KARNATAK UNIVERSITY, DHARWAD

B Sc (CHEMISTRY)

SYLLABUS FOR CHEMISTRY

Course: CHEMISTRY

Discipline Specific Course (DSC) For Sem I – VI

Skill Enhancement Course (SEC) For Sem IV/V/VI

Elective Course (EC) For Sem V and VI

As Per NEP (Revised) 2024

Effective from 2024-25

Karnatak University, Dharwad
B Sc in Chemistry
Effective from 2024-25

Sem	Type of Course	Theory/ Practical	Course Code	Instruction hour per week (h)	Total hours of Syllabus / Sem	Duration of Exam (h)	Formative Assessment Marks	Summative Assessment Marks	Total Marks	Credits
I	DSC -1	Theory	C 1 CHE 1 T1	04	60	03	20	80	100	04
I	DSC-2	Practical	C 1 CHE 1 P1	04	56	03	10	40	50	02
II	DSC -3	Theory	C 2 CHE 1 T1	04	60	03	20	80	100	04
II	DSC -4	Practical	C 2 CHE 1 P1	04	56	03	10	40	50	02
III	DSC -5	Theory	C 3 CHE 1 T1	04	60	03	20	80	100	04
III	DSC-6	Practical	C 3 CHE 1 P1	04	56	03	10	40	50	02
IV	DSC -7	Theory	C 4 CHE 1 T1	04	60	03	20	80	100	04
IV	DSC -8	Practical	C 4 CHE 1 P1	04	56	03	10	40	50	02
V	DSC -9A	Theory	C 5 CHE 2 T1	04	60	03	20	80	100	04
V	DSC-10A	Practical	C 5 CHE 2 P1	04	56	03	10	40	50	02
V	DSC -9B	Theory	C 5 CHE 2 T2	04	60	03	20	80	100	04
V	DSC -10B	Practical	C 5 CHE 2 P2	04	56	03	10	40	50	02
VI	DSC -11A	Theory	C 6 CHE 2 T1	04	60	03	20	80	100	04
VI	DSC-12A	Practical	C 6 CHE 2 P1	04	56	03	10	40	50	02
VI	DSC -11B	Theory	C 6 CHE 2 T2	04	60	03	20	80	100	04
VI	DSC -12B	Practical	C 6 CHE 2 P2	04	56	03	10	40	50	02
V	EC1	Theory	C 5 CHE 5 T1	03	45	03	20	80	100	03
V	EC2	Theory	C 6 CHE 5 T1	03	45	03	20	80	100	03
IV/V /VI	Skill	Practical	C 0 CHE 6 T1	04	56	03	10	40	50	02

Note

1 Student shall either opt DSC 9A and DSC 10A or DSC 9B and DSC 10B in the V Semester. Similarly they can Opt DSC 11A and DSC 12A or DSC 11B and DSC 12B in VI Semester

2 Student shall study skill of this subject either in IV/ V/ VI semester but not in all the semester.

Programme Outcomes (PO):

On completion of the 03 years Degree in Chemistry students will be able to:

PO 1 Demonstrate, solve and an understanding of major concepts in all the disciplines of chemistry.

PO 2 Provide students with broad and balanced knowledge and understanding of key chemical concepts.

PO 3 Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.

PO 4 Apply standard methodology to the solutions of problems in chemistry.

PO 5 Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.

PO 6 Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.

PO 7 Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.

PO 8 Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

PO 9 Prepare students effectively for professional employment or research degrees in chemical sciences.

PO 10 Cater to the demands of chemical industries of well-trained graduates.

PO 11 Build confidence in the candidate to be able to work on his own in industry and institution of higher education.

PO 12 Develop an independent and responsible work ethics.

B.Sc. Semester – I

DSC-1: Chemistry (Theory) 1

Course title - Chemistry-1

Course Code: C 1 CHE 1 T 1

Type of Course	Theory/ Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -1	Theory	04	04	60	03	20	80	100

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO1: Describe the dual nature of radiation and matter; dual behavior of matter and radiation, de Broglie's equations, Heisenberg uncertainty principle and their related problems. Orbital shapes of *s, p, d and f* atomic orbitals, nodal planes. Electronic configurations of the atoms.

CO2: Define periodicity, explain the cause of periodicity in properties, classify the elements into four categories according to their electronic configuration. Define atomic radii, ionisation energy, electron affinity and electro negativity.

CO3: Explain bond lengths, bond angles, bond energies and dihedral angles, bond polarity, dipole moment and illustrate with examples of organic compounds, factors affecting bond parameters. Localized and delocalized bonds. Linear and crossed conjugation system. Electron displacement effects and their applications: inductive effect, electrometric effect, resonance effect, hyper conjugation, and steric effect

CO4: Know the meaning of reaction mechanism. Curly arrow rules. Classification of organic reactions with suitable examples. Types of bond fission. Types of reagents. Reactive intermediates.

CO5: Understand the meaning of stereoisomerism, molecular representation, conformational isomers and configurational isomers, geometrical isomerism, E and Z notation, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, Syn and Anti isomers in compounds containing C=N and their significance.

CO6: Understand the molecular velocity , distribution of molecular velocities, Calculation of molecular velocities. Relation between RMS, average and most probable velocities. Distribution of energy amongst molecules. Law of equi partition of energy. Collision properties and coefficient of viscosity, calculation of σ and η , variation of viscosity with temperature and pressure .Critical phenomena Relation between critical constants and van der Waals equation, principle of continuity of states, law of corresponding states.

CO7: Know the principles of titrimetric analysis, titration curves, balancing redox equations, titration curves, theory of redox indicators and applications.

CO7: Understand the titration curves, indicators for precipitation titrations involving silver nitrate. Indicators for EDTA titrations - theory of metal ion indicators.

CO8: Understand stages in gravimetric analysis, conditions of precipitation. theories of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. To know about Structure, specificity, conditions and applications of organic reagents. Advantages of organic reagents over inorganic reagents.

