Chaudhary Devi Lal University Sirsa

(Establishment by the State Legislature Act 9 of 2003)

B.Sc. (Multidisciplinary)

Scheme of Examination & Syllabus
for
Chemistry Subject
in
Under Graduate Programmes
as per NEP 2020
1st to 2nd Semester (1st Year)

With effect from the session 2024-25

DEPARTMENT OF CHEMISTRY

Chaudhary Devi Lal University

Sirsa-125055

Course and Credit Scheme of Under Graduate Programmes in Chemistry - Multidisciplinary

Sr. No.	Course Code	Course Title	Credits			Level
Discipline Specific Courses (DSC)			**T**	**P**	**Total**	
1	BSC/CHEM/MD/1/DSC/101	Chemistry-I	3	1	4	100
3	BSC/CHEM/MD/2/DSC/102	Chemistry-II	3	1	4	100

Sr. No.	Course Code	Course Title	Credits			Level
Minor (MIC) Courses in Chemistry			**T**	**P**	**Total**	
1	BSC/CHEM/MD/1/MIC/101	Chemistry Minor -I	2		2	100
2	BSC/CHEM/MD/2/MIC/102	Chemistry Minor –II	2		2	100
Multidisciplinary Courses (MDC) in Chemistry			**L**	**P**	**Total**	**Level**
1	CDLU/CHEM/MDC/1/101	Introduction Chemistry-I	2	1	3	100
2	CDLU/CHEM/MDC/2/102	Introduction Chemistry-II	2	1	3	100
Skill Enhancement Courses (SEC) in Chemistry			**L**	**P**	**Total**	**Level**
1	CDLU/CHEM/SEC/1/101	Pesticide Chemistry	2	1	3	100
2	CDLU/CHEM/SEC/1/102	Fuel Chemistry	2	1	3	100
3	CDLU/CHEM/SEC/2/103	Basic Analytical Chemistry	2	1	3	200
4	CDLU/CHEM/SEC/2/104	Green Methods in Chemistry	2	1	3	200

Table: 2 Semester wise Course code and Title along with credit details
Under Graduate Programmes in chemistry
Multidisciplinary

Course Code	Course Title	Credits				Marks
Semester I						
		T		**P**	**Total**	
BSC/CHEM/MD/1/ /101	Chemistry - I	3		1	4	100
	anyone from Science discipline					100
	anyone from Science discipline					100
BSC/CHEM/MD/1/MIC/101	Chemistry Minor - I	2			2	50
CDLU/CHEM/SEC/1/101 or CDLU/CHEM/SEC/1/102	Pesticide Chemistry or Fuel Chemistry	2		1	3	75
CDLU/AEC/1/101	Proficiency in English/Hindi/Punjabi/ Sanskrit	2			2	50
CDLU/VAC/1/101	To be selected from the central pool of Multidisciplinary/Value Added Courses	2			2	50
CDLU/CHEM/MDC/1/101	Introduction To Chemistry-I	2		1	3	75
Total					**24**	**600**
Semester II						
BSC/CHEM/MD/2/DSC/102	Chemistry - II	3		1	4	100
	anyone from Science discipline					100
	anyone from Science discipline					100
BSC/CHEM/MD/2/MIC/102	Chemistry Minor - II	2			2	50
CDLU/CHEM/SEC/2/103 or CDLU/CHEM/SEC/2/104	Basic Analytical Chemistry Or Green Methods in Chemistry	2		1	3	75
CDLU/AEC/2/102	Proficiency in English/Hindi/Punjabi/ Sanskrit	2			2	50
CDLU/VAC/2/102	To be selected from the central pool of Multidisciplinary/Value Added Courses	2			2	50
CDLU/CHEM/MDC/2/102	Introduction To Chemistry-II	2		1	3	75
Total					**24**	**600**

FIRST SEMESTER

BSC/CHEM/MD/1/DSC/101- Chemistry - I

DURATION: 3+4 HOURS **MAXIMUM MARKS: 100**
Theory: 75 (External 50 + Internal 25), Practical: 25 (External 25+ Internal 00)

Course Objective: To make students to understand basics of chemistry.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:
CO1: Enable to understand the basics of atomic structure and periodic properties.
CO2: To learn about the gaseous state & solid state.
CO3: Get knowledge about the structure & bonding and stereochemistry of organic compounds.
CO4: To learn about the redox titrations and synthesis of organic compounds.

