $N_2O_5$), and explosive reactions ($H_2$- $O_2$). Determination of reaction mechanisms for Hypochlorite-iodide, Acetone-Iodine, CO - $Cl_2$, ethylene - hydrogen.

**CASE STUDY:**

Analyse and demonstrate the order of the reaction between $NO_2$-$F_2$ & Ammonium Cyanate-Urea

**UNIT 2 KINETICS IN SOLUTION AND FAST REACTIONS 12 Hrs.**

Solvent effects on reaction rates - cage effect, factors determining the reaction rates in solution (based on transition state theory) - reactions between ions - ion-dipole and dipole – dipole reactions - primary and secondary salt effects. Kinetic isotope effects-linear free energy relationships-Hammett and Taft equations.

Fast reactions: Chemical relaxation methods in two step and multi-step synthesis - Temperature and pressure jump methods – electrical field jump method- Reactions in flow systems: Continuous and Stopped flow methods – Shock tube methods – Laser Flash photolysis – Ultrasonic absorption technique - Diffusion controlled reactions - fluorescence quenching - electrochemical methods

**CASE STUDY:**

Determine the exchange rate of methyl proton in the fast reaction of Proton exchange between N,N-dimethylacetamide and solvent.

**UNIT 3 KINETICS IN THE EXCITED STATE 12 Hrs.**

Jablonski diagram - Kinetics of Unimolecular and bimolecular photophysical and photochemical processes - Quantum yield calculation - Excited state lifetime-quenching constant - Resonance energy transfer rates (RET) - Rate and efficiency of RET - Dynamics of electron transfer - Solvent re-organization energy - Marcus theory of electron transfer - Free energy and rate relation - RehmWeller behaviour - Marcus Inverted Region

**CASE STUDY:**

a) Examine and elaborate the theoretical investigation of ground and excited state transition in coumarin based dye in vitamin K.

b) Assuming that the equilibrium constant for the reaction is about 100 (favoring the product) and roughly independent of temperature over this range, what is the reorganization energy for this reaction (assume $\Delta G = \Delta G^0$ for this reaction).

**UNIT 4 ADSORPTION 12 Hrs.**

Adsorption isotherms: Types of adsorption isotherm – Langmuir theory of unimolecular layer adsorption isotherm – The BET theory of multimolecular layer isotherm – Determination of surface area of adsorbents – The Gibbs adsorption isotherm equation – Surfactants: Classification of surfactants – Formation of micelles – Critical micelle concentration (CMC) – Thermodynamics of micellization. Emulsions: Hydrophilic-Lipophilic Balance (HLB).

**CASE STUDY:**

a) Explain the surface science concepts like surface area, particle size, porosity in our kitchen materials.

b) Explain the effect of surface area and porosity of talcum powder, char coal, tooth paste

**UNIT 5 CATALYSIS 12 Hrs.**

Definition of Catalysis – Types of catalysis: homogeneous and heterogeneous. Catalytic kinetics: Concept of Langmuir-Hinshelwood – Photocatalysis using semiconducting oxides: Definition, basic principles and mechanism of photocatalysis – Application of photocatalysis in water remediation, air cleaning – Heterogeneous catalysis by intercalation compounds: Structural aspects of graphite intercalation compounds, catalytic reaction – Kinetics of enzyme catalysis – Lineweaver-Burk plot for the determination of Michaelis constant.

**CASE STUDY:**

a) Examine and explain the properties of Sn based catalyst alternate for the heavy metal catalysts in the plastics industry.

b) Analyse the efficiency of highly-active catalysts for the conversion of natural gas to liquid hydrocarbons

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to,

**CO1 -** Examine the thermodynamic and theoretical aspects of chemical kinetics.
**CO2 -** Demonstrate the experimental and theoretical aspects of kinetics of fast reaction techniques.
**CO3 -** Understand the kinetics of polymerization and learn the methods of determination of molecular mass of polymers.
**CO4 -** Analyse the surface chemistry and their kinetics process.
**CO5 -** Determine the importance of surfactants, micelle, and emulsions.
**CO6 -** Formulate the importance of heterogeneous catalysis

**TEXT / REFERENCES BOOKS**

1. K.J. Laidler, “Chemical Kinetics”, 3rd edn. 1987, Harper and Row Publishers. New York
2. J. Rajaram and J.C. Kuriokose, “ Kinetics and Mechanisms of chemical transformation, 1st edn 1993, Macmillan India Ltd,Delhi
3. A.A. Frost and R.G. Pearson, “Kinetics and Mechanism”,(2nd edn), 1963, John Wiley and sons INC.
4. K.K.Rohatgi Mukherjee, “Fundamentals of Photochemistry”, Revised edition 1978, New Age International Publishers, New Delhi.
5. B. Vishwanathan, S. Sivasankar and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004
6. C. Kalidas C, Chemical Kinetic Methods, New Age International, 1996.
7. F. Wilkinson, Chemical Kinetics and Reaction Mechanism, Van Nostrand Reinhold Co., 2000.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5203 | STEREOCHEMISTRY AND ASYMMETRIC SYNTHESIS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To suggest synthetic route for simple organic compounds with stereochemistry
- To understand and appreciate the concept of stereochemistry and reaction mechanism
- To understand the Stereo, Enantio, Regio, Chemo Selective reactions

**UNIT 1 STEREOCHEMISTRY I 12 Hrs.**

Elements of symmetry – Chirality – Representation of organic molecules (Fischer, Sawhorse, Newman and Zig-Zag) and their interconversion – Molecules with more than one chiral centre: Erythro and threo isomers – Optical activity in the absence of chiral carbon – biphenyls, allenes and spiranes – Criteria for optical purity – D and L Notation, Cahn-Ingold-Prelog rules – R and S-notations – Absolute and relative configuration Racemic modifications – Racemisation – Thermal, anion, cation, reversible formation – Resolution of racemic modifications – Epimerisation – Mutarotation.

**UNIT 2 STEREOCHEMISTRY II 12 Hrs.**

Stereospecific synthesis – Stereochemistry of compounds containing nitrogen, sulphur and phosphorus – Conformational analysis: In acyclic systems – Simple 1,2 disubstituted ethane derivatives – In cyclic systems (cyclobutane, cyclopentane, cyclohexane and cycloheptane) – Conformation and reactivity in disubstituted cyclohexanes – Cis and trans decalins – Topicity of ligands and faces – Enantiotopic and diastereotopic atoms – Prochiral centre and pseudoasymmetry –Stereoselective reactions – Cram's rule and Felkin-Ahn's modification – Prelog's rule.

**UNIT 3 STEREO, ENANTIO, REGIO, CHEMO SELECTIVE REACTIONS 12 Hrs.**

Introduction: Enantiomeric excess, Diasteriomeric excess, Enantioselective Reactions: Hydrogenation, Reduction of ketones, Epoxidation of Allylic alcohols, Dihydroxylation of alkenes – Stereo selective and Stereo specific reactions with suitable examples – Hydroboration - Regioselectivity with examples - The Use of acetylenes – Diastereoselectivity - Crams Rule - Chemoselectivity in Oxidizing and Reducing agents, dissolving metal reductions, and Catalytic hydrogenation.

**UNIT 4 ASYMMETRIC SYNTHESIS I 12 Hrs.**

Introduction to Asymmetric Synthesis – General strategies for asymmetric synthesis - ``Chiron'' approaches – Acyclic Diastereoselective approaches – Double asymmetric synthesis – Asymmetric Oxidations: Asymmetric Epoxidation of Allylic Alcohols: Sharpless Epoxidation - Selective opening of 2, 3 epoxy alcohols by metallic hydride and organometallic reagents - Asymmetric Diels Alder Reaction: Intramolecular and Retro Diels Alder Reaction.

**UNIT 5 ASYMMETRIC SYNTHESIS II 12 Hrs.**

Asymmetric Reformatsky Reactions - Double Asymmetric Cycloaddition – Asymmetric aldol reactions – Aldol reactions – Substrate controlled aldol reactions – Reagent controlled aldol reactions – Chiral catalyst controlled aldol reactions – Double Asymmetric aldol reactions – Asymmetric Transfer Hydrogenation - Asymmetric Hydroformylation.

**Max. 60 Hrs.**

## COURSE OUTCOME

On successful completion of the course, student will be able to

**CO1 -** Interconvert the representation and notations for organic molecules.
**CO2 -** Sketch the conformational analysis of acyclic and cyclic systems
**CO3 -** Solve the organic reactions with respect to stereo, enantio, regio and chemoselectivity
**CO4 -** Propose a strategic reaction pathway in synthesizing a chiral product
**CO5 -** Predict the products in asymmetric aldol, hydrogenation reactions, hydroformylation, cycloaddition reactions.
**CO6 -** Design and predict a suitable asymmetric reaction.

## TEXT / REFERENCE BOOKS

1. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 14th Reprint Edition, 1990.
2. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, New Age International Publishers, 8th Edition, 2015.
3. J. March and M. Smith, Advanced Organic Chemistry, John-Wiley and Sons, 7th Edition, 2013.
4. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry Part-A and B, Kluwer Academic/Plenum Publishers, 5th Edition, 2008.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5204 | COMPUTATIONAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concept of computational chemistry built for a simple system.
- To comprehend the concept of Variation theory for Density-Functional theory (DFT)
- To realize the basic construction method of "Density-Functional theory" using quantum mechanics.

**UNIT 1 INTRODUCTION TO COMPUTATIONAL CHEMISTRY 12 Hrs.**

The promise of computational chemistry, potential energy surfaces, computational strategies-coordinate systems, geometry optimization, local and global minima, conformational analysis, transition state optimization, saddle point, vibrational frequencies.

*Case study: Predict the local and global minima of benzene molecule using structural and energy values.*

**UNIT 2 COMPUTATIONAL CHEMISTRY METHODS 12 Hrs.**

Molecular Mechanics-Force field methods, Semi-empirical methods, Variational method, Roothaan-Hall equations, self-consistent field approach, electron spin and Pauli principle and Slater determinants.

*Case study: Derivation of Schrodinger equation for $H_2$ molecule by molecular mechanics and variational method.*

**UNIT 3 THE QUANTUM THEORY 12 Hrs.**

The Perturbation theory. *Ab initio* methods- Basis sets, Slater and Gaussian functions, polarization and diffuse functions, split-valence sets, correlation-consistent sets, Born-Oppenheimer approximation.

*Case study: Identify the basis set of $H_2$ molecule for polarization and diffuse functions.*

**UNIT 4 THE HARTREE–FOCK METHOD AND BEYOND 12 Hrs.**

Hartree-Fock theory, electron correlation problem, Koopmans theorem. Density Functional Theory (DFT) and methods.

*Case study: Determine the basis set of $H_2$ molecule for Hartree-Fock and DFT theory.*

**UNIT 5 MOLECULAR DYNAMICS SIMULATIONS 12 Hrs.**

Basic principles-Equations of motion, force calculations, integration schemes, boundary conditions, phase space and distribution functions, time step and time scale considerations, stability, Practical aspects of simulations, *ab initio* molecular dynamics.

*Case study: Determine the behaviour of bulk of $H_2O$ molecule by considering the* time *step and time scale.*

**COURSE OUTCOMES**

Upon completion of the course the students will be able to

**CO1 -** Examine the significance of computational chemistry to chemical systems.
**CO2 -** Interpret the currently available high-performance computational chemistry methods.
**CO3 -** Analyse the solutions for Chemical problems by using computational thinking.
**CO4 -** Evaluate the structural parameters of chemical systems by computational techniques.
**CO5 -** Compare the various theory available in computational chemistry software.
**CO6 -** Implement the programming skills in computational chemistry field.

## TEXT / REFERENCE BOOKS

1. Quantum chemistry, Ira N. Levine, Brooklyn, New York.
2. F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2003
3. C. J. Cramer "Essentials of Computational Chemistry", 2nd ed., Wiley 2004.
4. Foresman, J. B.; Frisch, Æ. Exploring Chemistry with Electronic Structure Methods, 3rd ed.
5. Gaussian, Inc.: Wallingford, CT, 2015. (See also: http://expchem3.com/) User manuals of Gaussian09.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB6201 | COMPUTATIONAL CHEMISTRY LAB | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concept about how to built for a simple system in computational chemistry visualization software.
- To understand the concept of energy optimization in Density-Functional theory (DFT)
- To understand and analyse the orbitals of a molecule.

