Chemistry Course Outcomes

B.Sc. Chemistry

1. Explain periodic properties of elements; understand formation of ionic bonding and factors affecting ionic bond formation.

2. Interpret aromaticity and based on that distinguish aromatic, and non- aromatic compounds able to know the structure Benzene and its electrophonic substitution reaction.

3. Describe synthesis and chemical reactions alkyl, halides aryl halides and alcohol.

4. Understand covalent – bonding metallic bonding and describe structure of molecule with regular and distorted geometry by using VSEPR theory and know about gravimetric and volumetric analysis.

5. Understand the phenomena of Nuclear Magnetic Resonance Spectroscopy and Rotational Spectroscopy

6. The learner will be acquired with knowledge of chemical energetics, Chemical equilibrium and ionic equilibria, fundamentals of organic chemistry, stereochemistry (Conformations,

Configurations and nomenclatures) and functional group approach for aliphatic hydrocarbons, quantum mechanical approach to atomic structure, Periodicity of elements, various theories for chemical bonding, basics of analytical chemistry, some techniques of analysis and able to do calculations essential for analysis.

7. The practical course is in relevance to the theory courses to improve the Understanding of the concepts. It would help in development of practical skills of the students and use of microscale techniques wherever require.

8. Students are able to verify theoretical principles experimentally. Interpret the experimental data on the basis of theoretical principles. Correlate theory to experiments. Understand theoretical principles by experiment observations; explain practical output with the help of theory.

9. Students will understand systematic methods of identification of substance by chemical methods. Write balanced equation for the chemical reactions performed in the laboratory. Perform organic and inorganic synthesis and is able to follow the progress of the chemical reaction by suitable method (colour change, ppt. formation, TLC).

10. Students can set up the apparatus / prepare the solutions - properly for the designed experiments. Perform the quantitative chemical analysis of substances explain principles behind it. Systematic working skill in laboratory will be imparted in student.

PG Course, M. Sc. (I)

A) Physical Chemistry

1) Study concepts of thermodynamics, entropy ,State function, path function, the Helmholtz and Gibbs function, Clausius inequality, Raoult's and Henery's law, Boltzmann distribution law, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics. and the problems based applying on these equations.

2) Study Applications of quantum chemistry, blackbody radiation, photoelectric effect, de Broglie wavelength, Schrödinger wave equation, Normalization and orthogonality of wave function, hydrogen like atoms, Operators-algebra of operators, commutative property, and linear operators, and the problems based applying on these equations.

3) Draw and explain Valence Bond Theory, Hybrid Orbital, geometry and hybridization, molecular orbital theory for di and tri atomic molecule.

4) Study concepts of kinetics, Reaction Dynamics, the temperature dependent reaction rates, consecutive reaction, parallel reactions, pre equilibrium, unimolecular reactions, Kinetics of Complex Reactions ,Fast reactions: flash photolysis, flow technique, stopped flow technique, relaxation method, free radical polymerization reaction of H 2 and Br 2 , explosive reaction, and the problems based applying on these equations.

5) Study Enzyme Catalysis Michaelis mechanism, Lineweaverburk and Eadie plots.

6) Study Microwave Spectroscopy , Infra-red Spectroscopy- Born-Oppenheimer approximation, Fourier transform spectroscopy and its advantages, Raman Spectroscopy,Quantum and classical theory of Raman effect, Electronic Spectroscopy of molecules - The fortrat diagram, Frank-condon principle, Mossbauer Spectroscopy- Principle, Instrumentation and Mossbauer spectra, Applications of Mossbauer Spectroscopy, and the problems based applying on these equations.

7) Study Nuclear and Radiation Chemistry- Radioactivity-Types of radioactive decay, Geiger-Nuttalis law, α-decay, Elements of Radiation- Interaction of radiation with matter, Radiation dosimetry, Nuclear Fission, Applications of Radioactivity.

B) Inorganic Chemistry

1. Student should visualize/ imagine molecules in 3 dimensions.

2. Students can understand the concept of symmetry and able to pass various symmetry elements through the molecule, the concept and point group and apply it to molecules, product of symmetry operations. Application of the concept of point group for determining optical activity and dipole moment, the importance of orthogonality theorem.