Unit-I

Atomic Structure

Dual behaviour of matter and radiation, de Broglie's relation, Heisenberg's uncertainty principle, concept of atomic orbitals, significance of quantum numbers, radial and angular wave functions, normal and orthogonal wave functions, significance of ψ and ψ^2, shapes of s, p, d and f orbitals, rules for filling electrons in various orbitals, effective nuclear charge, Slater's rules

Periodic Table and Atomic Properties

Classification of periodic table, definition of atomic and ionic radii, ionization energy, electron affinity and electronegativity, trends in periodic table (in s and p block elements), Pauling, Mulliken, Allred Rachow and Mulliken Jaffe's electronegativity scale.

Unit-II

Gaseous State

Kinetic theory of gases, Maxwell's distribution of velocities and energies (derivation excluded), Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision frequency and mean free path (derivation excluded), Deviation of real gases from ideal gas behaviour, derivation of van der Waal's equation of state, its applications in the calculation of Boyle's temperature (compression factor), Explanation of behaviour of real gases using van der Waal's equation

Solid State

Classification of solids, Elements of symmetry and symmetry elements of crystals, definition of unit cell and space lattice, bravais lattices, crystal system, Laws of crystallography – Law of constancy of interfacial angles, law of rationality of indices and law of symmetry, Miller Indices X-ray diffraction by crystals, derivation of Bragg's law and Bragg's equation, Determination of crystal structure of NaCl and KCl.

Unit-III

General Organic Chemistry

Localized and Delocalized chemical bond, van der Waal's interactions, resonance and its conditions and applications, hyperconjugation, inductive effect, electromeric effect and their comparison

Stereochemistry of Organic Compounds

Types of isomerism, optical isomerism - elements of symmetry, molecular chirality, chiral and achiral molecules with two stereogenic centres, enantiomers and their properties, diastereomers and their properties, erythro and threo diastereomers, meso compounds,

Difference between conformations and configurations, Newmann and Sawhorse projections, Fischer and Flying wedge configurations

Conformational isomerism – conformational analysis of ethane and n-butane, conformations of cyclohexane

Relative and absolute configurations, sequence rules, R & S systems of nomenclature

Geometric isomerism – cis, trans isomerism, E & Z system of nomenclature

Unit-IV (Practical)

1. Titrimetric Analysis: (i) Calibration and use of apparatus (ii) Preparation of solutions of different concentration
2. Standardization of different solution.
3. Redox titrations: Determination of Fe^{2+}, $C_2O_4^{2-}$ (using $KMnO_4$ and $K_2Cr_2O_7$)
4. To determine the surface tension of a given liquid by drop number method using stalagmometer.
5. To prepare m-dinitrobenzene from nitrobenzene using nitrating mixture
6. To prepare Iodoform from acetone/ ethyl alcohol

Reference Readings:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
3. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
4. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Peter Atkins, Julio de Paula, James Keeler Atkins' Physical Chemistry, Oxford University Press.
6. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
7. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
8. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
9. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.

10. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
11. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
12. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
13. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
14. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
15. Pradeep's Organic Chemistry, Volume I & II.
16. B. R. Puri, Madan S. Pathania, L. R. Sharma Principles of Physical Chemistry, Vishal Publications.
17. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
18. Advanced Practical Organic Chemistry, N K Vishnoi.
19. Advanced Practical Physical Chemistry, J B Yadav.
20. Advanced Practical Inorganic Chemistry, Gurdeep Raj.