Exp-1: Construction of the molecular structure of small molecule like $H_2$, $CH_4$, $CO_2$ by Gauss View software.
Exp-2: Design the method of calculating the lowest energy structure by Gaussian software.
Exp-3: Execute the orbital analysis of a given structure by Gaussian software.
Exp -4: Describe the vibrational frequency calculation by Gaussian software.
Exp -5: Implement the geometry optimization process of a given small molecule like $H_2$, $CH_4$, $CO_2$ by other computational theory by Gaussian software.
Exp -6: Construction and implementation of the geometry optimization process for organic complexes.
Exp -7: Construction and implementation of the geometry optimization process for transition metal complexes.
Exp -8: Investigate the absorption spectra for fullerenes.
Exp -9: Construction and implementation of the geometry optimization process for polymer materials.

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Construct the molecular structure of chemical compounds.
**CO2 -** Develop the skill for optimization process.
**CO3 -** Identify the orbital diagram computationally.
**CO4 -** Interpret the vibrational spectra computationally.
**CO5 -** Investigate the absorption spectra for solar cell materials.
**CO6 -** Implement the knowledge for real world problems.

**TEXT/REFERENCE BOOKS**

1. Warren J Hehre, Laboratory book of computational organic chemistry, wave function, 1998. 2. Tim Clark, A Handbook of Computational Chemistry: A Practical Guide to Chemical Structure and Energy Calculations, Wily Black Well, 1985.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB6202 | ORGANIC CHEMISTRY LAB I | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**Course Objectives**

- To enable the student to develop analytical skill in organic qualitative analysis
- Systematic identification of compounds containing one or more functional groups.
- Systematic identification of mixtures containing two compounds:

**COURSE CONTENTS**

- Separation of mixtures containing two compounds with one or more functional groups- Solid-solid separation; Liquid-Liquid separation (Miscible), Solution.
- Preparation of derivatives for the identified compounds and determine their melting points. (Merged)

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Understand the systematic identification of mixtures containing two compounds
**CO2 -** Separation and identification simple binary mixtures having acidic, basic and neutral components by chemical methods
**CO3 -** Preparation of the identified compound derivatives
**CO4 -** Recognize the chemical reactions in identifying the chemical compounds
**CO5 -** Identify the compounds containing one or more functional groups
**CO6 -** Acquire the separation skills for binary mixtures

**TEXT / REFERENCE BOOKS**

1. Gurtu J. N., and Kapoor R., Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
2. Vogel's Textbook of Practical organic chemistry, ELBS/Longman, 1984.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB6203 | INORGANIC CHEMISTRY LAB II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To learn the theoretical basis of qualitative inorganic analysis
- To understand the method of identification of group and cations using semi-microanalysis
- To gain knowledge about systematic semi-microanalysis

**COURSE CONTENTS**

- Semi-micro qualitative analysis of mixtures containing two common and two rare cations

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Develop practical skills in inorganic qualitative analysis
**CO2 -** Understand the concept of systematic identification of metal cation as their compounds
**CO3 -** Recognize the classification of various cations under different groups
**CO4 -** To analyze the mixture using semi-microanalysis
**CO5 -** To identify the common and rare cations in the mixture
**CO6 -** To acquire the group separation skills

**TEXT / REFERENCE BOOKS**

1. V. V. Ramanujam, Inorganic semimicro qualitative analysis, The national publishing company, Chennai, India, 3rd edition, reprinted 2008.
2. G. H. Jeffery, J. Bassett, J. Mendham and R. Denney, Vogel's Textbook of Quantitative chemical analysis, Pearsons Education, 6th Edition, 2004.
3. I. M. Kolthoff and E. B. Sandell, Text Book of Qualitative Inorganic Analysis, The Macmillan Company, 3rd edition, 1956.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB5301 | REACTIVE INTERMEDIATES AND REARRANGEMENTS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To comprehend the name reactions of alkyl halide and functional groups with their mechanism.
- To recognize the importance of free radicals in organic reactions.
- To learn the significant organic name reactions applied in industries with their mechanism.

**UNIT 1 REACTIVE INTERMEDIATES I 12 Hrs.**

Field effects (inductive, electromeric effects), mesomerism, resonance, steric effects. Types of reactions and mechanism. Generation, structure, stability and reactivity of carbocations, carbanions.

**UNIT 2 REACTIVE INTERMEDIATES II 12 Hrs.**

Generation, structure, stability and reactivity of free radicals, carbenes, nitrenes and benzynes.

**UNIT 3 MOLECULAR REARRANGEMENT 12 Hrs.**

General mechanistic considerations: Types of rearrangement by nature of migration – Intra and Inter molecular rearrangement – Cross over experiment. C-C Migration: Pinacol-Pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorski rearrangements. C-N migration: Neber, Arndt-Eistert synthesis, Beckmann, Hofman, Curtius, Schmidt rearrangements. C-O migration: Bayer-Villiger, Shapiro reaction. Miscellaneous: Fries, Cope, Sommelet Hauser, Stevens, Von-Richter rearrangement.

**UNIT 4 NAMED REACTIONS I 12 Hrs.**

Appel reaction – Corey-Chaykovsky reaction; Arbuzov reaction - Horner-Wadsworth Emmons reaction – ene - Strok enamine reaction - Mannich reaction- Michael addition - Robinson annulation Nef reaction - Barton reaction - Henry reaction - Stetter reaction - Sharpless asymmetric epoxidation, Grubb's metathesis reaction –Vilsmeier- Haack reaction- Bischler-Napieralski reaction.

**UNIT 5 NAMED REACTIONS II 12 Hrs.**

Mukaiyama reaction - Miyaura borylation reaction-Suzuki Coupling – Stille coupling –Negishi coupling-Hiyama Coupling - Kumada Coupling - Fukuyama coupling - Heck reaction- Trost- Tsuji coupling - Sonogashira reaction- Wacker reaction - Buckwald Hetwig reaction – Pauson - Khand reaction - Kulivikovich reaction.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Comprehend the stability and reactivity of carbocations, carbanions.
**CO2 -** Understand the stability and reactivity of carbenes and nitrenes.
**CO3 -** Design chemical reaction based on molecular rearrangements outlined
**CO4 -** Construct and predict the reaction mechanism for name reactions outlined.
**CO5 -** Formulate chemical reactions and mechanism for name reactions outlined
**CO6 -** Predict the products for name reactions and molecular rearrangement.

**TEXT / REFERENCE BOOKS**

1. J. March and M. Smith, Advanced Organic Chemistry, John-Wiley and Sons, 7th Edition, 2013.
2. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry Part-A and B, Kluwer Academic/Plenum Publishers, 5th Edition, 2007.
3. R. Morrison and R. Boyd, Organic Chemistry, Allyn & Bacon, 2nd Edition, 1967.

4. R. K. Bansal, Organic Reaction Mechanism, New Age International Pvt. Ltd. Publishers, 4th Edition, 2014.
5. S. H. Pine, Organic Chemistry, McGraw Hill International Edition, 5th Edition, 1987.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5302 | ADVANCED INORGANIC CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn about organometallic compounds in terms of structure and bonding including dinitrogen and dioxygen as ligands.
- To understand various synthesis methods of different types of organometallic compounds and to learn their reactivity with mechanism.
- To learn about different reactions involving organometallic compounds as catalysts in chemical synthesis.

**UNIT 1 ORGANOMETALLIC COMPOUNDS 12 Hrs.**

EAN Rule - Valence electron count (16/18 electron rules) – concept of hapticity - Structure and bonding of mono and heteroleptic metal carbonyls – dinitrogen and dioxygen as ligands in organometallic compounds - Infrared spectra of metal carbonyls – Metal clusters – Low and high nuclearity clusters – clusters having interstitial atoms - Isolobal analogies - Metallocenes and bent metallocenes.

**UNIT 2 SYNTHESIS OF ORGANOMETALLIC COMPOUNDS 12 Hrs.**

Types of M-C bonds – structure and bonding of metal alkyls, alkenes, allyl, alkynes and arenes - Ligand dissociation and substitution - Oxidative addition - Reductive elimination - Nucleophilic displacement – Insertion - Alkyl migration – 1, 2 insertion - Hydride elimination.

**UNIT 3 ORGANOMETALLIC CATALYSTS 12 Hrs.**

Terminology in catalysis: Turnover, Turnover number (TON), Turnover frequency (TOF). Homogeneous catalysis – Hydroformylation - Monsanto acetic acid process - Hydrogenation by Wilkinson's catalyst - Wacker (Smidt) process - Olefin metathesis - Heterogeneous catalysts – Ziegler Natta polymerization - Water gas reaction.

**UNIT 4 BIOINORGANIC CHEMISTRY 12 Hrs.**

Transition metal ions in biology.Active site structure and functions of dioxygen binding heme (hemoglobin and myoglobin) and non-heme (hemocyanin and hemerythrin) proteins. Characterization of coordinated $O_2$ species in oxy forms of heme and non-heme proteins by resonance Raman spectroscopy.Bohr effect. Electron transfer proteins: Active site structure and functions of cytochromes, and iron-sulphur proteins. Significance of electron transfer proteins in photosynthesis (Z scheme). Coenzyme F430, carboxypeptidase, carbonic anhydrase, vitamin $B_{12}$, ferritin and transferrin. Mechanism of action of cytochrome P450 and urease. Therapeutic uses of cisplatin, and radioisotopes (Tc, Co and Cu). Basic principles of MRI and application of metal (Mn and Fe) complexes as contrast agents. Toxicity of Cd, Hg and Pb in biology with specific examples.

**UNIT 5 NUCLEAR CHEMISTRY 12 Hrs.**

Terminology, Concept and formulae of Nuclear chemistry; Radioactivity, Types of particles, Radioactive decay, Radioacive decay constants, equilibrium, Nuclear reactions; Q – Value, Chemical effects of Nuclear Transformations, Fission and Fusion, stability of Nucleus, Radioactive techniques – Tracer technique, Neutron activation analysis, counting technique – G.M. ionization, Proportional counter. Application of Radioisotopes.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Identify organometallic compounds based on EAN rule and to elaborate on the different types of substituted carbonyl compounds.

**CO2 -** Interpret the structure, reactivity and significance of organometallic compounds with dinitrogen and dioxygen as ligands.

**CO3 -** Analyze the mechanism involved in various ligand dissociation and substitution reactions of organometallic compounds.

**CO4 -** Analyze the role of organometallic compounds in various catalysis processes which are of commercial use.

**CO5 -** Understand the role and importance of metals in forming biomolecules based on complexation and their application in biotransformation.

**CO6 -** Identify different particles in nuclear fission and fusion reactions and to evaluate the application of different radioactive isotopes.

**TEXT / REFERENCE BOOKS**

1. C.E. Housecroft and A.G. Sharpe, Inorganic Chemistry, 4th Edition, Pearson, 2012.
2. B. D. Gupta and A. J. Elias, Basic Organometallic Chemistry: Concepts, Synthesis, and Applications, 2nd Edition, Universities Press (India), 2013.
3. J. E. Huheey, E. A. Keiter, R.L. Keiter and O.K. Mehdi, Inorganic Chemistry, Principles of Structure and Reactivity, Pearson, 2006.
4. F. A. Carey, G. Wilkinson G., C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Interscience, 2003.
5. J. Lippard and J.M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.
6. W. Kaim, B. Schwederski and Axel klein, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life (An introduction and Guide),2nd Edition, John Wiley & Sons, 2013.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB5303 | ELECTROCHEMISTRY AND SOLID STATE CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 3 | 4 | 100 |

**COURSE OBJECTIVES**

- To study the Interaction and Migrations of ions
- To learn the Electrochemical reactions and measurements
- To study about the Corrosion – types and its applications

**UNIT 1 ELECTRO IONICS & ELECTRODICS 12 Hrs.**

Ion-solvent interactions: Ion-ion interactions – Ionic migration and diffusion – Ionic activity – Debye-Huckel-theory – Debye-Huckel limiting law – Electrolytic conductivity and Debye-Hückel-Onsager theory – Electrochemical interfaces: Electrical double layer – Lippmann equation Helmholtz and Gouy – Chapman – Stern models of the double layer – Modern theories of electrical double layer.

**Case study:** Chloroacetic acid has a dissociation constant of Ka = $1.38 \times 10^{-3}$. (a) Calculate the degree of dissociation for 0.0825 M solution of chloroacetic acid using the Debye–Hückel limiting law (b) Calculate the degree of dissociation for 0.022 m in KCl using the Debye–Hückel limiting law.