Syllabus DSC-1 : Chemistry 1 (C 1 CHE 1 T 1)	60 Hrs
Unit-I : ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS	**15 hrs**
Atomic Structure: Review of Rutherford's atomic model, Bohr's theory, Hydrogen atomic spectra. Derivation of radius and energy of an electron in hydrogen atom, limitations of Bohr's theory, dual behavior of matter and radiation, de Broglie's equations, Heisenberg uncertainty principle and their related problems. Schrodinger's wave equation for hydrogen atom and meanings of various terms in it (derivation not required). Significance of ψ and ψ^2. Radial and angular wave functions (atomic orbitals) and their distribution curves for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes, nodal planes and their significance. Quantum numbers and their significances. Shapes of *s, p, d and f* atomic orbitals. Rules for filling electrons in various orbitals, Electronic configurations of the atoms (atomic number up to 54). Concept of exchange energy. Anomalous electronic configurations. **(11 Lectures)** **Periodicity of elements:** Brief account on the following properties of elements with reference to s and p-block and trends in groups and periods: Atomic and ionic radii, Effective nuclear charge, screening effect, Slater's rules, ionization enthalpy, electron gain enthalpy, electronegativity, Pauling / Allred-Rochow scale **.** **(4 Lectures)** Numerical problems are to be solved wherever applicable.	
Unit-II FUNDAMENTALS OF ORGANIC CHEMISTRY & STEREOCHEMISTRY-I	**15 hrs**
Fundamentals of Organic Chemistry: Review of hybridization (sp^3, sp^2 and sp.). Bond parameters - bond lengths, bond angles, bond energies and dihedral angles, bond polarity, dipole moment and illustrate with examples of organic compounds, factors affecting bond parameters. Localized and delocalized bonds. Electron displacement effects and their applications: inductive effect, electrometric effect, resonance effect, hyper conjugation, and steric effect. **(6 Lectures)** **Organic reaction Mechanism**: Meaning of reaction mechanism. Curly arrow rules. Classification of organic reactions: substitution, addition, elimination, rearrangement, oxidation and reduction reactions with suitable examples (general mechanisms of all the reactions expected), Types of bond fission. Types of reagents: Electrophiles and nucleophiles (all types of examples to be given). Reactive intermediates: Structure, formation, stability and reactions of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes. **(5 Lectures)** **Stereoisomerism-I:** Meaning of stereoisomerism, Molecular representation: Fischer's projection formulae, Newman's formulae, Saw horse formulae. conformational isomers and configurational isomers (distinction between conformation and configuration), Geometrical isomerism: definition, reason for geometrical isomerism, E and Z notation, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, Syn and Anti isomers in compounds containing C=N and their significance. **(4 Lectures)**	
Unit-III GASEOUS & LIQUID STATES	**15 hrs**
Gaseous state: Review of kinetic theory of gases. Molecular velocity: Distribution of molecular velocities, Calculation of molecular velocities - , most probable, average and root mean square velocities. Relation between RMS, average and most probable velocities. Distribution of energy amongst molecules. Law of equi partition of energy. Collision properties: Collision frequency, collision diameter (σ), collision cross-section, collision number and mean free path and coefficient of viscosity, calculation of σ and η , variation of viscosity with temperature and pressure .	

Critical phenomena: Andrews isotherms of CO_2, critical constants and their determination. Relation between critical constants and van der Waals equation (Derivation), principle of continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable. **(7Lectures)** **Liquid state:** Molecular forces and general properties of liquids**.** **Surface tension:** surface tension, surface energy, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone. **Viscosity**: Viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of viscosity using Ostwald viscometer. Effect of temperature, weight, size and shape of molecules and intermolecular forces. **Refractive index**: Definition, specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Elucidation of structure of molecules. Numerical problems are to be solved wherever applicable. **(8 Lectures)**	
Unit-IV- VOLUMETRIC & GRAVIMETRIC ANALYSIS	**15 hrs**
Volumetric Analysis: Review of normality, molarity, molality, mole fraction, ppm & ppb . Standard solutions. **Acid-base titration**: Theory of acid – base indicators. Theory, titration curves for all types of acid – base titrations. **Redox titration**: Theory of redox indicators. Theory, types and applications. **Precipitation titration:** Theory, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences. **Complexometric titration:** Theory, titration methods employing EDTA (direct, back, displacement and indirect determinations). Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water. **(9 Lectures)** **Gravimetric Analysis:** Stages in gravimetric analysis, conditions of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. Structure, specificity, conditions and applications of organic reagents such as salicylaldoxime, oxine and dimethylglyoxime in inorganic analysis. Advantages of organic reagents over inorganic reagents. **(6 Lectures)** Numerical problems are to be solved wherever applicable.	

Recommended Books/References

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
3. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
5. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
6. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
7. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
8. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
9. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
10. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
11. P.W. Atkins: Physical Chemistry, 2002.
12. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
13. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
14. A text book of Physical Chemistry- A. S. Negi & S C Anand, 3rd edition 2022

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks
Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B.Sc. Semester – I

DSC-2 : Chemistry (Practical) 2

Course title - Chemistry-2

Course Code: C 1 CHE 1 P 1

Type of Course	Theory/Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -2	Practical	02	04	56	03	10	40	50

Course Outcome (CO):

After completion of course (Practical), students will be able to:

CO1: Understand and practice the calibration of glasswares (burette, pipette, volumetric flask).

CO2: Gain basic concepts involved in titrimetric analysis, primary standard substances, and preparation of standard solutions.

CO3: Explain the principles of acid-base, redox, iodometric and complexometric titrations.

CO4: Work out the stoichiometric relations based on the reactions involved in the titrimetric analysis.

CO5: Understand the technique of titrimetric analysis .

Syllabus- DSC-2 : Chemistry II (Practical) (C 1 CHE 1 P 1)	56 Hrs
Inorganic chemistry experiments Calibration of glassware (burette, pipette, volumetric flask), primary and secondary standard solutions, normality, molarity, molality and calculation of equivalent mass of acids, bases, oxidants and reductants. 1. Standardization of HCl solution using standard sodium carbonate solution and determination of sodium carbonate and sodium hydroxide present in a mixture. 2. Standardization of HCl solution using standard sodium carbonate solution and determination of sodium carbonate and sodium bicarbonate in in a mixture. 3. Standardization of $KMnO_4$ solution using standard oxalic acid solution and determination of Mohr's salt and water of crystallization in Mohr's salt. 4. Standardization of $K_2Cr_2O_7$ solution using standard Mohr's salt solution and determination of ferrous and ferric ions in a mixture. 5. Standardization of $Na_2S_2O_3$ solution using standard $K_2Cr_2O_7$ solution and determination of iodine in the given solution. 6. Standardization of EDTA solution using standard $ZnSO_4$ solution and determination of magnesium in the given solution. 7. Determination of temporary, permanent and total hardness of water using standard EDTA solution.	

8. Determination of total alkalinity in antacids in terms of calcium carbonate (two different samples). 9. Determination of Vitamin C in fruit juice / formulations by iodate method (two different samples). 10. Determination of alkali present in soaps / detergents (two different samples). 11. Determination of DO in water sample, pond lake / river water and compare the DOs (two different samples). 12. Determination of Chemical Oxygen Demand (COD) in two different waste water samples. **Distribution of marks** Accuracy- 20 (10+10)Marks, Technique and presentation - 04 Marks, Reactions & Calculations- 06 Marks, Viva- 05 Marks, Journal- 05 Marks, Total - 40 Marks Deduction of marks for accuracy **:** : ± 0.2 CC – 10 marks, ± 0.4 CC- 08 marks, ±0.6 CC- 06 marks, ±0.8 CC - 04 marks. Above ±1.0 CC - 02 marks	
General instructions: In the practical examination, in a batch of twenty students, minimum four different experiments may be given Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus**.** *Manual is not allowed in the examination. The same set of experiments may not be repeated in the immediate batch.*	

Books recommended:

1. Vogel's Quantitative Inorganic Analysis, Bessett et. al, Longman (2001).
2. Advanced Practical Chemistry, Jagadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
3. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut

B.Sc. Semester – II

DSC-3 : Chemistry (Theory) 3

Course title - Chemistry-3

Course Code: C 2 CHE 1 T 1

Type of Course	Theory/ Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -3	Theory	04	04	60	03	20	80	100

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO1: Explain ionic bond, Born Lande equation ,Born Haber cycle and Fajan's rules, VSEPR theory, hybridisation and shapes of various molecules. Understand the concept of resonance and write resonating structures of NO_3^- & CO_3^{2-}

CO2: Explain MO Theory and draw the MO diagrams for homonuclear diatomic molecules and ions and heteronuclear diatomic molecules such as CO, NO, physical properties of metals based on free electron theory, band theory of metals to explain conductors, insulators, extrinsic and intrinsic semiconductors

CO3: Explain the chemistry of aliphatic hydrocarbons & basic Concept in aromaticity.