Note for the Theory Paper Setter: The question paper will consist of seven questions in all. The first question will be compulsory and will consist of four short questions of 2 marks each covering the whole syllabus from unit 1^{st}, 2^{nd} and 3^{rd}. In addition, six more questions of 14 marks each will be set unit-wise comprising of two questions from each of the three units (I, II, III). The candidates are required to attempt one compulsory question and three more questions selecting at least one question from each unit.

Note:- Unit IV only practical purpose.

BSC/CHEM/MD/1/MIC/101 – Chemistry Minor - I

DURATION: 2 HOURS **MAXIMUM MARKS: 50**

Theory: 50 (External 35 + Internal 15)

Course Objective: To make students to understand alkanes, semiconductors and kinetics and bonding in molecules.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: To learn about the nomenclature, classification and methods of preparation of alkenes.
CO2: To learn about qualitative knowledge of conductors, semiconductors and insulators.
CO2: To get the basics of rates of chemical reactions and factors affecting it.
CO3: To understand the basics of covalent bonding in simple molecules.

UNIT I

Alkanes (up to 5 carbon atoms)

Alkanes, nomenclature, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, physical properties. Mechanism of free radical halogenation of alkanes: reactivity and selectivity.

Chemical Kinetics

Concept of reaction rates, rate equation, factors influencing the rate of reaction, Order and molecularity of a reaction, integrated rate expression for zero, first, second order reactions (for equal conc. of reactants), Half-life period of a reaction.

UNIT II

Metallic Bond and semiconductors

Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators). Semiconductors – Introduction, types, and applications

Covalent Bond

Valence bond theory approach, shapes of simple inorganic molecules and ions based on valence shell electron pair repulsion (VSEPR) theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Molecular orbital theory of homonuclear (N_2, O_2) and heteronuclear (CO and NO) diatomic molecules, dipole moment.

Learning Resources

1. Dhawan S. N., Organic Chemistry, Vol 1 Pardeep Publication.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania.
3. Concise Inorganic Chemistry, J. D. Lee.
4. Organic Chemistry, Morrison and Voyd.

Note for the Theory Paper Setter: Five questions will be set in all. Question No. 1 will be compulsory and will consist of seven short questions of one mark each (total marks 07) covering the whole syllabus from Unit (I, II). In addition, two more questions will be set from each unit consist of fourteen marks each. The candidate will be required to attempt two more question (14 marks), in addition to compulsory Question.

CDLU/CHEM/MDC/1/101 - Introduction to Chemistry-I

DURATION: 3+4 HOURS **MAXIMUM MARKS: 75**

Theory: 50 (External 35 + Internal 15), Practical: 25 (External 20 + Internal 05)

Course objective: The course provides an insight into the common things in chemistry.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: To get knowledge about structure and bonding.

CO2: To get aware about different polymers and get knowledge about preservative.

CO3: To get knowledge about experiments related to daily life.

UNIT I

Atomic Structure Concept of Bonding (1-20)

Introduction, Elementary introduction of atomic structure, Representation of elements/ atoms, Bhor Model, Lewis's dot structure, electronic configurations, Ionization Energy, Electron Affinity Electro Negativity, Types of Bonding

Carbon and its Compounds

Introduction, Tetravalency of Carbon, allotropes of carbon and their properties, hydrocarbons (1-5), Nomenclature (linear compounds), Applications of hydrocarbons.

UNIT II

Polymers

Introduction, elementary idea of polymer, Types of polymers: Natural, synthetic, semi-synthetic Homo polymers and copolymers, uses of polymer (Natural rubber, Vulcanized rubber, Polyethene, PVC, Styrene, Teflon, PAN, Nylon-66)

Food Preservatives

Elementary idea of natural and synthetic food preservatives, rancidity, uses and properties, different food preservation processes (pickle, Jam), artificial sweeteners, uses and properties

UNIT III (Practical)

Practicals:

1. Preparation of solution of different concentration.
2. Identify the pH of the given samples through pH strip/pH meter.
3. Experiments related to persevering food items.
4. To synthesize some polymers as per available resources.