**UNIT 2 ELECTROCHEMICAL REACTIONS & MEASUREMENTS 12 Hrs.**

Electrochemical Reactions: Electrochemical cell – Activation in ionics – Ohmic and diffusion overpotentials – Activation polarisation, concentration polarization – Current-potential relationship (derivation of Butler-Volmer and Tafel equations).Electrochemical Measurements: Two Electrode cell and Three Electrode cell – Types of Electrodes: Reference Electrodes, Working Electrodes and Counter Electrodes – Current and diffusion controlled redox reactions – Reversible and Irreversible systems: Quasi-reversible mechanism – Steady-State Polarization Measurements – Transient (Pulse) Measurements – Impedance Measurements.

**Case study:** Calculate the reversible oxidation of dopamine (DA) in two-electron process. A cyclic voltammetric anodic peak current of 2.2μA is observed for 0.4mM solution of dopamine in phosphate buffer at a glassy carbon disk electrode 2.6mm$^2$ area with a scan rate of 25mVs$^{-1}$. What will be $i_p$ for $v$ = 100mVs$^{-1}$ and 1.2mM of DA?

**UNIT 3 ELECTROCHEMICAL CORROSION STUDIES 12 Hrs.**

Electrochemical Corrosion: Different types of Corrosion – Pourbaix diagram – Stern Geary equation – Mixed Potential Theory – Electrochemical Impedance Spectroscopy: Determination of Nyquist plot, Bode Phase angle and impedance plot – Corrosion rate Measurements and Prevention of Corrosion.

**Case study:** Analyze the corrosion impact for graphene dispersion into coatings prepared under low shear condition with constant stirring at 1000 to 1500 rpm for 10 to 15 minutes.

**UNIT 4 ELECTROCHEMICAL SENSORS 12 Hrs.**

Electrochemical Sensors: Introduction to Electrochemical Sensors and Biosensors – Electrochemical Sensors in Environmental analysis – Glucose Biosensor – Immune Sensors – ISFETs and CHEMFETS.

**Case study:** Describe the major problem encountered in the detection of the NADH product of dehydrogenous-based amperometric biosensors and discuss the common approaches to circumvent these problems.

**UNIT 5 SOLID STATE CHEMISTRY 12 Hrs.**

Solid State Synthesis: Wagner reaction mechanism for solid state synthesis for spinel – Chemical precursor method for perovskite – Intercalation / deintercalation method – Methods of Single Crystal Growth: Hydrothermal method of synthesis – Czochralski method. Solid State Defects: Point Defects – Schottky Defect – Frenkel Defect – Extrinsic and Intrinsic Defects – Applications of Solid Electrolytes in

Batteries, Fuel cells, Oxygen sensor – Vacancies and Interstitials in Non-Stoichiometric – Superconductivity: High Temperature Superconductors: Cuprate Superconductors – Iron Superconductors.

**Case study:** Calculate the error in millivolt that would occur if the solution containing $5x10^{-5}$ M of fluoride ion solution (pH 10) is measured with fluoride ISE. ($k_{F,OH}$=0.1).

**Max. 60 Hrs.**

## COURSE OUTCOME

On successful completion of the course, student will be able to,

**CO1 -** Comprehend the theories and applications of electrochemistry.
**CO2 -** Interpret the electrode kinetics and the structure of electrified interface.
**CO3 -** Examine the basic concept of electrochemical measurements.
**CO4 -** Analyze the properties of electrochemical sensors chemical and biological systems.
**CO5 -** Evaluate the materials for electrochemical cells.
**CO6 -** Evaluate the electrochemical concepts to real time materials.

## TEXT / REFERENCE BOOKS

1. Electrochemistry by Carl H. Hamann, Andrew Hamnett and WolfVielstich, Wiley VCH,2007.
2. Modern Electrochemistry 1. Volume 1 and 2, by J. O'M. Bockris and A. K.N. Reddy, Kluwer Academic, 2000.
3. Modern Electrochemistry 1. Volume 1 and 2, by J. O'M. Bockris and A. K.N. Reddy, Kluwer Academic, 2000. L (hrs) Credit 60 4 26
4. Electrochemical Methods, by A. J. Bard and L. R. Faulkner, John Willey,2000, 2nd edition.
5. E. Gileadi, Physical Electrochemistry, Fundamental, Techniques and Applications, Wiley-VCH,2011
6. A. J. Bard and L. R Faulkner Electrochemical Methods: Fundamentals and Applications, 2nd Edition, Wiley,2001
7. P. H. Rieger, Electrochemistry, 2nd Edition, Springer 1994
8. J. Newman and K. E. Thomas-Alyea, Electrochemical Systems, 3rd Edition, Wiley Interscience, 2004
9. J. Wang, Analytical Electrochemistry, 3rd Edition, Wiley – VCH,2006 9. P.T.Kissinger and W.R. Heineman, Laboratory Techniques.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB6301 | PHYSICAL CHEMISTRY LAB – II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To know about the practical applications of conductometry.
- To learn concepts of potentiometry and pH metry.
- To apply the basic concept of chemical kinetics and adsorption studies.

**The list of probable experiments is mentioned below, which delineates the experiment to be performed in a semester. Any seven experiments can be selected from the list.**

**List of Experiments**

1. Calculation of HOMO-LUMO energy gap in D-A based system through cyclic voltammetry.
2. Acid-catalysed hydrolysis of methyl acetate (kinetics)
3. Determination of equivalent conductance of a weak electrolyte (CH3COOH) at infinite dilution by Kohlrausch's law.
4. Determination of CMC of a surface active agent (SDS) conductometrically.
5. Surface absorption kinetics of dyes on activated carbon using UV-Vis spectroscopy.
6. Intercalation of sodium into vanadium oxide and potentiometric estimation of extent of intercalculation.
7. Effect of ionic strength on reaction rate.
8. Determination of specific gravity of given organic liquids by u-tube viscometer.
9. Determination of equilibrium constant of reaction between Iodine and potassium iodide by partition method / UV-Visible spectrophotometer.
10. Study of kinetics of second order reaction by conductometric method.
11. Calculation of quantum yield of Coumarin.

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Illustration of HOMO-LUMO energy gap
**CO2 -** Acquire practical skills in conductance measurements.
**CO3 -** Interpretion of various applications of potentionmetric measurements.
**CO4 -** Elucidation of kinetics.
**CO5 -** Determination of equilibrium constant
**CO6 -** Measurement of quantum yield

**TEXT / REFERENCE BOOKS**

1. Carl Garland, Joseph Nibler and Schoemaker, Experiments in Physical Chemistry, Mcgraw-Hill College, 7th Edition, 2003.
2. D.V. Jahagirdan, Experiments in Chemistry, Himalaya Publishers House, 2003.
3. Arthuer, Halpem and George McBane, Experimental Physical Chemistry, Freeman, 2006.
4. Yadav, Advanced Practical Physical Chemistry, Goel Pub, 1994.
5. Sawyer, Heinemen and Beebe, Chemistry Experiments for Instrumental Methods, Wiley, 1984.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB6302 | ORGANIC CHEMISTRY LAB II | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To identify the students to understand the mechanism involved in conditions of the reactions involving the preparations.
- To elaborate the student to develop the analytical skill in organic quantitative analysis.
- To determine the interpretation of spectra provided and to understand the basic principle involved in thin layer chromatography.

**COURSE CONTENTS**

1. Determination of empirical and molecular formulae based on Elemental Analysis and Spectral data
2. Identification of unknown organic compounds by
   a) Ultraviolet-visible Spectroscopy
   b) Infrared spectroscopy
   c) Proton Magnetic Resonance Spectroscopy & Carbon Magnetic Resonance Spectroscopy
   d) Mass Spectroscopy
3. Preparation of organic compounds based on disconnection approach
4. Acquisition of spectral data for known organic compounds
5. Chromatography techniques in organic compound separation

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Estimate the empiricial formula for organic compound..
**CO2 -** Develop the skill in identifying the organic compounds.
**CO3 -** Demonstrate the mechanism involved in the organic reactions.
**CO4 -** Understand the mechanism and structural aspects of the organic compounds.
**CO5 -** Apply thin layer chromatography in separation and identifying the organic compounds.
**CO6 -** Identify the different spectroscopic data for the various organic compounds.

**TEXT / REFERENCE BOOKS**

1. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
2. Vogel's Textbook of Practical organic chemistry, ELBS/Longman, England, 1984.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 50** **Exam Duration: 6 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| S91BPT | SUMMER INTERNSHIP/ COMMUNITY INTERNSHIP | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 15 | 5 | 100 |

**COURSE OBJECTIVES**

- To make our student to prepare for industry ready

**INTERNSHIP REPORT: 60 Marks**

About the industry, Protocol of Industry, Industry safety, R&D lab, ETP etc.,

**VIVA-VOCE: 40 Marks**

Communication
Presentation using Teaching aids
Language and diction
Interpretation of Technical data

| S91BPROJ | PROJECT WORK | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 36 | 12 | 100 |

**COURSE OBJECTIVES**

- To make the student to understand and present a research finding on a topic in the subject related to Chemistry under the guidance of a department staff.

**PROJECT REPORT: 60 Marks**

Literature review
Problem Identification
Experimental / Results and Discussion
Originality, Technical and logical development
Summary and references

**VIVA-VOCE: 40 Marks**

Communication
Presentation using Teaching aids
Language and diction
Interpretation of Technical data

| SCYB1303 | ANCILLARY CHEMISTRY I (B.Sc., Mathematics, Bio, Physics Department only) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To know about the water quality parameters and the methods to estimate the hardness of water.
- To understand the charging and discharging characteristics in batteries.
- To understand the various synthesis of nanomaterials, organic materials and their applications.

**UNIT 1 WATER TECHNOLOGY 9 Hrs.**

Introduction: Water quality parameters - Contamination of water by arsenic, lead, fluoride, mercury and their removal. Hardness: Types - Expression - Units. Estimation of hardness of water by EDTA method - Problems. Estimation of iron, calcium and magnesium: AAS method. Water softening: Zeolite process – Demineralization process. Desalination: Reverse osmosis - Electrodialysis.

**UNIT 2 ELECTROCHEMICAL POWER SOURCES 9 Hrs.**

Electrochemistry: Galvanic cell - Electrochemical cell representation - EMF series and its significance. Batteries: Terminology - Lead-acid accumulator - Nickel-cadmium batteries. Lithium batteries: Li/$SOCl_2$ cell- Lithium ion batteries. Fuel Cells: Hydrogen-oxygen fuel cells - Solid oxide fuel cell (SOFC).

**UNIT 3 PHASE EQUILIBRIA 9 Hrs.**

Introduction: Definition of phase rule - Terms involved in phase rule with examples. One component system: Water system. Two component alloy systems: Classification - Reduced phase rule - Thermal analysis. Simple eutectic system: Lead-silver system. Congruent system: Zinc-magnesium system. Incongruent system: Sodium potassium system.

**UNIT 4 SYNTHESIS OF NANOMATERIALS 9 Hrs.**

Introduction: Nanomaterials: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by chemical reduction method. Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and multi walled nanotubes - Applications of CNTs - Synthesis of CNTs by electric arc discharge method and laser ablation method.

**UNIT 5 POLYMER CHEMISTRY 9 Hrs.**

Introduction to polymers: Nomenclature - Functionality. Types of polymerization. Mechanism of polymerization: Free radical mechanism - Cationic mechanism - Anionic mechanism. Plastics: Types - Thermoplastics and thermosetting plastics. Properties: Strength - Crystalline and amorphous state – Average molecular weight - Polydispersity. Compounding of plastics. Moulding of plastics: Compression moulding – Injection moulding - Extrusion moulding. Introduction to conducting polymers.

**COURSE OUTCOMES**

On completion of the course, student will be able to:

**CO1 -** Outline the water quality parameters of domestic and industrial water.
**CO2 -** Evaluate the charging and discharging characteristics of batteries and fuel cells.
**CO3 -** Construct the phase diagram to alloy systems for optimizing their mechanical and thermal Properties
**CO4 -** Understand the synthesis of nanomaterials and their applications.
**CO5 -** Interpret various properties of polymeric materials and its industrial applications.
**CO6 -** Evaluate the chemistry materials for real world applications.

## TEXT / REFERENCES BOOKS

1. Jain P.C. and Monica Jain, Engineering Chemistry, 15th Edition Dhanpat Rai Publishing Co., 2009.
2. Dara S.S., Text Book of Engineering Chemistry, S. Chand & Co, 2008.
3. Sheik Mideen A., Engineering Chemistry (I & II),13th Edition, Shruthi Publishers, 2010.
4. Kuriakose J.C. and Rajaram J., Chemistry in Engineering and Technology". Vol.1 & 2, 5th reprint, Tata McGraw Hill,Publishing Company (P) Ltd., 2010.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB1403 | ANCILLARY CHEMISTRY II (B.Sc., Mathematics, Bio, Physics Department only) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To know about the types and properties of solutions and their laws.
- To expose various separation techniques for the purification of compounds.
- To provide an idea about the chemical kinetics in terms of order, molecularity and catalytic properties.