CO4: Understand the orders of reactions, half–life period, Effect of temperature on reaction rates, temperature coefficient, activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates

CO5: Learn the Law of chemical equilibrium, factors affecting equilibria. Relations between K_p, K_c and K_x for reactions involving ideal gases. Common ion effect, solubility and solubility product. Ionization of acids and bases, hydrolysis of salts.

CO6: Explain the **o**ptical Isomerism, chirality/asymmetric centers, enantiomers. R and S notations,CIP rules with molecules containing one, two or more asymmetric centers, diastereomers, meso compounds, R and S notations, D and L configuration and threo and erythro nomenclature, racemic mixture and recemisation, resolution of racemic mixture, formation of diastereomers, biological significance of chirality.

CO7: Explain the preparation of benzene and alkyl benzenes, general mechanism of electrophilic aromatic substitution, examples of halogenation, nitration, sulphonation and Friedel-Craft alkylation and acylation. Oxidation of side chain (Benzene with alkyl groups $–CH_3$, $-CH_2CH_2CH_3$ and 1, 4 - dimethyl benzene).

C**O8:** Learn about relative reactivities of halogen in alkyl halides, vinyl halides, allyl halides, aryl halides and aralkyl halides. Nucleophilic substitution reactions and their mechanisms, Synthesis of aryl halide Aromatic Nucleophilic Substitution reactions, effect of nitro substitution on aromatic nucleophilic substitution reactions.

Syllabus- DSC-3 : Chemistry 3 (C 2 CHE 1 T 1)	60 hrs
Unit-I: CHEMICAL BONDING & MOLECULAR STRUCTURE	**15 hrs**
Ionic Bonding*:* Review of *g*eneral characteristics of ionic compounds. Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications .Fajan's rules, ionic character in covalent compounds and percentage of ionic character. **Covalent bonding :** VB approach, shapes of inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO_3^- and CO_3^{2-}. **(7 Lectures)** **Molecular Orbital Theory:** LCAO method, bonding and antibonding, Shapes of molecular orbitals, MO treatment of homo nuclear diatomic molecules H_2, He_2 , He_2^+ N_2 , O_2 , O_2^+, O_2^- and hetero nuclear diatomic molecules and ion such as CO and NO (Relationship between bond length, bond order, bond energy, magnetic properties). **(5 Lectures)** **Metallic Bond:** Physical properties of metals **(**conductivity, lustre, malleability & ductility) based on free electron theory. Band theory of metals to explain conductors, insulators, extrinsic and intrinsic semiconductors (including temperature effect). **(3 Lectures)**	
Unit-II : ALIPHATIC HYDROCARBONS & BASIC CONCEPT IN AROMATICITY	**15 hrs**
Chemistry of Aliphatic Hydrocarbons: Aliphatic hydrocarbons: Types - alkanes, alkenes, alkynes and alkadienes. **Alkenes**: mechanism of addition of hydrogen halides and bromine, Markovnikoff's Rule, peroxide effect, acid catalyzed hydration of alkenes (mechanism), oxymercuration–oxidation, hydroboration - oxidation, oxidative cleavage of alkenes with $KMnO_4$ and ozone (ozonolysis). **Alkadienes**: classification, mechanism of addition of halogen and hydrogen halides in 1,3-diene, Diels-Alder reaction. **Alkynes**: Mechanism of addition of halogen and halogen halides, hydration of alkynes, Acidic character of acetylenic protons (Acidity of 1-alkynes), Comparison of acidic strength of acetylene, ethylene and ethane. oxidative cleavage of alkynes with $KMnO_4$ and ozone (ozonalysis), cyclic polymerization. **(8 Lectures)** **Cycloalkanes**: Relative stability of cycloalkanes (Baeyer's Strain theory). Conformational analysis of cyclopropane, cyclobutane, cyclopentane and cyclohexane, axial and equatorial bonds, conformation and stability of monosubstituted cyclohexane. **(3 Lectures)** **Basic Concept in aromaticity:** Criteria for aromaticity: heat of hydrogenation (e.g. benzene), resonance and resonance energy (e.g. benzene). Huckel's rule with examples such as benzene, furan, thiophene, pyridine, naphthalene, non-benzanoid aromatic compounds- cyclopropenyl cation, cyclopentadienyl anion, and cycloheptatrienyl cation. **(4 Lectures)**	
Unit-III : CHEMICAL KINETICS AND CHEMICAL & IONIC EQUILIBRIA	**15 hrs**
Chemical Kinetics: Review of reaction rates. Orders of reactions. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life period of a reaction for various orders (numerical problems). Methods for determination of order of a reaction by half-life period and van't Hoff's differential method. Effect of temperature on reaction rates, temperature coefficient, Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **(8 Lectures)**	

Chemical and Ionic Equilibria: Law of chemical equilibrium and its thermodynamic derivation. Factors affecting equilibria (Le Chatelier's principle). Relations between K_p, K_c and K_x for reactions involving ideal gases. Common ion effect, solubility and solubility product and its applications in inorganic qualitative analysis. Ionization of acids and bases, hydrolysis of three types of salts and derivation for determination of pH of their solutions. Numerical problems are to be solved wherever required. **(7 Lectures)**	
Unit-IV: STEREOISOMERISM-II, AROMATIC HYDROCARBONS AND ALKYL AND ARYL HALIDES	**15 hrs**
Stereoisomerism-II : Optical Isomerism: optical activity, specific rotation and optical purity, chirality/asymmetric centers, enantiomers. R and S notations (one asymmetric center): CIP rules with molecules containing one, two or more asymmetric centers, diastereomers, meso compounds, D and L configuration and threo and erythro nomenclature, racemic mixture and recemisation, resolution of racemic mixture through mechanical separation, formation of diastereomers. **(5 Lectures)** **Aromatic Hydrocarbons:** Preparation of benzene and alkyl benzenes, General mechanism of electrophilic aromatic substitution, examples of halogenation, nitration, sulphonation and Friedel-Craft alkylation and acylation. Oxidation of side chain (Benzene with alkyl groups $-CH_3$, $-CH_2CH_2CH_3$ and 1, 4 - dimethyl benzene). **(5 Lectures)** **Alkyl and Aryl halides:** **Alkyl Halides:** Relative reactivities of halogen in alkyl halides, vinyl halides, allyl halides, aryl halides and aralkyl halides. Nucleophilic substitution reactions: S_N1 and S_N2 reactions and their mechanisms, stereochemistry and comparison. S_Ni reaction and mechanism. **Aryl halides:** Synthesis of aryl halide from phenols, Sandmeyer's reaction, Gattermann reaction, Raschig-Hooker process and Balz-Schiemann reaction. Aromatic Nucleophilic Substitution reactions: S_N^{Ar}, via Benzyne intermediate along with mechanisms. Effect of nitro substitution on aromatic nucleophilic substitution reactions. **(5 Lectures)**	

Recommended Books/References

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.

2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
3. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
5. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
6. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
7. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
8. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
9. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
10. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
11. P.W. Atkins: Physical Chemistry, 2002.
12. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
13. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
14. A text book of Physical Chemistry- A. S. Negi & S C Anand, 3rd edition 2022
15. Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
16. Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks
Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B.Sc. Semester – II

DSC-4 : Chemistry (Practical) 4

Course title - Chemistry-4

Course Code: C 2 CHE 1 P 1

Type of Course	Theory/Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -4	Practical	02	04	56	03	10	40	50

Course Outcome (CO)

After completion of course (Practical), students will be able to:

CO1: Learn crystallization, fractional crystallization, sublimation, reflux, distillation, fractional distillation, distillation under reduced pressure, steam distillation and determination of melting point of the crystallized solid & boiling point of the liquid.