Learning Resources

1. Subbulakshmi G, Food processing and preservation, New Age International Publishers.
2. Manas Chanda, 2013, Introduction to Polymer Science and Chemistry 2nd Edition.
3. Making Rayon Fiber - Artificial silk, chemical experiment!
4. How to make silk from cotton wool ("Artificial silk" experiment).
5. Neelam Seedher, Basic Concepts: Physical Chemistry Experiments, Kindley Edition.

Note for the Theory Paper Setter: The question paper will consist of five questions in all. The first question will be compulsory and will consist of seven short questions of 1 mark each covering the whole syllabus from 1st and 2nd unit. In addition, four more questions of 14 marks each will be set unit-wise (I, II) comprising of two questions from each of the two units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.

Note:- Unit III only practical purpose.

CDLU/CHEM/SEC/1/101: Pesticide Chemistry

DURATION: 3+4 HOURS **MAXIMUM MARKS: 75**

Theory: 50 (External 35 + Internal 15), Practical: 25 (External 20 + Internal 05)

Course Objective: To make students skilled in Pesticides.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: Students will be able to learn about the preparation and uses of pesticides in everyday life.

CO2: Get the knowledge of Pesticide formulations.

CO3: Generate knowledge of Pesticide formulations and their toxicity.

UNIT I

Introduction: Classification, synthesis, structure activity relationship (SAR), mode of action, uses and adverse effects of representative pesticides in the following classes: Organochlorines (DDT, Gammaxene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Botanical insecticides [No structure elucidation or synthesis is required for the following Compounds: Alkaloids (Nicotine); Pyrethrum (natural and synthetic pyrethroids); Azadirachtin; Rotenone and Limonene.

UNIT II

Pesticide Formulations: Wettable powders, Surfactants, Emulsifiable concentrates, Aerosols, Dust and Granules, Controlled Release Formulations

New Tools in Biological Pest Control: Repellants, Chemosterilants, Antifeedants.

UNIT III (Practical)

1. To carryout market survey of potent pesticides with details as follows:
   a) Name of pesticide b) Chemical name, class and structure of pesticide
   c) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes.
2. To carryout market survey of potent botanical pesticides with details as follows:
   a) Chemical name (active ingredient) and structure of active ingredient
   b) Useful information on label of packaging regarding: Toxicity, LD50 ("Lethal Dose, 50%"), Side effects and Antidotes.
3. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
4. Preparation of Neem Based Botanical Pesticide

Learning Resources

1. Perry, A.S.; Yamamoto, I.; Ishaaya, I.; Perry, R. Y. (1998), **Insecticides in Agriculture and Environment**, Springer-Verlag Berlin Heidelberg.
2. Kuhr, R. J.; Derough, H. W. (1976), **Carbamate Insecticides: Chemistry, Biochemistry and Toxicology**, CRC Press, USA.

Note for the Theory Paper Setter: The question paper will consist of five questions in all. The first question will be compulsory and will consist of seven short questions of 1 mark each covering the whole syllabus from 1st and 2nd unit. In addition, four more questions of 14 marks each will be set unit-wise (I, II) comprising of two questions from each of the two units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.

Note:- Unit III only practical purpose.

CDLU/CHEM/SEC/1/102: Fuel Chemistry

DURATION: 3+4 HOURS **MAXIMUM MARKS: 75**
Theory: 50 (External 35 + Internal 15), Practical: 25 (External 20 + Internal 05)

Course Objective: To make students skilled in Fuel Chemistry.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: The course covers both conventional petroleum-based fuels, and alternative & renewable fuels, including gaseous fuels. The students will learn the chemistry that underpins petroleum fuel technology, will understand the refining processes used to produce fuels and lubricants and will know how differences in chemical composition affect properties of fuels and their usage in different applications.

CO2: The course will also cover origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum. Further, course will cover various alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.).

CO3: The course will also cover fuel product specifications, various test methods used to qualify different types of fuels as well characterization methods.