3. They should able to learn the rules for constructing character table, using reduction formulae should be able to find out the possible type of hybridization, know the concept of SALC, to find out character for reducible representation, correlate the application of symmetry to spectroscopy, to find out the possible modes of vibration, to find out which mode are IR active, to know about projection operator and to apply projection operator to find out the normalized wave function for atomic orbital.

4. Student should understand the detail chemistry of S and P block elements w.r.t. their compounds, their reactions and applications, the advance chemistry boranes, fullerene, zeolites,

polymers etc. , organometallic chemistry of some important elements from the main groups and their application.

5. Student should able to find out the no of microstates and meaningful term symbols, construction of microstate table for various configuration. Students can understand Hund's rules for arranging the terms according to energy. Students should able to find out possible value of J. They understand concept of interelectronic repulsion, weak and strong ligand field. They will be able to find out splitting of the free ion terms in weak ligand field and strong ligand field, to draw correlation diagram for various configuration in Td an Oh ligand field

6. Student should know basic instrumentation and selection rules and relaxation in rules, d-d transition, d-p mixing, charge transfer spectra, interpretation of electronic spectra for spin allowed oh and td complexes using Orgel diagram, understand the concept of spectrochemical series and Nephelauxetic series, able to solve numerical based on crystal field parameters. understand the various terms involved in magneto chemistry, various phenomenons of magnetism and their temperature dependence, various experimental methods to find out magnetic moment, understand the various Quenching of orbital angular momentum.

7. Students know about the role of metal in metalloprotein and metalloenzyme, use of metals as communication devices, mechanism of action of cis-platin anticancer drug, similarities in coordination theory for metal complexes and metal ions complexes with biological ligands, importance and transport of metal ions, passive transport metal ions by in and the problems based applying on these equations, mechanism for active transport of Na^+ & K^+ , nerve impulse generation in rod cell of retina, importance and function of Ca, Fe & Mg in metalloprotein, catalytic role of Mn in photosynthesis.

C) Organic Chemistry

1) To learn Structure and reactivity: Aromaticity: Huckels rule, Application, antiaromaticity, Heterocyclic Chemistry- Synthesis, reactivity, aromatic character of following heterocyclicrings: Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, and Pyrimidine.

2) To study concept of Stereochemistry: Sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S,E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship,stereospecific andstereoselective reactions, optical activity in biphenyls, spiranes,allenes, Topicity.

3) To learn Structure, Stability and Reactions of reactive intermediates, Carbocation, Carbanion, Free Radical, Carbenes and nitrenes, NGP : Neighbouring group participation.

4) To study Rearrangement, Beckmann, Hofmann, Curtius, Smith, Wolff, Lossen, Bayer-villiger,Sommelet, Favorskii,Pinacol-pinacolone, Benzil-benzilic acid, Fries.

5) To study the concepts of ylides, Phosphorus, Nitrogen and Sulphur ylides.

6) To study Oxidation and Reduction reactions: Oxidising agents: CrO_3 , PDC, PCC, $KMnO_4$, MnO_2 , Swern, SeO_2 , $Pb(OAc)_4$, Pd-C, OsO_4 , m-CPBA, O_3 ,$NaIO_4$, HIO_4

7) To study Reducing agents: Boranes and hydroboration reactions, MPV reduction and reduction with H_2 /Pd-C, Wilkinson's catalyst, DIBAL and Wolff-Kishner reduction.

8) To leran Photochemistry and Pericyclic reactions: Photochemistry, Pericyclic reactions.

9) To study Spectroscopic Methods in Structure Determination of Organic Compounds: UV and IR spectroscopy, 1 H-NMR, 13 C-NMR, Mass spectrometry (MS).

10) To solve Problems: Based on 3-4 fragments of above mentioned functional groups should be discussed.and Combined problems: Problems based on UV, IR, MS, 1 H-NMR, 13 C-NMR should be solved.

D) General Chemistry

1) To study Introduction to Solid State of Matter, Bonding in Solids and Electronic Properties, Recollect the concepts: Crystalline solids, unit cell, and types of unit cells, Conductivity, The P-N Junction—Field-Effect Transistors, Semiconductors—Si And Ge, Bands In D-Block Compounds—Transition Metal Monoxides.

2) To study Defects and Non-Stoichiometry, point defects—an introduction, defects and their concentration, intrinsic defects, extrinsic defects the concentration of defects, Applications: 1) fuel cells, 2) sensors, 3) electrochromic devices, non-stoichiometric compounds, introduction, non-stoichiometry in wustite, the titanium monoxide structure.