CO2: Develop the techniques involved in the preparation and determination of organic compounds.

Syllabus- **DSC-4: Chemistry 4 (Practical) (C 2 CHE 1 P 1)**	**56 Hrs**
Explanation regarding crystallization, fractional crystallization, sublimation, reflux, distillation, fractional distillation, distillation under reduced pressure, steam distillation and determination of melting point of the crystallized solid & boiling point of the liquid. (Students should write in the journal regarding the above). **Preparation of organic compounds:** 1. Nitration - Nitration of salicylic acid using calcium nitrate and acetic acid (Green method) 2. Bromination – Acetanilide to p-bromo acetanilide. 3. Nitration – Acetanilide to p-nitro acetanilide. 4. Hydrolysis - Benzamide to benzoic acid. 5. Oxidation – Benzaldehyde to benzoic acid. 6. Preparation of urea formaldehyde resin. **Determination of Organic compounds:** 7. Determination of phenol by bromination method 8. Determination of aniline by bromination method. 9. Determination of acetamide by hydrolysis method. 10. Determination of ethyl benzoate by hydrolysis method. 11. Determination of aspirin in the tablet by hydrolysis method. 12. Determination of formaldehyde using sodium sulphite. Note: In the preparation experiment, student has to write mechanism of reactions, calculation of quantitative yield, determination of melting point and to perform recrystallization. **Distribution of marks for preparation experiments: (15 marks.)** Calculation of theoretical yield – 03 marks, observed yield -10 marks, M.P- 02 marks,	

Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - 2 marks. **Distribution of marks for determination experiments: (15 marks.)** Accuracy - 10(5+5) marks, Technique and presentation - 02 marks, Reactions and Calculations - 03 marks. Journal -05marks, Viva: 05 marks Total = 40 marks **Deduction of marks for accuracy :** : ±0.2 CC – 5 marks, ± 0.4 CC- 04 marks, ±0.6 CC- 03 marks, ±0.8 CC - 02 marks. Above ±1.0 CC -01 mark **General instructions:** In the practical examination, minimum two different preparation and determination experiments may be given. In a batch of twenty students, each student will be performing preparation and determination experiments. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus**.** *Manual is not allowed in the examination.*	

Books recommended:

1. Vogel's quantitative Organic Analysis, G.Svehla, 7th Ed, Longman (2001).

2. Advanced Practical Chemistry, Jagadamba Singh, Pragathi, Publications (2017).

3. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.

B.Sc. Semester – III

DSC-5: Chemistry (Theory) 5

Course title - Chemistry-5

Course Code: C 3 CHE 1 T 1

Type of Course	Theory/ Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -5	Theory	04	04	60	03	20	80	100

Course Outcomes (CO):

After completion of course, Chemistry (Theory) - V students will be able to:

CO1: Explain the Chemistry of s- and p- block elements .Preparation and bonding in diborane, borazine & boron nitride. Silicates-Classification and structures.Preparation and structure of oxyacids of nitrogen. Preparation and bonding in oxoacids of phosphorus, sulphur and chlorine. Preparation and bonding in inter halogen compounds ClF_3, BrF_5 , IF_7 and Pseudo halogens. Preparation and bonding in Xenon compounds- XeF_2, XeF_4, XeF_6 and XeO_3

CO2: Explain Chemistry of d- and f- block elements general characteristics of d-block elements with reference to electronic configuration, colors, variable oxidation states, magnetic, catalytic properties and ability to form complexes. IUPAC nomenclature of elements with atomic number greater than hundred. General characteristics of f-block elements with reference to electronic configuration, oxidation states, colors and magnetic properties. Lanthanide contraction and its consequences. Separation of lanthanoids by ion-exchange method.

CO3: Synthesis of primary, secondary and tertiary alcohols . Reduction of aldehydes and ketones, carboxylic acids and esters. Reactions of alcohols Preparation of glycol from ethene and glycerol from propene, Oxidation of ethylene glycol, Mechanism of Pinacol-Pinacolone rearrangement.

CO4: Understand the acidic character of phenol, effect of substituent on acidity of phenol Reactions of Phenol.

CO5: Know the preparation of ethers, reaction of ethers. Epoxides**:** Synthesis from alkenes using peroxides, acid and base catalyzed ring opening of epoxides with mechanism and polyether formation. Crown Ethers: Formation and properties (PhaseTransfer Catalyst).

CO6: Know internal energy and first law of thermodynamics, concept of enthalpy, derivation of work done in isothermal and adiabatic expansion of an ideal gas for reversible and irreversible processes. Joule-Thomson effect and its derivation. Joule-Thomson co-efficient and its derivation. Effect of temperature on enthalpy of reaction

CO7: Learn the concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H_2O and S), with applications. Phase diagrams for two component systems: solid-liquid equilibria involving eutectic, congruent and incongruent melting points.

CO8: Learn the Nernst distribution law and thermodynamic derivation of partition co-efficient. Applications of solvent extraction- simple and multiple extractions. Derivation for multiple extractions

CO9: Understand the steps in metallurgy Characteristics, uses and limitations of Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Extraction of titanium from ilmenite, chromium from chromite & nickel by Mond's process, Extraction of thorium from monazite sand, and uranium from pitchblende.

CO10: Learn the nuclear particles (positron, neutrino, mesons, pions, and quarks), nuclear instability, nuclear fission and fusion, nuclear reactors, Different types of nuclear reactors, nuclear reactions (α, n), (n, α), (α, p), (p, α), (p, n) and (n, p). Preparation of transuranic elements (Np, Pu, Am and Ru). Applications of radioisotopes in tracer technique, neutron activation analysis and carbon dating (numerical problems).

DSC-5: Chemistry 5 (C 3 CHE 1 T 1)	**60 Hrs**
UNIT-I : CHEMISTRY OF s , p , d & f -BLOCK ELEMENTS	**15 hrs**
Chemistry of s- and p- block elements: General characteristics, anomalous properties of lithium. Diagonal relationship of Li with Mg, and Be with Al. Preparation and bonding in diborane, borazine & boron nitride. Silicates-Classification and structures. Preparation and structure of oxyacids of nitrogen. Preparation and bonding in oxoacids of phosphorus, sulphur and chlorine. Preparation and bonding in inter halogen compounds ClF_3, BrF_5, IF_7 and Pseudo halogens. Preparation and bonding in Xenon compounds- XeF_2, XeF_4, XeF_6 and XeO_3 . **(10 Lectures)** **Chemistry of d- and f- block elements:** General characteristics of d-block elements with reference to electronic configuration, colors, variable oxidation states, magnetic, catalytic properties and ability to form complexes. IUPAC nomenclature of elements with atomic number greater than hundred. General characteristics of f-block elements with reference to electronic configuration, oxidation states, colors and magnetic properties. Lanthanide contraction and its consequences. Separation of lanthanoids by ion-exchange method. **(5 Lectures)**	
UNIT-II ALCOHOLS, PHENOLS AND ETHERS	**15 hrs**
Alcohols: Synthesis of primary, secondary and tertiary alcohols using Grignard reagent, ester hydrolysis. Reduction of aldehydes and ketones, carboxylic acids and esters. Reactions of alcohols with halo acids, esterification reaction and oxidation of alcohols with PCC, $KMnO_4$, HNO_3, $K_2Cr_2O_7$ and Oppenauer oxidation. Polyhydric alcohols: Preparation of glycol from ethene and glycerol from propene, Oxidation of ethylene glycol, Mechanism of Pinacol-Pinacolone rearrangement. **(6 Lectures)** **Phenols:** Acidic character, comparative acid strengths of alcohols and phenols, effect of substituent on acidity of phenol (Explain with $–NO_2$, $-CH_3$ groups and ortho effect). Reactions of Phenol: Kolbe's reaction, Claisen rearrangement, Fries rearrangement, Ledrer-Mannase reaction, Reimer-Tiemann reaction. Schotten – Baumann Reaction(Mechanism to be discussed for all the reactions**).** **(4 Lectures)** **Ethers:** Preparation of ethers, mechanism of Williamson's ether synthesis Reaction of ethers**:** mechanism of C-O bond cleavage by HI (Explain with symmetric and asymmetric ethers containing tertiary alkyl group and benzene ring). **Epoxides:** Synthesis from alkenes using peroxides, acid and base catalyzed ring opening of epoxides with mechanism and polyether formation. Crown Ethers: Formation and properties of 18- Crown 6-Ethers. **(5 Lectures)**	