UNIT I

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Determination of calorific value by Bomb calorimeter and Junker's calorimeter.

Coal: Analysis of coal, Proximate and ultimate Analysis, Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas composition and uses. Fractionation of coal tar, uses of coal tar-based chemicals, requisites of a good metallurgical coke, Coal gasification (Hydrogasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

UNIT II

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

UNIT III (Practical)

1. To prepare chart of calorific value of different fuel.
2. To determine the viscosity of biodiesel at various temperature.
3. To determine free fatty acid content in given sample.
4. To determine the density of the given fuel sample.
5. Simple Test Method (Density, Filter Paper Test) of Petroleum Product.

Learning Resources

1. Stocchi, E. (1990), **Industrial Chemistry**, Vol -I, Ellis Horwood Ltd. UK.

Note for the Theory Paper Setter: The question paper will consist of five questions in all. The first question will be compulsory and will consist of seven short questions of 1 mark each covering the whole syllabus from 1st, 2nd unit. In addition, four more questions of 14 marks each will be set unit-wise (I, II) comprising of two questions from each of the two units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.

Note:- Unit III only practical purpose.

SECOND SEMESTER

BSC/CHEM/MD/2/DSC/102: Chemistry-II

DURATION: 3+4 HOURS **MAXIMUM MARKS: 100**

Theory: 75 (External 50 + Internal 25), Practical: 25 (External 25 + Internal 00)

Course objective: To make students to understand bonding, structure of compounds & mechanism of reactions.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: Able to understand the different theories of covalent bonding & structure of solids.
CO2: To know the basics of hydrogen bonding & chemical kinetics of reactions.
CO3: To learn about the mechanism of organic reactions with special emphasis on alkanes & cycloalkanes.
CO4: To make the students to understand about the iodometry, chromatography and physical properties of liquids.

Unit-I

Covalent Bond

Valence bond theory and its limitations, types of bonds like covalent, ionic bond and dative bonds with examples, various types of hybridization and shapes of simple inorganic molecules and ions $BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, SO_4^{2-}, ClO_4^-$.

Valence Shell Electron Pair Repulsion theory to $NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, H_2O$

MO theory of homonuclear (H_2, N_2, O_2) and heteronuclear molecules (NO, NO^+, NO^-, CO, CO^+), and calculate their bond order, magnetic character. Concept of dipole moment and % ionic character in covalent bond.

Ionic Solids

Ionic structures (NaCl, CsCl, ZnS (Zinc blende), CaF_2). Radius ratio rule and its limitations, coordination number, Concept of lattice energy (mathematical derivation excluded) and Born Haber cycle, solvation energy and its relation with solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule.

Hydrogen Bonding & van der Waal's forces

Hydrogen Bonding - Definition, types, effects of hydrogen bonding on properties of substances, applications

Discussion of various types of van der Waals interactions

Unit-II

Acid and Base

Definition of pH and pK_a, Buffer solution, Buffer action, Handerson-Hazel equation, Buffer mechanism of buffer action

Chemical Kinetics

Rate of Reaction, rate equation, factors affecting the rate of reaction – concentration, temperature, light, catalyst. Order and molecularity of a reaction, Integrated rate expressions for zero, first order, second order, half-life period of reactions, their graphical representations also, Methods of determination of order of reaction, Effect of temperature on the rate of a reaction – Arrhenius equation. Theories of reaction rate – Simple collision theory for unimolecular and bimolecular collision, transition state theory for bimolecular reactions

Unit-III

Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows, homolytic and heterolytic bond fissions, types of reagents – electrophiles and nucleophiles, types of organic reactions - addition, substitution, condensation, elimination and rearrangement, pericyclic reactions.

Reaction intermediates – carbocations, carbanions, free radicals (preparation, structure and stability and reactions)

Alkanes

Classification of carbon atoms in alkanes, isomerism in alkanes, methods of preparation (with special reference to Wurtz reaction, Kolbe's electrolytic method, Corey-House reaction and decarboxylation of carboxylic acids, Sabatier and Sendern's reaction), physical properties, mechanism of halogenation of alkanes – reactivity and selectivity.