**UNIT 1 SOLUTIONS 9 Hrs.**

Introduction: Solid solution - Hume Rothery's rule. Types of solid solutions: Liquid solutions: Solubility of partially miscible liquids - Phenol-water system. Colligative properties: Lowering of vapour pressure. Raoult's law: Derivation - Osmotic pressure - Isotonic solution - Relationship between osmotic pressure and vapour pressure. Depression in freezing point - Derivation. Elevation in boiling point - Derivation - Problems.

**UNIT 2 INTRODUCTION TO SPECTROSCOPY 9 Hrs.**

Electromagnetic spectrum, Absorption of radiation, electronic transition – Vibrational transition – Rotational transition – Intensities of spectral lines – Beer- Lambers law – Colorimetric analysis – Estimation of concentration of a solution by colorimetry – Flame photometry – Theory, Instrumentation(block diagram only) and application – UV-Visible spectroscopy – principles, instrumentation(block diagram only) and IR spectroscopy – simple application only.

**UNIT 3 CHEMICAL KINETICS 9 Hrs.**

Introduction, Basic Concepts, Factors affecting reaction rates, rate equations for different orders – Derivation of Zero order, First order, Second order (A+A and A+B) reactions, Half life, problem based on First order and second order kinetics. Methods for the determination of the order of a reaction, Steady state hypothesis, Arrhenius Equation, Energy of activation, complex reactions – kinetics of opposing, parallel and consecutive reactions, Theories of reaction rates – Collision theory, Absoulte reaction rate theory.

**UNIT 4 SURFACE CHEMISTRY AND CATALYSIS 9Hrs.**

Adsorption – types of adsorption – Adsorption of gases on solids – adsorption isotherm – Freundlich, Langmuir isotherms – Adsorption of solutes from solutions – applications – Role of adsorption in catalytic reactions – Ion exchange adsorption – basic principles in adsorption chromatography – catalysis – classification – characteristic of catalysts – Auto catalysis – Enzyme catalysis – Michaelis – Menten equation – Acid – base catalysis.

**UNIT 5 SEPARATION TECHNIQUES 9 Hrs.**

Distillation techniques: Fractional distillation - Steam distillation - Vacuum distillation. Chromatography: Elution analysis - Paper chromatography - Thin layer chromatography - Liquid chromatography - High performance liquid chromatography (HPLC) - Gas chromatography (GC).

**Max. 45 Hrs.**

## COURSE OUTCOMES

On completion of the course, student will be able to:

**CO1 -** Examine the types of solutions and the colligative properties.
**CO2 -** Interpret the spectral transition of simple molecules and its applications.
**CO3 -** Determine the sequence of elementary reactions that comprise complex reactions.
**CO4 -** Analyze the surface phenomenon and study the types of catalyst reactions.
**CO5 -** Evaluate various separation techniques and its uses.
**CO6 -** Evaluate the materials for real world applications.

## TEXT / REFERENCES BOOKS

1. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Vishal Publishing Co, 48th edition, 2020.
2. Keith J. Laidler, Chemical Kinetics, Third Edition, Pearson education limited, 2004.
3. Atkins P. W., Physical Chemistry, 6 edition, Oxford University press, 1998.
4. Barrow G. M., Physical Chemistry, 5th edition, McGraw-Hill, 1988.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB2302 | ANCILLARY CHEMISTRY LAB I (B.Sc., Mathematics, Bio, Physics Department only) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To understand the basics of chemistry laboratory
- To understand and correlate the theory with laboratory
- To understand the basic concepts of real sample results interpretation.

**LIST OF EXPERIMENTS**

1. Estimation of Total hardness of water sample by EDTA method.
2. Estimation of glycine by Sorenson method
3. Estimation of Ferrous ion by potentiometric method.
4. Determination of pH of a strong acid using pH meter
5. Estimation of mixture of acids by conductometric method.
6. Determination of molecular weight of unknown solute
7. Estimation of Fe by photocolorimeter
8. Estimation of Nickel in a Nickel-Steel alloy

**COURSE OUTCOME**

At the end of the course, the students will be able to:

**CO1 -** Estimate ionic conductance ($\Lambda_c$) in samples.
**CO2 -** Evaluate the aminoacid content in samples.
**CO3 -** Construct the redox cell and measure emf ($E_{cell}$) of the cell
**CO4 -** Analyse the hardness in water samples.
**CO5 -** Relate viscosity ($\eta$) in determining molecular weight of a polymer.
**CO6 -** Assess the iron content in samples by photocolorimetry.

**TEXT / REFERENCES BOOKS**

1. Vogel's Text Book of Inorganic Qualitative Analysis, 4th ed., ELBS, London, 1974.
2. Inorganic lab manual by S.Mumazuddin, Shailendra Kumar Sinha. 2009.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | 25 Marks | **50 Marks** |
| | Model practical exam | 25 Marks | |
| **ESE** | University Practical exam | | **50 Marks** |

| SCYB2402 | ANCILLARY CHEMISTRY LAB II (B.Sc., Mathematics, Bio, Physics Department only) | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 0 | 2 | 100 |

**COURSE OBJECTIVES**

- To understand the basics of chemistry laboratory
- To understand and correlate the theory with laboratory
- To enable the students to understand better the concepts of organic analysis and appreciate better the applications of organic chemistry towards biological systems.

**ORGANIC ANALYSIS**

a) Identification of acidic, basic, phenolic and neutral organic substances
b) Detection of N, S and halogens
c) Test for aliphatic and aromatic nature of substances.
d) Test for saturation and unsaturation.
e) Identification of functional groups i) Carboxylic acid ii) Phenols iii) Aldehydes iv) Ketones v) Esters v

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Understand the systematic identification of mixtures containing two compounds
**CO2 -** Separation and identification simple binary mixtures having acidic, basic and neutral components by chemical methods
**CO3 -** Preparation of the identified compound derivatives
**CO4 -** Recognize the chemical reactions in identifying the chemical compounds
**CO5 -** Identify the compounds containing one or more functional groups
**CO6 -** Execute practical knowledge in real world application

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

| | | | |
|---|---|---|---|
| **CAE** | Evaluation of Regular Lab class | **25 Marks** | **50 Marks** |
| | Model practical exam | **25 Marks** | |
| **ESE** | University Practical exam | | **50 Marks** |

## LIST OF DISCIPLINE SPECIFIC ELECTIVES

| SCYB3001 | FUNDAMENTALS OF SPECTROSCOPY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To study the interaction of radiation with matter and selection rules and applying it in spectroscopy techniques.
- To understand the principle and instrumentation in electronic, IR and NMR spectroscopic techniques
- To apply the concept of spectral data in assigning the structure of organic compounds.

**UNIT 1 INTRODUCTION TO SPECTROSCOPY 9 Hrs.**

Interaction of radiation with matter – Electromagnetic spectrum – quantization of energy – Boltzman distribution (formula only) - Electronic, vibrational and rotational energy levels: Relative population – Absorption and emission spectra – Selection rules – line widths – resolution and signal to noise ratio.

**UNIT 2 UV-VISIBLE SPECTROSCOPY 9 Hrs.**

Electromagnetic spectrum – Energy-Wavelength relationship – Introduction to UV-VIS spectroscopy – Beer-Lamberts Law – Instrumentation – Bands in UV-VIS spectrum – Possible electronic transitions – Types of electronic transitions based on selection rules – Characteristic absorption (λmax and εmax) – Factors influencing absorption – Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Hypochromic shift, Hyperchromic shift.

**UNIT 3 IR AND RAMAN SPECTROSCOPY 9 Hrs.**

Introduction to IR spectroscopy – Principle, types of stretching and bending vibrations, vibrational frequencies – Instrumentation – Bands in IR spectrum – Selection rules – Identification of organic molecules from characteristic absorption bands.

Raman spectroscopy – Principle – Raleigh and Raman scattering – Stoke's and antistoke's line – Differences between IR and Raman spectroscopy - Mutual exclusion principle – applications.

**UNIT 4 NMR SPECTROSCOPY 9 Hrs.**

Principle of nuclear magnetic resonance – Instrumentation – Shielding mechanism - Chemical shift – Multiplicity – Spin-spin coupling and coupling constants – Splitting of signals - Deuterium labeling – Interpreting the NMR spectra of some organic molecules.

**UNIT 5 MASS SPECTROMETRY 9 Hrs.**

Basic principles of mass spectrometry – Molecular ion peak – Base peak – Isotopic peak – Metastable peak and their uses – Fragmentation – m/z values of various fragments – Nitrogen rule - McLafferty rearrangement - Interpreting the mass spectra of some organic molecules – Instrumentation – Combined application in identifying organic compounds.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to:

**CO1 -** Examine the principles of spectroscopy for absorption and emission spectra
**CO2 -** Analyze the UV-Visible spectral transitions of molecules
**CO3 -** Examine the principles of IR and Raman spectroscopic techniques
**CO4 -** Interpret the strucuture of organic compounds by NMR spectroscopy
**CO5 -** Apply the principles of mass spectroscopy for molecule identifications.
**CO6 -** Evaluate the basic concept of chemistry to real world applications

## TEXT / REFERENCE BOOKS

1. Banwell C. N., Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1983.
2. Kalsi P. S., Stereochemistry, 3rd Edition, New Age International Publishers, 1995.
3. Barrow G. M., Introduction to Molecular Spectroscopy, McGraw-Hill, 1962.
4. Willard H. H., Merritt Jr. L. L., Dean J. A., and Settle Jr. A. F., Instrumental methods of analysis, 6th Edition, Van Nostrand, 1981.
5. Kemp W., Applications of Spectroscopy, English Language Book Society, 1987.
6. Skoog D. A., West D. M., Holler f. J., and Crouch S. R., Fundamentals of Analytical Chemistry, 9th Edition, Wadsworth Publishing Co. Inc., 2012

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3002 | CHEMISTRY OF NATURAL PRODUCTS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn isolation of alkaloids and structural elucidation of coniine, nicotine, piperine, terpeniods and papaverine.
- To recognize the biological importance of purines and pyrimidines in organic reactions.
- To impart an insight into structural details of hormones and Vitamins.

**UNIT 1 ALKALOIDS 9 Hrs.**

Classification, isolation, purification, general methods of structure determination - functions of alkaloids. Structural elucidation of coniine, nicotine, piperine and papaverine.

**UNIT 2 TERPENOIDS AND CAROTENOIDS 9 Hrs.**

Terpenoids: Introduction, classification, Isoprene rule - General methods of determining structure – Structural elucidation of citral, menthol, geraniol and camphor.

Carotenoids: Introduction, geometrical isomerism, structure determination and synthesis of β-carotene and vitamin A.

**UNIT 3 PURINES AND PYRIMIDINES 9 Hrs.**

Purines: Introduction, biological importance - Structure and synthesis of Uric acid, Xanthine and Caffeine - Pyrimidines: Introduction, Structure and synthesis of Uracil and Thymine.

**UNIT 4 ANTHOCYANINS AND FLAVONES 9 Hrs.**

Anthocyanins: Introduction to anthocyanins - Structure and general methods of synthesis of anthocyanins - Cyanidine chloride: structure and determination – Flavones and Isoflavones: Structure and determination of flavone and flavonoids - Quercetin: Structure determination and importance.

**UNIT 5 HORMONES AND VITAMINS 9 Hrs.**

Hormones: Introduction - Difference between hormones and vitamins. Classification - Structure and functions of steroid hormones: Androsterone - Progesterone - Testosterone - Estrone. Adrenocortical hormones: Cortisone. Vitamins: Structure and importance of Vitamin D - Folic acid - Nicotinamide.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Elaborate on the methods and structural elucidation of Coniine, Nicotine, Piperine and Papaverine.
**CO2 -** Outline the synthetic steps involved in the production of Terpenoids and Carotenoids.
**CO3 -** Analyse the structure of purines and pyrimidines for biological activity
**CO4 -** Explain the structure of flavones
**CO5 -** lustrate the functions of vitamins and hormones by structure activity relationship.
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCE BOOKS**

1. O. P. Agarwal, Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House, 2002.
2. L. Finar, Organic Chemistry, Vol-2, 6th ed., Pearson Education Asia. 2004.
3. Gurdeep Chatwal and Anand, Chemistry of Natural Products Vol 1 & 2, Himalayan Publishing Co, 2001.
4. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN**

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3003 | SYNTHETIC ORGANIC CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn the importance of oxidizing and reducing agents in organic reaction.
- To recognize the importance of organometallic compounds in organic reactions.
- To impart an insight into modern methodologies used in synthesis of organic compounds.