3) To learn Superconductivity, Josephson Effects, The Bcs Theory Of Superconductivity, High Temperature Superconductors, Theory Of High Tc Superconductors, Uses Of High Temperature Superconductors.

4) To Synthesis of Solids, , Soft-Chemistry Routes,Ceramic Methods, Decomposition of Precursor Compounds, Combustion Synthesis, , Soft Chemistry Routes ,Use of Fluxes, Sol–Gel Synthesis, Procedures of synthesis of some nano-materials- Gold and Silver nanoparticles,CdS nanoparticles, ZnO, TiO_2 and Fe_2O_3 nanoparticles and Porous Silica.

5) To study Material Characterization Technique: Transmission Electron Microscopy, X-Ray Diffraction Methods, Scanning Electron Microscopy, X-Ray Spectroscopy for Elemental Analysis and problem solving.

PG Course, M. Sc. (II) Organic Chemistry

CCTP-7, CHO-350: Organic Reaction Mechanism and Biogenesis

Students will be able to understand the concept of Methods for determining Reaction Mechanisms, Free Radicals, Linear Free Energy Relationships, Hammet plots, Hammet equation, substituent constants, reaction constants, use of Hammet plots, calculation of k and K, Deviations from straight line plots, Taft equation, solvent effects, Terpenoids,alkaloids, The Shikimate pathway

CCTP-8, CHO-351: Structure Determination of Organic Compounds by Spectroscopic Methods

Students know the topic of NMR in Stereochemistry Determination, 13C NMR spectroscopy, 15N, 19F and 31P NMR spectroscopy, 2D NMR, Mass Spectrometry,

CCTP-9, CHO-352: Stereochemistry and Asymmetric Synthesis of Organic Compounds

Students understands concept of stereochemistry of fused and bridged ring systems, Determination of configuration, Cram's rule, Cram's cycle model, Cram's dipolar model, Felkin-Anh Model; resolution and analysis of stereomers, decalols, decalones, octahydronaphthalenes, decahydroquinolines, asymmetric synthesis.

CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and Carbohydrate

Students become aware of Protection and de-protection of functional group in organic synthesis, chiron approach, basics of carbohydrates, synthesis of glycosides, synthesis of disachharides, trisachharides & polysachharides.

CCPP-3, CHO-354: Practical-I Solvent Free Organic Synthesis

Students will be able to perform practical like Solvent Free Carbon–Carbon Bond Formation, C–N Bond Formation, C–S Bond Formation, C–X Bond Formation, N–N Bond Formation, Other Solvent-Free Reactions, supramolecular assembly formation

CCTP- 10, CHO-450: Chemistry of Natural Products

Students will be able to understand and do planning of total synthesis while maintaining the stereochemistry. They can perform the experiments of synthesis of Hirsutellone B, Ribisins A and B, Vannusals and Pinnaic acid.

CCTP- 11, CHO-451: Organometallic Reagents in Organic Synthesis

Students learn about transition metal complexes in organic synthesis, C=C formation reactions, multi-component reactions, ring formation reactions, click chemistry, metathesis reaction and use of boron and silicon reagents in organic synthesis

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry

Students learn about peptides and proteins, sequencing and applications in therapeutics, solution phase and solid phase peptide synthesis and modern techniques for biomolecules and disease diagnosis. They become aware of medicinal chemistry, pharmacokinetics and pharmacodynamics of drug.

CBOP-5, CHO-453: Practical-III

A) Ternary Mixture Separation and Carbohydrates Synthesis & Isolation Natural Products.

Students will be capable of separating the ternary mixture of organic compounds. They can do the practical of carbohydrate synthesis which includes

1) Synthesis and structural determination of α- and β-D-glucose penta- acetate.

2) Selective deacylation of α- and β-D-glucose penta-acetate.

3) Benzoylation of D-glucose.to D-glucose penta-benzoate.

4) Selective debenzoylation of D-glucose penta-benzoate

5) Synthesis 1,2:5,6-di-O-isopropylene-D-glucofuranose.

6) Synthesis of 1,2: 5,6 – di-O-isopropylene-3-O-benzyl –D-glucofuranose.

Students will be acquainted with the special practical skill in order to get product in hand.