Cycloalkanes

Baeyer's ring strain theory and its limitations, theory of strainless rings.

Unit-IV (Practical)

1. **Iodometric titrations:** Determination of Cu^{2+} (using standard hypo solution)
2. To determine any one of the following cations and anions by paper chromatography: $Pb^{2+}, Cu^{2+}, Ca^{2+}, Ni^{2+}, Cl^{-}, Br^{-}, I^{-}, PO_4^{3-}, NO_3^{-}$
3. To determine the viscosity of a given liquid using Ostwald's viscometer.
4. To determine the specific refractivity of a liquid by refractometer.
5. To prepare S-Benzyl isothiouronium chloride from thiourea.
6. To separate mixture of organic compounds using common organic solvents by using TLC and determine R_f values.

Reference Readings:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
3. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
4. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Peter Atkins, Julio de Paula, James Keeler Atkins' Physical Chemistry, Oxford University Press.
6. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
7. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
8. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
9. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
10. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
11. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
12. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
13. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
14. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
15. B. R. Puri, Madan S. Pathania, L. R. Sharma Principles of Physical Chemistry, Vishal Publications.
16. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
17. Advanced Practical Organic Chemistry, N K Vishnoi.
18. Advanced Practical Physical Chemistry, J B Yadav.
19. Advanced Practical Inorganic Chemistry, Gurdeep Raj

Note for the Theory Paper Setter: The question paper will consist of seven questions in all. The first question will be compulsory and will consist of four short questions of 2 marks each covering the whole syllabus from 1st,2nd and 3rd unit. In addition, six more questions of 14 marks each will be set unit-wise (I, II, III) comprising of two questions from each of the three units. The candidates are required to attempt one compulsory question and three more questions selecting at least one question from each unit.

Note:- Unit IV only practical purpose.

BSC/CHEM/MD/2/MIC/102: Chemistry Minor -II

DURATION: 2 HOURS **MAXIMUM MARKS: 50**

Theory: 50 (External 35 + Internal 15)

Course Objective: To make students to understand periodic properties and ionic solids.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: To know the basics of periodic properties and hybridization and the ionic solids.
CO2: Understand about the semiconductors and metallic bonds.
CO3: Get the knowledge of stereochemistry of simple organic molecules

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UNIT I

Periodic Table and Atomic Properties

Atomic properties: atomic and ionic radii, ionisation energy, electron affinity and electronegativity definition, methods of determination or evaluation, trend in periodic table, effective nuclear charge, Slater's rules. Directional characteristics of covalent bond, various type of hybridisation and shapes of simple inorganic molecules and ions $BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, SO_4^{2-}, ClO_4^{-1}$

Ionic Solids and Semiconductors:

Stoichiometric and non-stoichiometric defects in crystals, Lattice energy and Born- Haber cycle, Solvation energy and its relationship with solubility of Ionic solids, Polarizing power and Polarisability of ions, Fajan's rule. Metallic bond – Qualitative idea of valence bond and Band theories of metallic bond (conductors, semiconductors, insulators) Semiconductors – Introduction, types, and applications.

UNIT II

Bonding & Structure of Organic Compounds

Structure and Bonding in Organic Compounds, Localized and delocalized chemical bond, Van der Waal's interactions, Resonance: conditions, resonance effect and its applications, hyperconjugation, inductive effect, Electromeric effect & their comparison.

Stereochemistry of Organic Compounds

Concept of isomerism. Types of isomerism. Optical isomerism, element s of symmetry, enantiomers, stereo genic centre, optical activity, properties of enantiomers, chiral and achiral molecules (upto two stereo genic centres), diastereomers, threo and erythro diastereomers, meso compounds Relative and absolute configuration, sequence rules, R & S systems of nomenclature. Geometrical isomerism. Determination of configuration of geometric isomers.