**UNIT 1 ORGANIC REAGENTS I 9 Hrs.**

Introduction to Organic Reagents - Types of Reagents - Oxidation Reagents – DDQ - $SeO_2$ - $KMnO_4$ - $OsO_4$ - Epoxidation of Olefins - Jones Reagent - Oppenauer Oxidation - $HIO_4$.

**UNIT 2 ORGANIC REAGENTS II 9 Hrs.**

Reducing Agents - Hydride ion transfer mechanism - Electron Transfer mechanism – LAH - $NaBH_4$ - Electrophilic Reducing Agents - Allanes and Boranes. Hydroboration - Dissolving metal reduction - Birch Reduction - Clemmensen Reduction - Wolf-Kishner Reduction - Lindlars Reagent.

**UNIT 3 ORGANIC REAGENTS III 9 Hrs.**

Introduction to organo-metallic reagents - Grignard reagent , Gilman's reagent – LDA - 1, 3 dithianes - Wittig Reagent - Peterson olefination.

**UNIT 4 SYNTHETIC NAME REACTIONS 9 Hrs.**

Synthetic reactions :Mannich reaction – Mannich bases – Robinson annulations. TheShapiro reaction, Stork–enamine reaction. Use of dithioacetals – Umpolung, phasetransfercatalysis – mechanisms and use of benzyl trialkyl ammonium halides. Witting reaction.

**UNIT 5 MOLECULAR REARRANGEMENTS 9 Hrs**

Types of rearrangement (nucleophilic and electrophilic) - Classification as anionotropoic, cationotropic, free radical, inter and intramolecular - Mechanism and Stereochemical aspects of Pinacol-pinacolone rearrangement, Beckmann, Hoffmann, Curtius and Benzilic acid rearrangements – Benzidine, Lossen and Schmidt rearrangements Wagner-Meerwin and Fries rearrangement.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Interpret the products formation in organic chemical reactions involving oxidizing reagents.
**CO2 -** Identify reducing agents for chemical reactions.
**CO3 -** Select the organometallic catalyst for chemical reactions.
**CO4 -** Interpret the mechanisms involved in the named reactions
**CO5 -** Outline the mechanism for electrophilic and nuclephilic molecular rearrangements.
**CO6 -** Design and predict the reaction mechanism in electrophilic, nucleophilic reactions

## TEXT / REFERENCE BOOKS

1. Clayden, Greeves, Warren and Wothers., Organic chemistry, Oxford University, 2001.
2. J. March's Advanced Organic Chemistry Reaction, Mechanisms and Structure, Wiley 2007.
3. Ian Fleming, Pericyclic Reactions, Oxford Science Publications, Cambridge, 1999.
4. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
5. RashmiSanghi, M.M. Srivastava, Green chemistry, Environment Friendly Alternatives, Narosa Publishing House, 2007.
6. Carey F. A., and Sundberg R. J., Advanced Organic Chemistry Part-A and B, 4th edn,Kluwer Academic/Plenum Publishers 2000.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB 7001 | BIOORGANIC CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn about the isolation and structural elucidation of alkaloids and their significance.
- To emphasize on to the isolation and structural determination of terpenoids and carotenoids.
- To impart an insight into the synthesis and properties of five, six and fused ring heterocyclic compounds

**UNIT 1 MECHANSIMS AND DETERMINATION METHODS 12 Hrs.**

Types of Mechanisms and Reactions - Thermodynamic and Kinetic requirements of a reaction - Representation of Potential Energy Changes in Reactions - General relationship between Thermodynamic stability and Reaction Rates - Kinetic vs thermodynamic control –Hammond Postulate-Curtin-Hammett Principle-Methods of Determining Mechanisms: Identification of Products, Determination of the presence of Intermediates, the study of catalysis, Isotopic labeling, Stereochemical Evidence, Kinetic Evidence - Isotope effects- Linear Free energy relationship- Hammett Equation, Taft Equation, sensitivity factors.

**UNIT 2 NATURAL PRODUCTS 12 Hrs.**

**Alkaloids** - General occurrence, reactions and degradations. Chemical and Physico-Chemical methods for the elucidation of structures-synthesis and structural elucidation of Atropine & Morphine

**Terpenoids -** Classification – Nomenclature – Occurrence – Isolation − General methods of structure determination −Isoprene rule. Structure determination, synthesis of the following representative molecules: Menthol, Zingiberene

**UNIT 3 SUPRAMOLECULAR CHEMISTRY 12 Hrs.**

Concepts of Supramolecular Chemistry: Definition, Nature of supramolecular interactions, Host-guest interaction, Molecular recognition, Types of recognition, Self-assembly. Cation-binding Hosts- Crown ethers, Cryptands, Spherands, Calixarens. Selectivity of cation complexation, Macrocyclic and template effects. Structure & Significance of fascinating molecules like podands, cryptands, spherands, cyclodextrins, cyclophanes clathrates, cavitands.

**UNIT 4 PROTEINS 12 Hrs.**

Proteins – Introduction to proteins – classification – Nomenclature. Physical properties of proteins-Colour reactions- Isolation and their synthesis of peptides- Structure of proteins- Primary, secondary and tertiary and quaternary structure. Enzymes-mechanism of enzyme action- chymotrypsin; coenzymes.

**UNIT 5 PHARMACEUTICAL CHEMISTRY 12 Hrs.**

Pharmacy, pharmacology, pharmaco kinetics, pharmaco dynamics, Theory and Mechanism of Drug action -metabolism of drugs- Oxidation, Reduction, hydrolysis, conjugation..Assays of Drugs-Determination of sugar in serum by quantitative methods such as Benedict Test and Fehlings test, Detection of Diabetes, Anaemia, Estimation of Hemoglobin. Structural elucidication of streptomycin and its SAR.

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Analyze the mechanism involved in basic organic reactions
**CO2 -** Elaborate on structural elucidation and chemical synthesis of alkaloids, terpenoids
**CO3 -** Understand the role of Supramolecules and their significance.
**CO4 -** Assess the importance of proteins and enzymes.
**CO5 -** Examine the action of drugs.
**CO6 -** Propose the structural activity of natural products.

**TEXT / REFERENCE BOOKS**

1. Finar I. L., Organic Chemistry, 6th Edition, Pearson Education Asia, 2004.
2. O.P. Agarwal., Organic Chemistry-Natural Products Vol.I and II, Goel Publishing House, 1980.
3. J. M. Lehn, Supramolecular Chemistry, Concepts and Perspectives, VCH, 1995.
4. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.
5. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabhprakashan, Pitampura, NewDelhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB7002 | SPECTROSCOPY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of Molecular Spectroscopy.
- To apply the principles of UV-Visible, IR, NMR and Mass spectroscopy.
- To know the application of spectroscopy to study the structure of molecules.

**UNIT 1 ELECTRONIC SPECTROSCOPY 12 Hrs.**

Electronic transitions (185-800 nm) − Beer-Lambert law − Effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Electronic spectra of inorganic and coordination compounds: Charge transfer and d-d transitions, electronic spectra of transition metal halides and oxo compounds.

**UNIT 2 IR SPECTROSCOPY 12 Hrs.**

Principle, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies. Study of isomerism: linkage isomerism in coordination compounds-cyano and isocyano-thiocyanato- and isothiocyanato complexes.

**UNIT 3 $^{1}$H NMR AND $^{13}$C SPECTROSCOPY 12 Hrs.**

General introduction and definition − Chemical shift, spin-spin interaction, shielding and desheilding mechanism and measurement, chemical shift values and correlation for protons bonded to carbon complex spin-spin interaction between two, three, four and five nuclei (first order spectra), spin system-Pople notation, virtual coupling. Hindered rotation, Karplus curve − variation of coupling constant with dihedral angle. Fourier transform technique. Further tools for simplification (chemical and instrumental) and elucidation of structures by NMR. Carbon-13 NMR Spectroscopy – General considerations, chemical shift - coupling constants. nuclear overhauser effect (NOE).

**UNIT 4 MASS SPECTROMETRY 12 Hrs.**

Principle of Mass spectra - Representation of Mass spectrum, Molecular ion – types of ions in mass spectra. Effect of isotopes on mass spectra – Determination of molecular formula – McLafferty rearrangement- ortho effect- Meta stable ions – Doubly charged ion – Nitrogen rule – General fragmentation modes – Mass spectra of hydrocarbons – Alkanes, cycloalkanes, alkene, alkynes, aromatic hydrocarbons, alcohols and thiophenols.

**UNIT 5 ESR AND MÖSSBAUER SPECTROSCOPY 12 Hrs.**

**ESR Hyperfine splitting**: hyperfine splitting in isotropic systems involving one nucleus and more than one nucleus, hyperfine splitting caused by quadrupole nucleii. Anisotropic systems: anisotropy in g-value, factors causing anisotropy. EPR spectra of systems with more than one unpaired electrons: zero-field splitting, causes of ZFS, ZFS and EPR transitions, EPR spectrum of triplet naphthalene and highspin Mn(II) complexes.

**Principles of Mössbauer spectroscopy:** Doppler shift, recoil energy, experimental technique-sources, absorber, calibration. Applications of Mossbauer spectroscopy: isomer shift, quadrupole splitting, magnetic interactions; magnetic and quadrupole splitting in ferromagnetic $^{57}$Fe compounds, Mossbauer spectra of high and low-spin Fe(II) and Fe(III) compounds, site symmetry of metal centers in iron complexes, differentiation of nonequivalent metal centers in polynuclear complexes, discovering

oxidation states-Sn, Sn(II), Sn(IV) compounds. Problems pertaining to known and unknown simple organic and Inorganic compounds by using UV, IR, Mass and NMR spectroscopy.

**Max. 60 Hrs.**

## COURSE OUTCOMES

On successful completion of the course, student will be able to

**CO1 -** Identification Of $\lambda_{max}$ Value Of Inorganic and Organic Compounds**.**
**CO2 -** Identify the functional group of molecules using IR Spectral data.
**CO3 -** Analyze for NMR chemical shifts and splitting patterns.
**CO4 -** Investigate the Mass spectra of a given organic molecule**.**
**CO5 -** Demonstrate ESR hyperfine splitting and Mossbauer spectroscopy**.**
**CO6 -** Examine organic compounds by spectroscopic tools.

## TEXT / REFERENCE BOOKS

1. Banwell C. N and McCash E. M., Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw Hill, New Delhi, 2000.
2. Silverstein R. M and Webster F. X., Spectroscopic Identification of Organic Compounds, 6th Edition, John Wiley & Sons, New York, 2003.
3. Levine I. N., Molecular Spectroscopy, John Wiley & Sons, New York, 1974.
4. Williams D. H and Fleming I., Spectroscopic Methods in Organic Chemistry, 4th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. Kemp W., Applications of Spectroscopy, English Language Book Society, 1987.
6. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience: 1994.

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB7003 | PHOTO, HETEROCYCLIC AND PERICYCLIC CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn the alpha cleavage and gamma hydrogen transfer reactions
- To understand the photochemical organic reactions and rearrangement reactions
- To impart an insight into the synthesis and properties of five, six and fused ring heterocyclic compounds.

**UNIT 1 ORGANIC PHOTOCHEMISTRY I 12 Hrs.**

Organic photochemistry – General principles – Frank-Condon principle – Electronic transitions – Jablonski diagram: Inter-system crossing and Energy transfer – Photochemistry of carbonyl compounds: $\pi \rightarrow \pi*$ and $n \rightarrow \pi^*$ transitions – alpha cleavage or Norrish type I reaction – Gamma hydrogen transfer or Norrish type II reaction - Energy transfer reactions – Sensitizer and Quencher.

**UNIT 2 ORGANIC PHOTOCHEMISTRY II 12 Hrs.**

Photoreduction – Paterno-Buchi reactions – di-pi-methane rearrangement – Barton rearrangement – Photo-Fries rearrangement - photochemistry of an α,β-unsaturated ketones – Olefin photochemistry (Cis-Trans isomerism) – Photochemistry of conjugated dienes – Photochemistry of arenes and benzene derivatives – Cycloaddition of benzene to olefins and dienes.