They can perform the practical related with isolation of pigments from the natural products, isolation of essential oils from the natural products, isolation of medicinally important component from the natural products.

B) Project

1. Maintain proper record of analytical data in note book for research purpose.
2. Perform review of literature related to the topic of project work and design the problem for project work.
3. Decide and describe methodology for problem to solve proposed problem in the form of project.Decide and perform application of research work.
4. To design experiment for research work. Collect the resources, design small equipment, etc. for completion of research work.
5. Collect experimental data (raw data) and analyse the data in the perspective of problem. Present data in graphical forms for the conclusive results.
6. Use computer as a tool for result analysis, presentation and writing the project.
7. To obtain concrete conclusion from the results on the basis of reported theory / research work and analytical results.
8. To perform report writing, scientifically.
9. To write research project / paper in scientific manner.

PG Course, M. Sc. (II) Analytical Chemistry

CCTP-7, CHA-390: Electrochemical and Thermogravimetric Methods of Chemical Analysis

1. Define various terms in electrochemistry and thermogravimetry.
2. Explain instrumentation in electrochemistry and thermogravimetry.
3. describe basic principles of electrochemistry and thermogravimetry.
4. Explain /Describe applications of electrochemistry and thermogravimetry in industry and in analytical laboratory.
5. Apply / select particular method of analysis for sample to be analysed.
6. Solve numerical problems on electrochemistry and thermogravimetry.
7. Interpret polarogram, cyclic voltammogram, pulse polarogram, thermogram, differential thermogram and DSC thermogram.
8. Differentiate among the various methods of electrochemistry and thermogravimetry.

CCTP-8, CHA-391: Analytical Method Development and Extraction Techniques

1. Define / understand various terms in analytical extraction and method development and validation.
2. Explain instrumentations and methodology in analytical extraction.
3. Explain / describe basic principles of analytical extraction method development and validation.
4. Explain /Describe applications analytical extraction and method development and validation in industry and in analytical laboratory.
5. Apply / select particular method of analysis for sample to be analysed.
6. Solve numerical problems on analytical extraction and method development and validation.
7. Develop analytical method for analysis of given sample. Apply statistical treatment to the analytical data. Select appropriate parameters for the development of analytical method
8. Differentiate among the methods of analytical extraction.

CCTP-9, CHA-392: Advanced Chromatographic Methods of Analysis

1. Define / understand various terms in chromatography (GC and HPLC) and mass spectroscopy.

2. Explain instrumentations in chromatography (GC and HPLC) and mass spectroscopy.

3. Explain / describe i) basic principles of chromatography (GC and HPLC) and mass spectroscopy. ii) separation in GC / HPLC column. iii) Functioning and construction of GC / HPLC/ MS detectors.

4. Explain /Describe applications chromatography (GC and HPLC) in industry and in analytical laboratory.

5. Apply / select particular method / instrumental parameters for analysis for sample GC / HPLC.

6. Solve numerical problems on chromatography (GC and HPLC) and mass spectroscopy.

7. Integrate GC and HPLC chromatogram, Mass spectrum

8. Differentiate among the chromatography (GC and HPLC) methods of analysis.

CBOP-3, CHA-393: Bioanalytical Chemistry

1. Define / understand various terms in Electrophoresis, capillary electrophoresis, HPTLC, Body fluid analysis, ELISA, RIA.

2. Explain instrumentations in in Electrophoresis, capillary electrophoresis, HPTLC, Body fluid analysis, ELISA, RIA.

3. Explain / describe i) basic principles of chromatography (GC and HPLC) and mass spectroscopy. ii) Separation in GC / HPLC column. iii) Functioning and construction of GC / HPLC/ MS detectors.

4. Explain /Describe applications chromatography (GC and HPLC) in industry and in analytical laboratory.

5. Apply / select particular method / instrumental parameters for analysis for sample GC / HPLC.

6. Solve numerical problems on chromatography (GC and HPLC) and mass spectroscopy.

7. Integrate GC and HPLC chromatogram, Mass spectrum

8. Differentiate among the chromatography (GC and HPLC) methods of analysis.

CCPP-3:Practical I: Basics of Instrumental Methods of Chemical Analysis

CBOP-5, CHA-493: Practical III A) Optional Analytical Chemistry Practical

CCPP-4, CHA-494: Practical III: Applied Analytical Chemistry

1 Maintain proper record of analytical data in notebook. Observer personal safety in laboratory and able handle all chemicals, instruments, etc safely in laboratory.