Learning Resources

1. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009),
2. Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
3. Atkins, P.W.; Paula, J.de. (2014), Atkin's Physical Chemistry Ed., 10th Edition, Oxford University Press.
4. Kapoor, K. L. (2015), A Textbook of Physical Chemistry, Vol 1, 6th Edition, McGraw Hill Education.
5. Nasipuri, D. (2018), Stereochemistry of Organic Compounds: Principles and Applications, 3rd Edition, New Age International.
6. Gunstone, F. D. (1975), Guidebook to Stereochemistry, Prentice Hall Press.

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Note for the Theory Paper Setter: Five questions will be set in all. Question No. 1 will be compulsory and will consist of seven short questions of one mark each (total marks 07) covering the whole syllabus. In addition, two more questions will be set from each unit consist of fourteen marks each. The candidate will be required to attempt two more question (14 marks), in addition to compulsory Question.

CDLU/CHEM/MDC/2/102: Introduction to Chemistry-II

DURATION: 3+4 HOURS **MAXIMUM MARKS: 75**

Theory: 50 (External 35 + Internal 15), Practical: 25 (External 20 + Internal 05)

Course objective: The course provides an insight into Indian scientists in the upliftment of research and some reaction in daily life.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: To learn about role of Indian scientists in the upliftment of research and classification of elements with their properties.

CO2: To learn about three states of matter and more knowledge about role of fertilizers in fertility of soil.

CO3: To learn about reaction in daily life**.**

UNIT I

Renowned Indian Scientists

Brief Biography of Renowned Indian Scientists (Hargobind Khurana, Dr. P. C, Ray, Sir C.V. Raman, Dr. A.P.J. Abdul Kalam, Dr. Vikram Sara Bhai, Dr. Homi Jahangir Bhabha, Dr. J.C. Bose)

Metal and Non-Metals

Periodic table, classification of elements, physical and chemical aspects of metals and non-metals, Ore and Minerals of Iron, Copper, Aluminum, alloys.

UNIT II

Physical Properties of Matter

Classification of matter, properties, uses, ideal gas equation, real gas equation, some important compounds (baking soda, washing soda, plaster of Paris, gypsum, glass)

Soil and fertilizers

Green revolution, soil: types of soil and their components for fertility, grow condition, pH, irrigation, biofertilizers, chemical fertilizers and their uses, acid rain

UNIT III (Practical)

Practicals:

1. To prepare Plaster of Paris.
2. To prepare Potash Alum.
3. To study the effect of acid on Baking and washing soda.
4. To perform the action of water on quick lime and identify the nature of reaction (Exo/Endothermic).

Learning Resources

1. Chemistry In Daily Life: Third Edition by Kirpal Singh, PHI Learning.
2. General Chemistry: Principles, Patterns, and Applications, Bruce Averill, Strategic Energy.
3. Security Solution, Patricia Eldredge, R.H. Hand, LLC, Copyright Year: 2011.
4. The Great Indian Scientists Paperback – 1 January 2017, Cengage Learning India.

Note for the Theory Paper Setter: The question paper will consist of five questions in all. The first question will be compulsory and will consist of seven short questions of 1 mark each covering the whole syllabus from 1st and 2nd unit. In addition, four more questions of 14 marks each will be set unit-wise (I, II) comprising of two questions from each of the two units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.

Note:- Unit III only practical purpose.

CDLU/CHEM/SEC/2/103: Basic Analytical Chemistry

DURATION: 3+4 HOURS **MAXIMUM MARKS: 75**
Theory: 50 (External 35 + Internal 15), Practical: 25 (External 20 + Internal 05)

Course Objective: To make students skilled in Basic Analytical Chemistry.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:
CO1: Handle analytical data and pH of soil.
CO2: Do quantitative analysis of metal ions in water, Separate mixtures using separation techniques.
CO3: Determine composition, which can be useful in agriculture.