UNIT-III: THERMODYNAMICS-I, PHASE EQUILIBRIA AND DISTRIBUTION LAW	15 hrs
Thermodynamics I: Internal energy and first law of thermodynamics. Concept of enthalpy, derivation of work done in isothermal and adiabatic expansion (T-V and P-V relationships) of an ideal gas for reversible and irreversible processes. Joule-Thomson effect and its derivation. Joule-Thomson co-efficient and its derivation. Effect of temperature on enthalpy of reaction (Kirchhoff's equation), numerical problems are to be solved wherever required. **(5 Lectures**) **Phase Equilibria:** Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems (H_2O and S), with applications. Phase diagrams for two component systems: solid-liquid equilibria involving eutectic, congruent and incongruent melting points. **(6 Lectures)** **Distribution law:** Nernst distribution law and thermodynamic derivation of partition co-efficient. Distribution law for changes in molecular state (Association and dissociation). Applications of solvent extraction- simple and multiple extractions. Derivation for multiple extractions, numerical problems. **(4Lectures)**	
UNIT-IV: METALLURGY AND NUCLEAR CHEMISTRY	**15 hrs**
Principles and processes of metallurgy: Minerals, ores, stages in metallurgy (crushing, concentration, calcination, roasting, smelting/reduction, refining). Characteristics, uses and limitations of Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Extraction of titanium from ilmenite, chromium from chromite & nickel by Mond's process, Extraction of thorium from monazite sand, and uranium from pitchblende. **(9 Lectures)** **Nuclear chemistry** Nuclear particles (positron, neutrino, mesons, pions, and quarks), nuclear instability, nuclear fission and fusion, nuclear reactors- power and breeder, nuclear reactions (α, n), (n, α), (α, p), (p, α), (p, n) and (n, p). Preparation of transuranic elements (Np, Pu and Am). Applications of radioisotopes- tracer technique, neutron activation analysis and carbon dating (numerical problems). **(6 Lectures)**	

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks
Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

Recommended Books/References

1. Modern Inorganic Chemistry: R.D.Madan, S.Chand and Co.Ltd, New Delhi, 2019
2. Chemistry of degree students, R.L.Madan, S.Chand and Co.Ltd, New Delhi.
3. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
4. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
5. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
6. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
7. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
8. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
9. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
12. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
13. P.W. Atkins: Physical Chemistry, 2002.
14. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
15. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
16. A text book of Physical Chemistry- A. S. Negi & S C Anand, 3rd edition 2022

B.Sc. Semester – III

DSC-6 : Chemistry (Practical) 6

Course title - Chemistry-6

Course Code: C 3 CHE 1 P 1

Type of Course	Theory/Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -6	Practical	02	04	56	03	10	40	50

Course Outcomes (CO):

After completion of Chemistry Practical – , students will be able to:

CO1: Understand the errors, types of errors, accuracy, precision, significant figures, standard deviation, and Use of log table.

CO2: Learn the rate constant , adsorbtion , surface tension, viscosity, distribution, enthalpy of ionization, heat of solution , degree of dissociation and specific refraction experiments and related techniques.

Syllabus **DSC-6: Chemistry (Practical) - VI**	**56 Hrs**
Physical Chemistry Experiments	
Explanation regarding errors, types of errors, accuracy, precision, significant figures, standard deviation, and Use of log table (students should write in the journal regarding the above). 1. Study the effect of acid strength on hydrolysis of methyl acetate using HCl and H_2SO_4. 2. Determination of velocity constant and effect of concentration on velocity constant of second order reaction, KI and $K_2S_2O_8$ (a = b). 3. Study the adsorption of acetic acid on animal charcoal and verify the Freundlich adsorption isotherm. 4. Determination of surface tension and parachor of benzene series or alcohol series. 5. Determination of density and viscosity of ethyl acetate, ethyl alcohol & toluene. 6. Determination of viscosity of sucrose solutions for various concentrations by Ostwald's Viscometer and calculation of radius of sucrose molecule. 7. Study the distribution of acetic acid/ benzoic acid between water and toluene. 8. Determination of enthalpy of ionization of acetic acid by calorimetric method. 9. Determination of heat of solution of KNO_3 by calorimetric method. 10. Determination of degree of dissociation of KCl by Landsberger's method. 11. Determination of critical solution temperature of two partially miscible liquids (water and phenol). 12. Determination of specific refraction of liquids A & B and calculation of percentage composition of unknown liquid mixture of A and B using Abbe's refractometer (formula and graphical method).	

Examination In a batch of twenty students, not more than four students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. Manual is not allowed in the examination. **Distribution of Marks:** Accuracy-18 marks, Technique and Presentation-3 marks Calculation and graph- (5+4) 9 marks, Journal-5 marks, Viva-Voce-5 marks, Total=40 marks. **Deduction of Marks for accuracy:** Error up to 5% - 18 marks, 6 - 10%-15 marks, 11-15%- 12 marks, 16-20% 09 marks, above 20% - 3 marks	

Books recommended:

1. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
2. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
3. A text book of Physical Chemistry- A. S. Negi & S C Anand, 3rd edition 2022
4. Advanced Practical Chemistry, Jagadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
5. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.

B.Sc. Semester – IV

DSC-7: Chemistry (Theory) -7

Course title - Chemistry-7

Course Code: C 4 CHE 1 T 1

Type of Course	Theory/ Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -7	Theory	04	04	60	03	20	80	100

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO1: Understand the types of solids, symmetry elements, unit cells, crystal systems, Laws of Crystallography - Law of constancy of interfacial angles, Miller indices. X-Ray diffraction by crystals, Structures of NaCl, KCl and CsCl. Defects in crystals.

CO2: Learn about the theories of coordination compounds, IUPAC system of nomenclature. Isomerism in coordination compounds

CO3: Gain the knowledge in inorganic polymers like Silicones & Phosphazines

CO4: Acquire the knowledge in properties and typical reactions in liquid ammonia and liquid sulphur dioxid.

CO5: Understand the structure, properties and mechanisms of the reactions in the carbonylcompounds.

CO6: Understand the preparation, properties and the mechanism of the reactions in Carboxylic acid and amines.

CO7: Learn the about entropy, free energy, second law of thermodynamics, and variation of free energy with several variables.