**UNIT 3 SYNTHESIS OF HETEROCYCLIC COMPOUNDS I 12 Hrs.**

Importance of heterocyclic compounds – classification based on the nature of hetero atom, Synthesis of 5 and 6 membered ring -size of the ring and Π excessive and Π deficient nature of the ring. A general and comparative study of Furan, pyrrole and thiophene Ring transformations. General comparison with benzenoid compounds, pyridine in case of nucleophilic substitution.

**UNIT 4 SYNTHESIS OF HETEROCYCLIC COMPOUNDS II 12 Hrs.**

Preparations and Reactions of Bicyclic ring systems-Indole, quinoline, Isoquinoline Rings with two heteroatoms- aziridines and oxiranes Imidazole, benzimdazole, purines, pyrimidines- structure and aromaticity. Structure of DNA and RNA.

**UNIT 5 PERICYCLIC REACTIONS 12 Hrs.**

Characteristics – Types of Pericyclic reactions – electrocyclic, cycloaddition, cheletropic and sigmatropic reactions – Woodward Hoffmann rules; The Mobius and Huckel concept, FMO method and Correlation diagrams – Electrocyclic reactions of conjugated dienes and trienes – Cycloaddition and Cheletropic reactions [2 + 2] and [4 + 2] cycloadditions – Diels Alder and Retro Diels Alder reactions – 1, 3-dipolar cycloaddition – Sigmatropic rearrangements involving hydrogen and carbon migration – Cope and Claisen rearrangements.

**Max. 60 Hrs.**

**COURSE OUTCOME**

On successful completion of the course, student will be able to

**CO1 -** Apply Frank-codon principle, Jablonski in the α-cleavage or γ-hydrogen transfer mechanism to organic molecules

**CO2 -** Illustrate on the mechanism of photochemical reaction

**CO3 -** Explain the conformational analysis of acyclic and cyclic systems

**CO4 -** Explain the mechanism of various pericyclic reactions such as electrocyclic, cycloaddition, cheletropic and sigmatropic reactions and understand the concept of Woodward Hoffmann rules, The Mobius and Huckel concept and FMO method

**CO5 -** Assess Woodward Hoffmann rule, Mobius and Huckel concept and FMO t in pericyclic reaction
**CO6 -** Evaluate the organic reaction by thermal and photochemical methods.

**TEXT / REFERENCE BOOKS**

1. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 14th Reprint Edition, 1990.
2. T.L. Gilchrist., Heterocylclic Chemistry, Longman Scientific and Technology, 2005.
3. J. March and M. Smith, Advanced Organic Chemistry, John-Wiley and Sons, 7th Edition, 2013.
4. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry Part-A and B, Kluwer Academic/Plenum Publishers, 5th Edition, 2008.
5. G. B. Gill and M. R. Wills, Pericyclic Reactions, Chapman Hall, 1974.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB3004 | FUNDAMENTALS OF COMPUTATIONAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic concept about the history of Quantum chemistry.
- To understand the concept of construction of Quantum Theory.
- To understand the basic application of Quantum Theory.

**UNIT 1 THE CONCEPT OF QUANTUM CHEMISTRY 9 Hrs.**

Black body radiation, Rayleigh-Jeans spectrum, Planck's Black Body Theory, Quantum Theory of Radiation, Photoelectric Effect, Einstein's Photoelectric Equation, Compton Effect, Bohr's Model of the Hydrogen Atom, The Somerfield Extension of Bohr's Theory, De Broglie's Hypothesis.

**UNIT 2 THE CONSTRUCTION OF QUANTUM THEORY 9 Hrs.**

The Harmonic Wave Function, Wave Packet, the Heisenberg Uncertainty Principle and its application, Operators- Commutations, expression for operators, The Schrodinger wave equation, significance of $\Psi$ and $\Psi^2$.

**UNIT 3 APPLICATION OF QUANTUM THEORY I 9 Hrs.**

Quantum No, the relation between wave function and shape of orbital, hydrogen atomic spectrum, theorem of quantum mechanics, Hermitian operator.

**UNIT 4 APPLICATION OF QUANTUM THEORY II 9 Hrs.**

Particle in 1-D box, Particle in a 3-D box, 1-D simple Harmonic Oscillator, Hydrogen atom, Huckel's MO theory: Expectation value of energy – Huckel's theory and the LCAO approximation.

**UNIT 5 THE MOLECULAR MODELING AND MOLECULAR DYNAMICS SIMULATIONS 9 Hrs.**

Introduction to molecular modeling and molecular dynamics simulations, Molecular Simulations Across Scales, Interactions of Molecular Dynamics, The Potential Energy Function (force field) - Morse model, Electrostatic Interactions: the Coulomb potential, Energy Minimization of the Potential Energy function.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

Upon completion of the course the students will be able to

**CO1 -** Implement the significance of quantum chemistry.
**CO2 -** Interpret the basic theory of quantum chemistry.
**CO3 -** Translate the simple problems into solutions by using quantum knowledge.
**CO4 -** Execute the quantum thinking for higher level of computational theory.
**CO5 -** Understand the theory behind other available computational process.
**CO6 -** Implement different computational tools for different problems.

**TEXT / REFERENCE BOOKS**

1. Quantum chemistry, Ira N. Levine, Brooklyn, New York.
2. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, Madan S. Pathania, Vishal Publishing Co.
3. F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2003
4. C. J. Cramer "Essentials of Computational Chemistry", 2nd ed., Wiley 2004.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3005 | MATERIALS CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To get an understanding of materials science and energy materials
- To introduce various spectroscopic techniques for materials
- To study the electronic materials and their conductive properties.

**UNIT 1 MATERIALS CHARACTERIZATION 9 Hrs.**

Introduction to Materials Chemistry- Basics. Introduction to Material Characterization. Various characterization techniques - their application in characterization of materials i.e. UV-VIS , FTIR, XRD, Electron Microscopy, FESEM, TEM, AFM, XPS, OES, Particle Size Analysis, BET Surface Area Analyzer, Zeta potential, TGA, DTA, DSC, Raman Spectroscopy, Conductivity Measurements, NMR, Mass Spectrometry, Mossbauer Spectra.

**UNIT 2 ENERGY MATERIALS 9 Hrs.**

Introduction: Current energy requirements, growth in future energy requirements, Importance of Renewable Energy Sources. Introduction to Solar Cell, Fuel cells, Wind energy.

**UNIT 3 MAGNETIC MATERIALS 9 Hrs.**

Magnetic properties of solids- classification of magnetic materials, Magnetic susceptibility, Langevin diamagnetism, Weiss theory of para-magnetism. Chemistry Electronic Materials.

**UNIT 4 ELECTRONIC MATERIALS 9 Hrs.**

Electronic properties of metals, insulators and semi-conductors: Electronic structure of solids, Band theory, band structure of metals, insulators and semiconductors. Electrons, holes and excitons. The temperature dependence of conductivity of extrinsic semiconductors. Photo conductivity and photovoltaic effect-p-n junctions.

**UNIT 5 SUPER CONDUCTIVITY 9 Hrs.**

Superconductivity - Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meisner effect. Types of superconductors - Theories of super conductivity - BCS theory.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** To interpret the characterization of materials by different analytical and spectroscopic methods.
**CO2 -** To analyse different types of energy sources and its future demands.
**CO3 -** To examine properties of magnetic materials.
**CO4 -** Relate the electronic properties of metals and understand the chemistry behind it.
**CO5 -** To learn the principle of superconductivity and the theory behind superconductivity.
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXTBOOKS / REFERENCES**

1. Material Science, by S. L . Kakani, A. Kakani, New Age International Pvt. Ltd, 2016.
2. Solid State Chemistry, by D K CHAKRABARTHY, New Age International Pvt. Ltd, 2012.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3006 | INDUSTRIAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of chemistry in laboratory level and plant level
- To understand the chemical engineering operations and hest capacity values at critical conditions.
- To identify the various filteraion and drying process in chemical industry.

**UNIT 1 PRINCIPLES OF CHEMICAL TECHNOLOGY 12 Hrs.**

Introduction: Basic principles – importance – classification – designing and modeling of chemical plants. Basic requirements of industrial reactors – choice and selectivity of reactor – basic principles of homogeneous and heterogeneous processes and reactors with examples.

**UNIT 2 INDUSTRIAL ASPECTS OF PHYSICAL CHEMISTRY 12 Hrs.**

Flow diagram for material balance − Simple material balance for chemical engineering operations such as distillation or absorption etc. Energy Balance: Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in fluids.

**UNIT 3 UNIT OPERATIONS IN CHEMICAL INDUSTRY 12 Hrs.**

Distillation: Introduction, batch and continuous distillation, separation of azeotropes, plate columns and packed columns. Absorption: Introduction, equipments, packed columns, spray columns, bubble columns, mechanically agitated contactors. Evaporation: Introduction, equipments, short tube evaporator, forced circulation evaporators, falling film evaporators, wiped (agitated) film evaporators. Filtration: Introduction, equipments, plate and frame filter press, Nutch filter, rotary drum filter, sparkler filter, candle filter, Bag filter. Drying: Introduction, free moisture, bound moisture, drying curve, equipments - tray dryer, rotary dryer, flash dryer, fluid bed dryer, drum dryer, spray dryer.

**UNIT 4 UNIT PROCESSES IN ORGANIC CHEMICALS MANUFACTURE 12 Hrs.**

Nitration: Introduction, nitrating agents, mechanism and nitration of paraffin hydrocarbons. Halogenation: Introduction, reagents for halogenations, halogenations of aromatics. Sulphonation: Introduction, sulphonating agents, sulphonation of benzene. Oxidation: Introduction, types of oxidation reactions, oxidizing agents, commercial manufacture of benzoic acid. Hydrogenation: Introduction, catalysts for hydrogenation reactions, hydrogenation of vegetable oil. Alkylation: Introduction, types of alkylation, manufacture of phenyl ethyl alcohol. Esterification: Introduction, esterification by organic acids, by addition of unsaturated compounds, commercial manufacture of ethyl acetate.

**UNIT 5 INDUSTRIAL POLLUTION 12 Hrs.**

Pollutants and their statutory limits, pollution evaluation methods. Air pollution – various pollutants, Water pollution – organic/inorganic pollutants, Noise pollution, Pesticide pollution, Radiation pollution and Green House Effect.

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the basic concepts of homogeneous and hetergeneous process.
**CO2 -** Explain the different chemical engineering operations for distillation or absorption.
**CO3 -** Analyse the heat transfer processes involved in distillation or absorption.
**CO4 -** Understand of various manufacturing chemical process for organic reagents.
**CO5 -** Have the basic knowledge about alkylation and esterification process.
**CO6 -** Understand various environmental factors that effect on air pollution.

## TEXT / REFERENCE BOOKS

1. Mukhlyonov I., (ed.), Chemical Technology, Vol.1, 3rd Edition, Mir publication, Moscow, 1979.
2. De A. K., Environmental Chemistry, 11th Edition, Wiley Eastern Ltd., Meerut 1989.
3. Sharma B. K., Industrial chemistry, Goel publishing house, 2011.
4. Norris Shreve R and Brink J. A., Jr. Chemical Process Industries. 4th Edition, McGraw Hill, Tokyo, 1977.
5. Chakrabarty B. N., Industrial Chemistry, Oxford & IBH Publishing Co., New Delhi, 1981.
6. Singh P. P., Joseph T. M and Dhavale R. G., College Industrial Chemistry, 4th Edition, Himalaya Publishing House, Bombay, 1983.

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 10 Questions of 2 Marks each-No choice 2**0 Marks**

**PART B :** 2 Questions from each unit of internal choice, each carrying 16 Marks. 8**0 Marks**

(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB7004 | SURFACE CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of adsorption and adsorption isotherms.
- To learn the pore size and particle size distribution of absorbents and theories of solid liquid interface..
- To study the properties and applications of colloidal systems.

**UNIT 1 ADSORPTION ISOTHERM 12 Hrs.**

Introduction to Adsorption Solid/Gas interface: Physical adsorption and Chemical Adsorption. Adsorption of gases on solids, Adsorption isotherms: Freundlich adsorption isotherm, Langmuir adsorption isotherm. Draw Backs of Langmuir adsorption isotherm. Industrial adsorbent materials: Role of adsorbents in catalysis and water softening.

**UNIT 2 PORE SIZE AND SURFACE AREA 12 Hrs.**

Introduction to Pore size, Pore volume and Surface Area. Porosity – Micro, Mesoporous materials. The BET adsorption isotherm - Determination of BET Surface area measurement. Significance of Surface area.