UNIT I

Introduction to analytical chemistry and its interdisciplinary nature, Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Significant figures. Presentation of experimental data and results.
Composition of soil, concept of pH and its measurement, complexometric titrations, chelation, chelating agents, use of indicators

UNIT II

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods

Chromatography
Definition and general introduction on principles of chromatography. Paper chromatography, thin layer chromatography, Column chromatography and ion-exchange chromatography.

UNIT III (Practical)

1. Determination of pH of soil samples by pH meter.
2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.
3. Determination of pH, acidity and alkalinity of a water sample by pH meter.
4. To study the use of phenolphthalein.
5. Determination of dissolved oxygen of water samples.

Learning Resources

1. Christian, G.D. (2004), Analytical Chemistry, John Wiley & Sons.
2. Harris, D. C. (2007), Exploring Chemical Analysis, W.H. Freeman and Co.
3. Skoog, D.A.; Holler F.J.; Nieman, T.A. (2005), Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd.
4. Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.
5. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), Vogel's Quantitative Chemical Analysis,6th Edition, Prentice Hall.

Note for the Theory Paper Setter: The question paper will consist of five questions in all. The first question will be compulsory and will consist of seven short questions of 1 mark each covering the whole syllabus from 1st and IInd unit. In addition, four more questions of 14 marks each will be set unit-wise (I, II) comprising of two questions from each of the two units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.

Note:- Unit III only practical purpose.

CDLU/CHEM/SEC/2/104: Green Methods in Chemistry

DURATION: 3 HOURS **MAXIMUM MARKS: 75**
Theory: 75 (External 50 + Internal 25)

Course Objective: To make students skilled in Green Methods in Chemistry.

Course Learning Outcomes (CLO): After completing the course, the student shall be able to:

CO1: Get idea of toxicology, environmental law, energy and the environment, think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry.

CO2: Get ideas of innovative approaches to environmental and societal challenges. Know how chemicals can have an adverse/potentially damaging effect on human and vegetation.

CO3: Think of chemical methods for recovering metals from used electronics materials. Critically analyze the existing traditional chemical pathways and processes and creatively think about. bringing environmentally benign reformations in these protocols. Convert biomass into valuable chemicals through green technologies

UNIT I

Introduction

Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry.

1. Need of green chemistry
2. Importance of green chemistry in- daily life, Industries and solving human health problems.
3. A brief study of methods of preparation in green chemistry of any two.

UNIT II

Twelve Principles of Green Chemistry

The twelve principles of the Green Chemistry with their explanations.

Special emphasis on the following:

1. Prevention of waste / byproducts, pollution prevention hierarchy.
2. Green solvents-supercritical fluids, water as a solvent for organic reactions, ionic liquids, solvent less reactions, solvents obtained from renewable sources.
3. Catalysis and green chemistry- comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
4. Prevention of chemical accidents, designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
5. Green matrix to assess greemess of reaction: Environmental impact factor, atom economic and calculation atom economic.

UNIT III

The following Real-world Cases in green chemistry should be discussed: Surfactants for carbon dioxide replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.

Designing of environmentally safe marine antifoulant. Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (polylactic acid) made from corn.

Learning Resources

1. Anastas, P.T.; Warner, J.C. (1998), Green Chemistry, Theory and Practice, Oxford University Press.
2. Lancaster, M. (2016), Green Chemistry: An Introductory Text. 2nd Edition, RSC Publishing.
3. Cann, M. C.; Umile, T.P. (2008), Real world cases in green chemistry Vol 11, American chemical Society, Washington.
4. Matlack, A. S. (2001), Introduction to Green Chemistry, Marcel Dekker.
5. Ryan, M.A.; Tinnesand, M. (2002), Introduction to Green Chemistry (Ed), American Chemical Society, Washington DC.

Note for the Theory Paper Setter: The question paper will consist of seven questions in all. The first question will be compulsory and will consist of four short questions of 2 marks each covering the whole syllabus. In addition, six more questions of 14 marks each will be set unit-wise comprising of two questions from each of the three units. The candidates are required to attempt one compulsory question and two more questions selecting at least one question from each unit.