CO8: Understand the classification of polymers degree of polymerization, the mechanism of polymerization Molecular weight of polymers and determination

CO9: Leqrn about thermodynamics of ideal solution, Gibb's Duhem – Margules equation and its applications, theory of fractional distillation:completely immiscible liquids, solutions of solid in liquids, solid solution Know types of **a**dsorption isotherms, types of catalysis and their theories with examples and autocatalysis.

Syllabus **DSCC- 7: Chemistry (Theory) – 7** **Course Code: C 4 CHE 1 T 1**	**60 Hrs**
UNIT-I COORDINATION CHEMISTRY-I , INORGANIC POLYMERS & NON - AQUEOUS SOLVENT	**15 hrs**
Solids: Types of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and ZnS. Defects in crystals. **(5 Lectures)** **Coordination chemistry-I** Classification of ligands. Werner's theory of coordination compounds with reference to Cobalt ammine complexes. IUPAC system of nomenclature. Isomerism in coordination compounds (ionization, hydrate, linkage, geometrical and optical) with respect to coordination number 4 and 6. Valence bond theory- strong and weak field complexes of Cr, Fe, Co, Ni and Cu with coordination number 4 and 6 and their magnetic properties. Limitations of valence bond theory. **(5 Lectures)**	

Inorganic polymers: General properties and types of inorganic polymers. Comparison with organic polymers. Silicones: Classifications, preparation and structure. Phosphazines: Preparation and structure of phospho nitrilic chloride (trimer). **(3 Lectures)** **Non-aqueous solvents: Solvent** properties and typical reactions studied in liquid ammonia and liquid sulphur dioxide. **(2 Lectures)**	
UNIT-II : CARBONYL COMPOUNDS AND AMINES	**15 hrs**
Carbonyl Compounds: Structure of carbonyl compounds, General mechanism of nucleophilic addition to the carbonyl compounds, mechanism of addition of hydrogen cyanide and hydroxyl amine, addition of alcohol, amines. Acidity of α-hydrogens, mechanism of aldol condensation, crossed aldol condensation, Perkin's reaction, Claisen's condensation, Dieckman condensation and Darzen's condensation. Reactions of compounds with no α-hydrogens: mechanism of Benzoin condensation and Cannizaro's reaction, crossed Cannizaro's reaction. Reduction of carbonyl groups via Wolf-Kishner reduction and Meerwein-Pondorff Verley reduction. **(6 Lectures)** **Carboxylic acids and their derivatives*:*** Acidity of carboxylic acid, effect of substituents on acidity of aliphatic and aromatic acids. Hell – Vohlard - Zelinsky (HVZ) reaction. **Carboxylic acid derivatives:** Preparation from Acid chlorides, Anhydrides, and Esters, synthesis of Amides from acids and their interconversion. Reactions: Reformatsky Reaction, Hydrolysis of esters, A_{AC}^2, B_{AC}^2 reaction mechanism, definition and examples keto-enol tautomerism in ethylacetoacetate (EAA), Knoevenagel's Reaction and Michael addition with mechanism. (**5 Lectures)** **Amines:** Structure of amines, basicity of aliphatic amines, aryl amines and effect of substituents on basicity of aliphatic and aromatic amine, basicity of amines versus amides, preparation of amines by Gabriel phthalimide synthesis, through reduction of nitro compound by Hofmann and Curtius reaction with mechanism, reactions of aliphatic and aromatic amines with nitrous acid, replacement reaction of arenediazonium salt (replacement by –Cl/-Br, -CN, -I, -F, -OH, -H), coupling reaction of arenediazonium salts. **(4 Lectures)**	
UNIT-III : THERMODYNAMICS-II, POLYMERS AND SOLUTIONS	**15 hrs**
Thermodynamics II: Carnot Cycle, Concept of entropy and its physical significance, thermodynamic scale of temperature, statements of second law of thermodynamics, calculation of entropy change for reversible and irreversible processes. Free energy functions: Gibbs and Helmholtz energy, variation of S, G, A with T, V and P. Gibbs-Helmholtz equation, free energy change and spontaneity. Statement of third law, calculation of absolute entropy of molecules. Numerical problems are to be solved wherever applicable. **(6Lectures**) **Polymers:** Introduction, definition, classification, degree of polymerization. Mechanism of polymerization- Free radical, ionic and Zeigler – Natta polymerization. Molecular weight of polymers- Number average molecular weight and mass average molecular weight, Determination of molecular weight by Viscometry and Osmotic pressure method **(5 Lectures)** **Solutions** Thermodynamics of ideal solution, Gibb's Duhem – Margules equation and its applications, theory of fractional distillation: fractional azeotropic distillations, the nature of azeotropic mixtures, partially miscible liquids, critical solution temperature (CST), completely immiscible liquids, solutions of solid in liquids, solid solutions (qualitative treatment).	

(4Lectures)	
UNIT-IV ELECTROCHEMISTRY-I & PHOTOCHEMISTRY	**15 hrs**
Electrochemistry-I Arrhenius's theory of electrolytic dissociation and its limitations. Migration of ions - Transport number, Determination of transport number by Hittorf's and Moving boundary methods. Problems on transport number. Kohlrausch's law and its applications. **Conductivity:** Conductance of an electrolyte, specific conductance, equivalent conductance and molar conductance. Conductivity cell, cell constant and measurement of conductance. Applications of conductivity measurements in various acid-base titrations, and precipitation titrations. Advantages of conductometric titration. Determination of solubility and solubility product of sparingly soluble salts. Determination of dissociation constant of a weak acid. **Theory of strong electrolytes:** Debye – Huckel theory of strong electrolytes, relaxation effect, electrophoretic effect, Debye–Huckel-Onsagar equation and its significance (no derivation). **(8 Lectures)** **Photochemistry** Absorbance, transmittance, Beer-Lambert law and its limitations, Calculation of molar extinction coefficient. Laws of photochemistry–Grotthus-Draper law, Stark–Einstein's law of photochemical equivalence, difference between photochemical and thermal reactions. Quantum yield - reasons for high and low quantum yields with examples. Determination of quantum yield by thermo-couple method and chemical actinometry. Photosensitization with examples. **Photophysical process** - definition, fluorescence, phosphorescence, chemiluminescence and bioluminescence with examples, Difference between photophysical and photochemical process. Numerical problems are to be solved wherever applicable. **(7 Lectures)**	

Recommended Books/References

1. Concise Inorganic Chemistry-J. D. Lee, 5th Edn, New Age International (1996)
2. Modern Inorganic Chemistry Sathya Prakash's by R.D.Madan, S.Chand and Co.Ltd, New Delhi.
3. Inorganic Chemistry-Principles of Structure and Reactivity, 4thEdn-J. E. Huheey, E.A. Keiter, R. L. Keiter and O.K. Medhi. Pearson Education (2009).
4. A Guidebook to Mechanism in Organic Chemistry Sykes, P., Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Organic Chemistry Morrison, R.T. & Boyd, R.N., Pearson, 2010.
7. Advanced Organic Chemistry Bahl, A. & Bahl, B.S., S. Chand, 2010.
8. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
9. Organic Chemistry- Mehta and Mehta, 2005.
10. Physical Chemistry P.W. Atkins:, 2002.
11. Physical Chemistry W.J. Moore: 1972.
12. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
13. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
14. An introduction to electrochemistry by Samuel Glasstooe 2011.
15. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
16. Photochemistry by Gurdeep Raj, 5th edition -2008
17. A text book of Physical Chemistry- A. S. Negi & S C Anand, 3rd edition 2022

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks
Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B.Sc. Semester – IV

DSC-8 : Chemistry (Practical) 8

Course title - Chemistry-8

Course Code: C 4 CHE 1 P 1

Type of Course	Theory/Practical	Credits	Instruction per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -8	Practical	02	04	56	03	10	40	50

Course Outcome (CO):

After completion of course (Practical), students will be able to:

CO1: Explain regarding solubility, solubility product, common ion effect and their applications in separation of cations into groups in qualitative analysis of inorganic salts

CO2 Understand the principle, reactions and techniques involved semi micro qualitative analysis of salt mixtures

CO3 Learn the steps involved in gravimetric analysis.