**UNIT 3 PARTICLE SIZE DISTRIBUTION 12 Hrs.**

Introduction to Particle Size Distribution – Representation of particle size distribution – Unimodel and Bimodel with examples. Measurement by Laser diffraction and Dynamic Light Scattering – Significance of Particle size.

**UNIT 4 SOLID LIQUID INTERFACE 12 Hrs.**

Introduction to Solid liquid interface - The stability of solid/liquid interface by zetapotential. Determination of zetapotential and its significance.

**UNIT 5 COLLOIDS 12 Hrs.**

Introduction - Colloidal State – Lyophilic and Lyophobic colloids. Coagulation. Contact angle measurement by sorption method. Surface Energy Measurements.

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the basic concepts of adsorption and adsorption isotherms..
**CO2 -** Apply the pore size distritubion and surface area significance to materials.
**CO3 -** Explain the significance of particle size distribution of materials.
**CO4 -** Determine the zetapotential for solid/liquid interface.
**CO5 -** Determine the surface energy and contact angle measurements for various colloidal systems.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

**TEXT / REFERENCE BOOKS**

1. Mukhlyonov I., (ed.), Chemical Technology, Vol.1, 3rd Edition, Mir publication, Moscow, 1979.
2. De A. K., Environmental Chemistry, 11th Edition, Wiley Eastern Ltd., Meerut 1989.
3. Sharma B. K., Industrial chemistry, Goel publishing house, 2011.
4. Norris Shreve R and Brink J. A., Jr. Chemical Process Industries. 4th Edition, McGraw Hill, Tokyo, 1977.
5. Chakrabarty B. N., Industrial Chemistry, Oxford & IBH Publishing Co., New Delhi, 1981.

6. Singh P. P., Joseph T. M and Dhavale R. G., College Industrial Chemistry, 4th Edition, Himalaya Publishing House, Bombay, 1983.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB7005 | HETEROGENEOUS CATALYSIS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of catalysis and kinetics in chemical reaction.
- To study the preparation and characterization of catalyst materials.
- To learn the various catalytic processes and green catalytic applications.

**UNIT 1 INTRODUCTION TO CATALYSIS 12 Hrs.**

Catalyst – Homogeneous and Heterogeneous catalysts: Definition of catalytic activity, Conversion, selectivity, contact time, time on stream, Kinetics of heterogeneous catalysis, adsorption, phase transfer catalysis, Inter and intramolecular catalysis, enzyme catalysis, photocatalysis and promoters, stabilizers, activation energies.

**UNIT 2 CATALYSTS PREPARATION 12 Hrs.**

General Synthesis methods - Sol-gel method, Colloidal method, hydrothermal method, CVD, PVD, Laser ablation method, Electric arc discharge method – Definition: surface area, pore volume, pore size, particle size, porous materials and its classification. Catalysts Preparation: Microporous materials (Zeolites, AlPO-5, 11, Carbon) Mesoporous materials (MCM-41, MCM-48, SBA-15, Alumina and Carbon), Super acids and Hydrotalcites.

**UNIT 3 CATALYST CHARACTERIZATION TECHNIQUES 12 Hrs.**

Surface area measurements, XRD, ESCA (XPS, UPS and AES), ESR, NMR, MASS, Raman, IR spectroscopy and UV-Vis, Surface acidity (spectral and thermal methods), Thermal methods; TG-DTA, TPD, TPR, Electron microscopy (SEM, TEM and AFM) and probe molecule characterizations (pyridine, ammonia, NO and CO adsorption).

**UNIT 4 OPERATING CATALYTIC PROCESS AND CATALYST DEACTIVATION 12 Hrs.**

Mechanism of performing mass transfer effect in chemical reactions, metal-support interaction, reactors – batch reactor, flow reactor, trickle bed and fluidized bed reactor - Poisons, sintering of catalysts, Pore mouth plugging and uniform poisoning models, Kinetics of deactivation, Catalyst regeneration.

**UNIT 5 INDUSTRIAL CATALYTIC PROCESSES AND GREEN CATALYSIS 12 Hrs.**

Cracking, reforming, alkylation, isomerization, hydrogenation/dehydrogenation, dehydrocyclisation, dehydrosulphurization, hydrocracking, oxidation, metathesis, carbonylation, polymerization, synthetic fuels, hydrogen generation. Green solvents (Industrial applications, Volatile Organic compounds), Biofuels (Ethanol, Biodiesel), Solar cells and Fuel Cells.

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the basic concepts of homogeneous and hetergeneous catalytic process.
**CO2 -** Explain the various synthetic methods for microporous and mesoporous materials.
**CO3 -** Analyse the catalyst materials by various characterization techniques.
**CO4 -** Apply the catalytic mechanism to catalytic processes involving reactors.
**CO5 -** Understand the different catalyst reactions involved in industrial processes.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCES BOOKS

1. Jens Hagen, “Industrial catalysis”, 2nd Edition, Wiley-VCH Verlay Gambh& Co, 2006.
2. Herman Pines, “The chemistry of catalytic hydrocarbon conversions”, Academic Press, New York, 1981.
3. R. Pearce and W.R.Patterson, “Catalysis and chemical processes”, Leonard Hill, London, 1981.
4. Charles, N. Satterfield, “Heterogeneous catalysis in industrial practice”, 2ndEdn. Mc.Graw Hill, International Edition, Singapore, 1993.
5. B.Viswanathan, “Catalysis for selected application”, Narosa, 2009.
6. Viswanathan, S.Kannan and R.C. Deka, “Catalysts and surfaces: Characterization techniques”, Alpha science international Ltd., UK., 2006.

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB7006 | SUPRAMOLECULAR AND NANO CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the principles of binding interactions in supramolecular compounds.
- To learn the synthesis, properties and applications of nanomaterials.
- To study the basic principles and applications of green chemistry.

**UNIT 1 INTRODUCTION TO SUPRAMOLECULAR CHEMISTRY 12 Hrs.**

Introduction. Classification of supramolecules. Nature of binding interactions in supramolecular structure - ion-ion, ion-dipole, dipole-dipole, h-bonding and cation –pi bonding and anion-pi, pi-pi and vander waals interactions.

**UNIT 2 INTRODUCTION TO NANOMATERIALS 12 Hrs.**

Introduction: Nanomaterials: Definition – Classification based on dimensions-Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by chemical reduction method. Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism.

**UNIT 3 CARBON MATERIALS 12 Hrs.**

Allotropes of carbon – Diamond, Graphite and Fullerenes. Introduction to Carbon Nanotubes, Carbon Microtubes, Graphene and their applications.

**UNIT 4 CARBON NANOTUBES 12 Hrs.**

Carbon Nanotubes (CNTs): Single walled and multi walled nanotubes – Mechanical and Electrical properties of CNTs – Applications of CNTs – Synthesis of CNTs by electric arc discharge method, Laser ablation method and CVD method.

**UNIT 5 GREEN CHEMISTRY 12 Hrs.**

Introduction, the Basic principles of Green Chemistry, Green Synthesis, Green Catalysts, Microwave and Ultrasound Assisted Green Synthesis.

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Understand the basic concepts of host-guest interaction involved in supramolecular chemistry.
**CO2 -** Analyse the various size dependent properties of synthesized nanomaterials.
**CO3 -** Understand the various allotropes of carbon nanomaterials.
**CO4 -** Examine the properties and applications of carbon nanotubes.
**CO5 -** Apply the principles of green chemistry to chemical laboratories.
**CO6 -** Evaluate the basic concept of chemistry to real world applications

**TEXT / REFERENCES BOOKS**

1. C.David Gutsche , *Philip* Gale, Rocco Ungaro, J. Fraser Stoddart, Alan E. Rowan, Stuart J. Rowan, Takuzo Aida, Calixarenes Softcover (Monographs in Supramolecular Chemistry) CRC Press; New edition edition (10 June 1993)
2. M.S. Ramachandra Rao & Dr. Shubra Singh, Nanoscience and Nanotechnology Wiley, 2013.
3. V. K. Ahluwalia, M. Kidwai, New trends in Green Chemistry, Kluer Academic Publishers

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)

| SCYB3007 | FOOD CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic principles of Food Chemistry and the importance of good health
- To learn about the functions and importance of nutrients and a balanced diet
- To learn about the various quality control processes in the food industry

**UNIT 1 FOOD, ENERGY AND HEALTH 9 Hrs.**

Food as a source of nutrients – sources and functions of food – nutrients – adequate, optimum, good and malnutrition – Food pyramid – different food groups – food guide - Proper diet – food in relation to health - Food as a source of energy – determination of energy value of food – energy yielding nutrients - Factors influencing energy requirements – recommendations for different age groups and special conditions – Recommended dietary allowances.

**UNIT 2 FOOD ADDITIVES 9 Hrs.**

Artificial sweeteners – saccharin, cyclomate, and aspartame – food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking. Emulsifying agents - preservatives – leavening agents. Baking powder –Yeast - Taste enhancers – MSG - vinegar.

**UNIT 3 FOOD AND BEVERAGE 9 Hrs.**

Production of bread, bun and biscuits - Raw materials, methods and machinery required - Candy manufacturing – Caramelization - Fast foods - Instant foods - Dehydrated foods - Oleoresin of spices – Condiments - Beverages: Soft drinks, soda, fruit juices and alcoholic beverages - Examples, Carbonation - Addiction to alcohol - Cirrhosis of liver. Social problems. Composition of soft drinks - Nitrogen preservation and packing of fruit juices.

**UNIT 4 BALANCED DIET 9 Hrs.**

Nutrition – calorific value of food – Respiratory quotient of food – basal metabolic rate – factors influencing BMR and specific dynamic action of food. Energy requirements of individuals – diet and its components – the protein requirements –Protein malnutrition - Nutritional value of carbohydrates. – Fibers in the diet, dietary sugars – nutritional aspects of lipids.

**UNIT 5 FOOD ADULTERATION AND QUALITY CONTROL 9 Hrs.**

Adulterants: Common adulterants in different foods – Contamination with toxic chemicals – pesticides and insecticides - Principles involved in the analysis of detection and prevention of food adulteration - Food preservation and processing: Food deterioration, methods of preservation and processing - Quality control: Specifications and standards - PFA, FPO, FDA, drug license, WHO standards, BIS specifications - packing and label requirements - essential commodities act - consumer protection act.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1 -** To learn the nutrient value and energy value of food groups obtained through proper diet.
**CO2 -** To learn the properties of food additives and their role as food value enhancers.
**CO3 -** To analyse the role of materials in the method and machinery required in food processing.
**CO4 -** To understand the energy requirements of individuals in the form of food.
**CO5 -** To understand the quality specifications of food in terms of detection and prevention of food adulteration.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCE BOOKS

1. Alex Ramani V, Food Chemistry, MJP Publishers, Triplicane, Chennai, 2009.
2. M. Swaminathan Advanced Text Book on Food and Nutrition, Vol. I Printing and Publishing Co., Ltd., Bangalore. 1993.
3. M. Swaminathan Advanced Text Book on Food and Nutrition, Vol II Printing and Publishing Co., Ltd., Bangalore. 1993.
4. B. Srilakshmi Nutrition Science, New Age International Pvt. Ltd Publishers, New Delhi, Bangalore. 2003.
5. S N Manay and S Swamy Food, facts and Principles, Wiley Eastern Ltd, New Delhi. 1987.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3008 | CHEMISTRY OF PHARMACEUTICAL, PESTICIDES AND COSMETICS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn about the Glidants, lubricants, diluents, preservatives, antioxidants, emulsifying agents, coating agents, binders, coloring agents, flavouring agents, gelatin
- Synthesis of paracetamol, ibuprofen and chloramphenicol
- Classification of Drugs based on Antibacterial, antifungal, antiviral and Cardiovascular agents.

**UNIT 1 PHARMACEUTICAL AGENTS I 9 Hrs.**

Various types of pharmaceutical excipients – their chemistry, process of manufacture and quality specifications – Glidants, lubricants, diluents, preservatives, antioxidants, emulsifying agents, coating agents, binders, coloring agents, flavouring agents, gelatin and other additives, sorbitol, mannitol, viscosity builders etc.

**UNIT 2 DRUGS AND PHARMACEUTICAL AGENTS I 9 Hrs.**

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, antiinflammatory agents (Aspirin, paracetamol, Ibuprofen); antibiotics (Chloramphenicol)

**UNIT 3 DRUGS AND PHARMACEUTICAL AGENTS II 9 Hrs.**

Antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine).

**UNIT 4 PESTICIDES 9 Hrs.**

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion ); Carbamates (Carbofuran and carbaryl); Quinones ( Chloranil), Anilides (Alachlor and Butachlor).