2. Define / understand various terms involved practical methods of quantitative analysis.

3. Explain instrumentations of colorimeter, spectrophotometer, photoflurometer, TGA, HPLC, GC, Flame-photometer, CV, AAS, etc.

4. Explain / describe basic principles of chromatography different instrumental methods of analysis. Able to handle particular instrument according to SOP.

5. Design / modify and validate new analytical method for chemical analysis of particular sample.

6. Apply / select particular method / instrumental parameters for analysis of given sample.

7. Give mathematical treatment to analytical data and able to interpret the results accurately.

8. Verify theoretical principle practically or apply theory to explain practical observations.

9. To conclude the results able to take the decision regarding quality of sample.

10. Differentiate among the various analytical methods / techniques of chemical analysis.

B) Project

1. Maintain proper record of analytical data in note book for research purpose.

2. Perform review of literature related to the topic of project work and design the problem for project work.

3. Decide and describe methodology for problem to solve proposed problem in the form of project.Decide and perform application of research work.

4. To design experiment for research work. Collect the resources, design small equipment, etc. for completion of research work.

5. Collect experimental data (raw data) and analyse the data in the perspective of problem. Present data in graphical forms for the conclusive results.

6. Use computer as a tool for result analysis, presentation and writing the project.

7. To obtain concrete conclusion from the results on the basis of reported theory / research work and analytical results.

8. To perform report writing, scientifically.

9. To write research project / paper in scientific manner.

CCTP- 10, CHA-490: Advanced Analytical Spectroscopic Techniques

1. Define / understand various terms in atomic absorption, atomic emission, fluorescence, ESR and electron spectroscopy.

2. Explain instrumentation of atomic absorption, atomic emission, ICPAES, ICPAES-MS, fluorescence, ESR and electron spectroscopy.

3. To describe basic principles of atomic absorption, atomic emission, ICPAES, ICPAES-MS, fluorescence, ESR and electron spectroscopy.

4. Select appropriate methods for sample treatment in AAS / AES, ICPAES, ICPAES-MS.

5. Explain advantages of ICPAES-MS over AES spectroscopy, fluorescence spectroscopy.

6. Solve numerical problems on analysis all these spectroscopic methods.

7. Interpret ESR spectra, super hyperfine splitting and g value in ESR, and parameters affecting it.

8. Calculate theoretical parameters from ESR data and characterize compound.

9. Solve problems based on atomic absorption, atomic emission, ICPAES, ICPAES-MS, fluorescence, ESR and electron spectroscopy.

CCTP-11, CHA-491: Chemical Methods of Pharmaceuticals Analysis

1. Define / understand various terms in pharmaceutical raw material and finished product analysis.

2. Explain various pharmaceutical dosage forms and types of raw materials used.

3. To describe basic principles of methods of pharmaceutical analysis according to IP.

4. Explain importance particular test in pharmaceutical raw material and finished product analysis.

5. Perform and explain importance of limit tests, identification tests and micobiological limit test of raw materials and finished products.

6. Solve numerical problems on analysis pharmaceutical raw material and finished product analysis.

7. Interpret IR spectra, HPLC chromatogram, UV-Visible spectra of pharmaceutical materials.

8. To perform total analysis of pharmaceutical raw material and finished product analysis according to IP / BP / USP.

9. Standardize analytical instruments according IP /BP/ USP.

10. Take a decision on the basis of analytical results regarding quality of raw materials so that material can be accepted for production or rejected.

CBOP-4, CHA-492: Analytical Chemistry of agriculture, Polymer and Detergents

1. Define / understand various terms in soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.
2. Explain / describe techniques / methods of soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.
3. To describe basic principles techniques / methodssoil analysis, pesticide residue analysis, detergent analysis and polymer analysis.
4. Explain importance of soil analysis, pesticide residue analysis, detergent analysis and polymer analysis.
5. Choose suitable method / techniques to characterize quality of soli polymer and detergent.
6. Describe / explain results of analysis soil, pesticide residue, detergent and polymer.
7. Solve numerical problems on analysis soil, pesticide residue, detergent and polymer.
8. Draw conclusion regarding soil, detergent and polymer quality from analytical results.