Syllabus **DSC-8: Chemistry (Practical) - (034CHE012)**	**Total** **Hrs: 52**
Inorganic chemistry experiments	
Explanation of solubility, solubility product, common ion effect and their applications in separation of cations into groups in qualitative analysis of inorganic salts (students should write in the journal regarding the above). **A. Semi-micro qualitative analysis of mixtures containing two anions and two cations.** **Experiment Number: 1 to 7** **ANIONS:** CO_3^{2-}, S^{2-}, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, $C_2O_4^{2-}$, BO_3^{3-} and PO_4^{3-}	

CATIONS: Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, Na^{+}, K^{+} and NH_4^{+}.

Phosphate separation technique is to be demonstrated but not to be given at the time of examination.

B. Gravimetric Analysis:

8 Determination of barium as $BaSO_4$.
9 Determination of iron as Fe_2O_3.
10 Determination of aluminium as Al_2O_3
11 Determination of nickel (II) using Dimethylglyoxime (DMG).
12 Separation of Fe(II) and Ni(II) from the solution. Determination of Fe (III) gravimetrically

Examination

In a batch of twenty students in the practical examination, ten students may be given Semi micro qualitative analysis and other ten students may be given gravimetric determination. Selection of experiments may be done by the students based on the lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. Manual is not allowed in the examination.

Distribution of Marks for Semi-micro qualitative analysis :

Preliminary tests and presentation - 08 marks ,(6+2)
Anions (group test + C.T) (2+3) × 2 = 10 marks,
Cations (group test + C.T) (2+4) × 2 = 12 marks,
Journal-5 marks, Viva-Voce-5 marks, Total = 40 marks.

Distribution of Marks for gravimetric analysis :

Accuracy- 20 marks, Technique and Presentation- 6 marks Calculation and reactions 4 marks, Journal- 5 marks, Viva-Voce- 5 marks, Total = 40 marks.

Deduction of Marks for accuracy:

±6mg- 20 marks, ±8mg- 18 marks, ±10mg- 16 marks , ±12mg -14 marks ,±14mg- 12 marks, ±16mg -10marks, above ±16 mg - 4 marks.

Recommended Books/References

1. Vogel's Qualitative Inorganic Analysis, G.Svehla, 7th Ed, Longman (2001).
2. Vogel's Quantitative Inorganic Analysis, Bessett et. al, Longman (2001).
3. Advanced Practical Chemistry, Jagadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
4. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
5. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut.
6. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.

B.Sc. Semester – V

(Student shall select DSC 9A & 10A or 9B & 10B for 6 credits only)

DSC-9A: Chemistry (Theory) 9A

Course title - Chemistry-9A

Course Code: C 5 CHE 2 T 1

Type of Course	Theory/ Practicle	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -9A	Theory	04	04	60	03	20	80	100

Course Outcomes (CO)

After completion of course chemistry (theory) IX students will able to

CO1: Explain crystal field splitting in octahedral, tetrahedral and square planner complexes, calculation of CFSE and John Teller distortion. Determination of magnetic susceptibility by Gouy's method. Stability of metal complexes.

CO2: Understand Metal carbonyls : Types, nomenclature, preparation, and properties. Preparation and structure of methyl lithium, Zeiss salt and ferrocene. Explain role of metal ions in biological systems, structures of hemoglobin, myoglobin and chlorophyll, and the roles of metal ions in these pigments.

CO3: Understand role of metal ions in biological systems, structures of hemoglobin, myoglobin and chlorophyll, and the roles of metal ions in these pigments.

CO4: Study aromaticity of 5-membered and six member rings containing one hetero atom, synthesis of pyrrole, furan, pyridine, Mechanism of Electrophilic substitution reactions of furan, pyrrole and pyridine. Indole, quinoline and isoquinoline.

CO6: Define spectroscopy and different regions of electromagnetic spectrum. Basics of UV/visible spectroscopy. different kind of transitions that can take place within molecule.

CO7: Explain the origin of IR spectrum. Describe different types of vibrational modes of simple molecules. Explain the principles of different types of IR instruments. Outline different applications of UV, IR.& Raman spectroscopy

CO8: Understand the types, theory, technique and applications of separation techniques like solvent extraction and chromatography.

CO9: Know the manufacture, properties and applications of glass and cement.

CO10: Learn the types, manufacture of soaps, detergents and their cleansing actions.

DSC -9A: Chemistry (Theory) 9A (C 5 CHE 2 T 1)	60 hrs
UNIT-I: COORDINATION CHEMISTRY-II, ORGANOMETALLIC COMPOUNDS & BIOINORGANIC CHEMISTRY	15 hrs
Coordination chemistry-II Crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, calculation of CFSE in octahedral and tetrahedral complexes, crystal field effects in weak and strong field ligands. Factors affecting the magnitude of crystal field splitting. Tetragonal distortion of octahedral geometry, John Teller distortion. Explanation of colour and magnetic moments of complexes. Determination of magnetic susceptibility by Gouy's method. Stability of metal complexes (thermodynamic and kinetic), stepwise and overall stability constant and their relationship. Factors affecting the stability of metal complexes. (**8 Lectures)** **Organometallic compounds** Definition and classification with examples, concept of hapticity of organic ligands with examples. Metal carbonyls: Types, nomenclature, preparation, and properties. 18-electron rule, electron count in metal carbonyls of Cr, Mn, Fe, Co and Ni. Structure of mononuclear ($Cr(CO)_6$, $Fe(CO)_5$ & $Ni(CO)_4$) and binuclear carbonyls ($Mn_2(CO)_{10}$, ($Co_2(CO)_8$ & ($Fe_2(CO)_9$ using VBT. **(4 Lectures)** **Bioinorganic chemistry** Role of metal ions in biological systems with special reference to Na^+, K^+ , Ca^{2+} and Mg^{2+} ions. Structures of hemoglobin, myoglobin and chlorophyll, and the roles of metal ions in these pigments. Role of Ca^{2+} in blood clotting. **(3 Lectures)**	
UNIT-II: HETEROCYCLIC COMPOUNDS, UV AND IR SPECTROSCOPY	15 hrs
Heterocyclic Compounds: Classification, Nomenclature by Hantzsch and Widmann method, aromaticity of 5- and 6-membered rings containing one hetero atom, synthesis of pyrrole, furan (Paal-Knor synthesis), pyridine (Hantzsch synthesis). Electrophilic substitution reactions in furan, pyrrole and pyridine (Nitration, sulphonation, halogenation, Friedel-Craft's reaction). Nucleophilic substitution reactions in pyridine: Chichibabin reaction with organo lithium compounds (butyl and Phenyl lithium). Indole (Fischer's synthesis), quinoline (Skrap's synthesis). (**7 Lectures)** **Ultraviolet Spectroscopy:** Types of electronic transitions, λ_{max}, chromophores and auxochromes, bathochromic and hypsochromic shifts, intensity of absorption, Woodward – Fieser rules for calculating λ_{max} of α, β-unsaturated aldehydes, ketones, carboxylic acids, esters. **(4 Lectures)** **Infrared Spectroscopy:** Introduction to infrared spectroscopy, intensity of absorption band, position of absorptions, C-H, >C=O, O-Hand N-H absorption bands with explanation for variation in stretching frequencies. Identification of Hydrogen bonding in alcohols, phenols and carboxylic acids using IR spectroscopy. **(4 Lectures)**	
UNIT-III: MOLECULAR SPECTROSCOPY	15 hrs
Molecular Spectroscopy: Interaction of electromagnetic radiation with matter, electromagnetic spectrum. **(a). Rotational Spectroscopy:** Rotation of molecules, diatomic: rigid rotator, selection rule, derivation for expression of energy and bond length (HCl), problems on bond length, polyatomic molecules: linear, symmetric top, asymmetric top molecules(qualitative approach). **(3 Lectures)**	