**UNIT 5 COSMETICS& PERFUMES 9 Hrs.**

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Understand the impact of pharmaceuticals.
**CO2 -** Retero synthetic approach for the Analgesic and Antipyretic drugs.
**CO3 -** Classification of Drugs with respect to antiviral, antifungal and antibacterial activity.
**CO4 -** Pesticides role in disease control management.
**CO5 -** Cosmetics& Essential oils and their importance in Daily life.
**CO6 -** Evaluate the basic concept of chemistry to real world applications.

## TEXT / REFERENCE BOOKS

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.
2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, VallabhPrakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.
4. E. Stocchi: Industrial Chemistry,Vol -I, Ellis Horwood Ltd. UK.
5. P.C. Jain, M. Jain: Engineering Chemistry, DhanpatRai& Sons, Delhi.
6. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut(1996).
7. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3009 | AGRICULTURAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To learn about agricultural chemistry
- To analyse a suitable method to cultivate and promote agricultural growth.
- Understand the role of fungicide, pesticide and herbicides.

**UNIT 1 SOIL CHEMISTRY 9 Hrs.**

Introduction: Formation of Soil. Classification of Soil and properties of Soil–Soil acidity-Causes-Soil alkalinity-causes-determination of soil pH- Buffering of soil-Limitation of Soil-availabiltiy of soil nutrients to plants-Reclamation of Soil.

**UNIT 2 FERTILIZERS 9 Hrs.**

Fertilizers - Classification of fertilizers - Requisites of good fertilizers - Nitrogenous fertilizers - Phosphatic fertilizers - super Phosphate of lime - NPK fertilizers - ill effects of fertilizers - effect of mixed fertilizers on soil pH - Micronutrients - role of micronutrients sources- Need for nutrient balance - Soil management and Micronutrients needs.

**UNIT 3 MANURES 9 Hrs.**

Bulky organic manures – Farm yard manure – handling and storage. Oil cakes. Blood meal –Meat meal-Fish meal and green manures.

**UNIT 4 PESTICIDES AND FUNGICIDES 9 Hrs.**

Pesticides-Classifiation of Insecticides-Stomach and contact poisons-Fumigants –Insecticides-Organic insecticides-DDT, Gammaxene-Malathion- Parathion.

**UNIT 5 FUNGICIDES AND HERBICIDES 9 Hrs.**

Fungicides: Inorganic (Bordeaux Mixture) and organic (dithiocarbamate). Industrial fungicides: creosote fractions.

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

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Outline soil chemistry and its nutrient content.
**CO2 -** To learn the classification of fertilizers and the manures.
**CO3 -** Explain the method of handling and storage of manures.
**CO4 -** Examine the side effects of pesticides and fungicides.
**CO5 -** Identify the composition of fungicides and herbicides.
**CO6 -** Evaluate the basic concept of agricultural chemistry to real world applications

**TEXT / REFERENCES BOOKS**

1. G.T. Austin :shreve's Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984
2. B.A. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow), 1976.

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**

**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB3010 | POLYMER CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- Learn the characteristics and classification of polymers based on polymerisation of monomers.
- Identify types of polymers and various polymer degradation processes.
- Understand compounding process in moulding methods.

**UNIT 1 INTRODUCTION TO POLYMERS 9 Hrs.**

Monomers, Oligomers, Polymers and their characteristics. Classification of polymers: Natural, synthetic, linear, cross linked and network, Plastics, elastomers, fibres, Homopolymers and Co-polymers. Bonding in polymers: Primary and secondary bond forces in polymers, cohesive energy. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and weight average molecular mass (Mw) of polymers.

**UNIT 2 MECHANISM OF POLYMERIZATION 9 Hrs.**

Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization, Step growth polymerisation.

**UNIT 3 TECHNIQUES OF POLYMERIZATION AND POLYMER DEGRADATION 9 Hrs.**

Bulk, Solution, Emulsion, Suspension, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers.

**UNIT 4 INDUSTRIAL POLYMERS 9 Hrs.**

Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde and expoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers: Elementary ideas, examples: poly sulphur nitriles, poly phenylene, poly pyrrole and poly acetylene.

**UNIT 5 INTRODUCTION TO POLYMER PROCESSING 9 Hrs.**

Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On successful completion of the course, student will be able to

**CO1 -** Explain the characteristics and classification of polymers.
**CO2 -** Oultine the mechanism involved in different types of polymerization reactions.
**CO3 -** Understand polymerization reactions and polymer degradation processes.
**CO4 -** Analyze polymers starting from various monomers.
**CO5 -** Assess the basics concept of conducting polymers and importance of moulding methods.
**CO6 -** Evaluate the basic concept of polymer chemistry to real world applications

## TEXT / REFERENCE BOOKS

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995
2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Ltd, 1996
3. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971
4. A. Kumar and S.K. Gupta, Fundamentals of Polymer Science and Engineering, Tata McGraw-Hill, 1978

## END SEMESTER EXAMINATION QUESTION PAPER PATTERN

**Max. Marks: 100** **Exam Duration: 3 Hrs.**

**PART A:** 10 Questions of 2 marks each-No choice **20 Marks**
**PART B:** 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**
(Out of 100 Marks, maximum of 10% problems may be asked.)

| SCYB7007 | MEDICINAL CHEMISTRY | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the basic knowledge about drugs used in pharmacology.
- To explain the drug absorption process and its metabolis activities in medicinal chemistry.
- To know the importance of drugs in diabetic studies.

**UNIT 1 PHARMACOLOGY 12 Hrs.**

Interdisciplinary nature of medicinal chemistry – Pharmacology, Molecular Pharmacology, Microbiology, Biochemistry, Physiology, Medicine and Pharmacy. Classification of Drugs – Central Nervous system acting drugs- (General and Local anaesthetics, Sedatives and Hypnotics, Anticonvulsants, Narcotic and Non-narcotic analgesics, Anti-Parkinsonian agents, Anti-depressants, Tranquilizers, Psychomimetics), Pharmacodynamic agents (Anti-arrythmics, Anti-anginals, Vasodialators, Anti-hypertensives, Diuretics, Antihistamines), Chemotherapeutic Agents (Antibiotics, Antivirals, Antifungals), Drugs for metabolic and endocrine disorders (Anti-thyroid drugs, Antidiabatic drugs, biosynthetic insulin) (Definitions with examples).

**UNIT 2 PHARMACOKINETICS AND PHARMACODYNAMICS 12 Hrs.**

Pharmacokinetics: Introduction to drug absorption, disposition, elimination using pharmacokinetics − Important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process. Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, suphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

**UNIT 3 DRUGS OF IMPORTANCE 12 Hrs.**

Anti-neoplastic drugs: Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Mechlorethamine, cyclophosphamides, mustards and mercaptopurine. Recent development in cancer chemotherapy. Anticonvulsant drugs: Hydantoin, Barbiturates, Valium (Diazepan). Analgesics, antipyretic and anti inflammatory agents – Narcotic analgesic: Morphine, Codine – structure activity relationship of morphine – Synthetic analgesic – Pethadine, Benzomorphan non-narcotic analgesics – Nalorphine, Aspirin, Antibiotics: Classification based on the spectrum of biological action of antibiotics and the chemical structure. Penicillin, Streptomycine – structure, properties, structure activity relationship. Diabetes and hypoglycemic drugs – Chemical structure of insulin.

**UNIT 4 DRUG DESIGN 12 Hrs.**

Development of new drugs − Procedures followed in drug design − Concepts of lead compound and lead modification − Concepts of prodrugs and soft drugs − Structure-activity relationship (SAR) − Factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug-receptor interactions.

**UNIT 5 THEORIES OF DRUG ACTIVITY AND QUANTITATIVE ANALYSIS 12 Hrs.**

Occupancy theory − Rater theory − Induced fit theory − Activation-aggregration theory. Principles of quantitative analysis of the following drugs in formulation i) Aspirin ii) Benzylpenicillin iii) Ascorbic acid iv) Chloramphenicol v) Folic acid.

**Max. 60 Hrs.**

## COURSE OUTCOMES

On completion of the course the student will be able to

**CO1 -** To understand the classifications of drugs in medicinal chemistry
**CO2 -** To explain the different types of drug activities and significance in medicinal chemistry.
**CO3 -** To understand the importance of antineoplastic drugs, antibiotics and hypoglycemic drugs.
**CO4 -** To understand of various drug design pattern for quantitative drug discovery.
**CO5 -** To have the basic knowledge of factors affecting bioactivity.
**CO6 -** To understand various theories and concepts of drug activities in quantitative analysis.

## TEXT / REFERENCE BOOKS

1. Taylor J. B., and Kenewell P. D., Introductory Medicinal Chemistry, Halsted Press, 1985.
2. Lea and Febige, Principles of medicinal chemistry, 3rd Edition, Varghese Company, Bombay, 1989.
3. Patrick G. L., An introduction to medicinal chemistry, Oxford University Press, 1995.
4. Korolkoras and Burckhalter, Essentials of medicinal chemistry, Wiley, 1976.
5. Beckett and Stenlak, Practical pharmaceutical chemistry, Athlone Press of the University of London, 1988.

## END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10 problems may be asked)

| SCYB7008 | CHEMISTRY OF MATERIALS | L | T | P | EL | Credits | Total Marks |
|---|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES**

- To understand the fundamentals of nanoscience and technology.
- To know the various synthetic methods of various dimensional nanomaterials.
- To illustrate the characterization of nanomaterilas using different instrumental techniques.

**UNIT 1 INTRODUCTION TO NANOMATERIALS 12 Hrs.**

0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms – specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States – the General Methods available for the Synthesis of Nanostrutures – precipitative – reactive – hydrothermal/solvothermal methods – suitability of such methods for scaling – potential Uses.

**UNIT 2 SYNTHESIS OF NANOMATERIALS 12 Hrs.**

Bulk synthesis-sol gel processing – Mechanical alloying and mechanical milling – Inert gas condensation techniques – Chemical approaches – Biomimetic Approaches – Electrochemical Approaches – Physical approaches.

**UNIT 3 CHARACTERIZATION OF NANOMATERIALS 12 Hrs.**

X-Ray Diffraction – Thermal analysis methods – Qualitative and Quantitative Analysis – Spectroscopic Techniques – Nanoindentation.

**UNIT 4 IMAGING TECHNIQUES 12 Hrs.**

Optical microscopy – Scanning electron microscopy – Transmission electron microscopy – Atomic force microscopy – Scanning tunneling microscopy.

**UNIT 5 APPLICATIONS 12 Hrs.**

Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics – Carbon Nanotube – Photonics- Nano structures as single electron transistor – principle and design, pharmaceutical applications, semiconductor nanodevices,

**Max. 60 Hrs.**

**COURSE OUTCOMES**

On completion of the course the student will be able to

**CO1 -** Explain the introduction and properties of nanomaterials for potential use.
**CO2 -** Discuss the various synthetic methods for preparing nanomterials.
**CO3 -** Characterize the nanomaterials using advanced instrumentation techniques.
**CO4 -** Understand the basic instrumentation of different microscopic techniques.
**CO5 -** Understand the basic concepts of molecular electronics and nanoelectronics**.**
**CO6 -** Illustrate the applications of nanomaterials in different fields.

**TEXT / REFERENCE BOOKS**

1. Goldstein D. E., Newbury D.C. Joy and Lym C.E., Scanning Electron Microscopy and X-ray Microanalysis, Springer Publications, 2003.
2. Flegler S.L., Heckman J.W and Klomparens K.L., Scanning and Transmission Electron Microscopy: A Introduction, WH Freeman & Co, 1993.
3. Goodhew P.J., Humphreys J and Beanland R., Electron Microscopy and Analysis, 3rd Edition, Taylor & Francis, London, 2001.
4. Haynes R., Woodruff D. P and Talchar T. A., Optical Microscopy of Materials, Cambridge University Press, 1986.

5. Cullity B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
6. Loretto M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.
7. Rose R. M., Shepard L. A and Wulff J., The Structure and Properties of Materials, Wiley Eastern Ltd, 1968.
8. Mott B. W., Micro-Indentation Hardness Testing, Butterworths, London, 1956.
9. Gaponenko S. P., Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.
10. Gaddand W., Brenner D., Lysherski S and Infrate G.J., (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 2002.

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100** **Exam Duration : 3 Hrs.**

**PART A :** 6 Questions each carrying 5 marks without choice **30 Marks**
**PART B :** 2 Questions from each unit of internal choice, each carrying 14 marks **70 marks**
(Out of 100 marks, maximum of 10% problems may be asked)