(b). Vibrational Spectroscopy: Vibrating diatomic molecules - energy of diatomic molecules, force constant, vibrational spectra: harmonically vibrating diatomic molecules (HCl) and anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies, and problems on force constants. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. **(5 Lectures)** **Raman Spectroscopy:** Classical theory, Rotational Raman spectroscopy (Linear and symmetric top molecules for S and R branch), Vibration - rotational Raman spectra (Rotational fine structures), complementary of Raman and IR vibrations. **(3 Lectures)** **(c) Electronic Spectroscopy:** Diatomic molecules: Born- Oppenheimer approximation, vibrational course structure of electronic transition and intensity, Franck – Condon principle, pre-dissociation, 'g' and 'u' transitions and their applications for organic molecules. **(4 Lectures)**	
UNIT-IV : SEPARATION TECHNIQUES & INDUSTRIAL CHEMISTRY	15 hrs
Separation technique: **Chromatography**: **Paper Chromatography**: Theory, R_f value, and its calculations, techniques and applications. Separation of Pb^{2+}, Ag^{+} and Hg_2^{2+}. **Column Chromatography**: Theory, techniques and applications. Separation of methylene blue and malachite green. **Ion Exchange Chromatography**: Principle, types of ion exchangers and applications. Separation of amino acids from its mixture. (**7 Lectures)** **Industrial Chemistry:** **Glass and Cement:** General properties, silicate and non-silicate glasses and manufacture. Composition, properties and applications of soda lime glass, lead glass, armored glass, safety glass, borosilicates glass, coloured glass, photosensitive glass. Classification with properties & manufacture of Portland cement. Setting and hardening of cement. RCC and quick setting cements. **Soaps and detergents:** Composition, types & preparation of soaps & detergents (sodium alkyl sulphate, sodium alkyl benzene sulphonates). Comparison of soaps and detergents. **Micelles**: Mechanism of cleansing action of soap and detergents. Detergents builders and additives (only examples). **(8 Lectures)**	

Recommended Books/References

1. Concise Inorganic Chemistry-J. D. Lee, 5th Edn, New Age International (1996)
2. Modern Inorganic Chemistry Sathya Prakash's by R.D.Madan, S.Chand and Co.Ltd, New Delhi.
3. Inorganic Chemistry-Principles of Structure and Reactivity, 4thEdn-J. E. Huheey, E.A. Keiter, R. L. Keiter and O.K. Medhi. Pearson Education (2009).
4. Advanced Inorganic Chemistry-Agarwal & Keemtilal, 11th edition, Pragathi publication, 2012.
5. A Guidebook to Mechanism in Organic Chemistry Sykes, P., Orient Longman, New Delhi (1988).
6. Organic Chemistry Morrison, R.T. & Boyd, R.N., Pearson, 2010.
7. Advanced Organic Chemistry Bahl, A. & Bahl, B.S., S. Chand, 2010.
8. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.

9. Organic Chemistry- Mehta and Mehta, 2005.
10. Physical Chemistry P.W. Atkins:, 2002.
11. Fundamental of molecular spectroscopy by C N Banwell-2008
12. Spectroscopy by H. Kaur, A pragati edition-9th edition 2014.
13. Molecular structure and spectroscopy by G. Aruldhas, 2nd edition-2014
14. Physical Chemistry W.J. Moore: 1972.
15. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
16. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
17. Analytical Chemistry-S Usharani, Macmillian India Limited, 2000
18. Industrial Chemistry, B.K. Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

B.Sc. Semester – V

DSC-10A: Chemistry (Practical) 10A

Course title - Chemistry-10A

Type of Course	Theory/Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC 10A	Practical	02	04	56	03	10	40	50

Course Code: C 5 CHE 2 P 1

Course Outcomes (CO)

After completion of course chemistry (Practical) XIV students will able to

CO1: Identify nature of solid – solid organic mixtures, (in semi micro scale). Analyse any one separated compound through preliminary tests, element test, physical constant, function nal group test and preparation of suitable derivative and its physical constant.

CO2: To understand the – conductivity cell, cell constant & conductivity measurement. Electrodes & its potential, reference electrodes and measurement of electro motive force. pH cell and measurement of pH of a solution. Beer- Lambert law, optical density & molar extinction coefficient. Developing skills to handling the instruments for the measurement of conductance, emf, pH and optical density.

DSCC -10A: Chemistry (Practical) 10A (Code : C 6 CHE 2 P1)		
Expt. No.	**Title: ORGAIC CHEMISTRY EXPERIMENTS**	56 hrs
1 to 6	**Qualitative analysis of solid – solid organic binary mixtures** **Experiments 1 to 6** Identification of nature and separation of mixture. Analysis of any one compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant. **Acids:** Salicylic, Cinnamic and Phthalic acid **Phenol:** β–naphthol **Base:** m-nitroaniline and p-nitroaniline. **Neutral:** Naphthalene, Acetanilide, Benzamide. Thiourea & p-bromo acetanilide	
PHYSICAL CHEMISTRY EXPERIMENTS		
1	Determination of i) HCl & ii) CH_3COOH solutions using standard NaOH solution by conductometric titration.	
2.	Determination of HCl using standard NaOH solution by potentiometric titration.	
3	Determination of HCl using standard NaOH solution by pH titration.	
4	Verification of Beer- Lambert law by colorimetric method and calculation of molar extinction coefficient of tetraamminecopper (II) complex.	
5	Determination of equivalent conductance of strong electrolyte (NaCl) at infinite dilution (λ_∞).	

6	Determination of Fe^{2+} using standard $KMnO_4$ solution by potentiometric titration.	

Examination

In a batch of twenty students in the practical examination, ten students may be given organic experiments and other ten students may be given physical chemistry experiments. Selection of experiments may be done by the students based on the lots.

Organic Chemistry

In a batch of ten students, not more than two students should get the same mixture in the practical examination. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. During practical examination chart is not allowed.

Distribution of marks:
Nature & Separation- 6, Preliminary test and Elemental analysis test:- 6 marks, Physical Constant-3, Functional Group test -5, Confirmative test -5, Preparation of the derivative-3, systematic presentation -2, Journal -5, Viva-voce -5.

Physical chemistry

In a batch of ten students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:
Accuracy-18, Technique and Presentation -3 Calculation and graph- 9 (5+4), Journal-5, Viva-Voce-5, **Total=40.**

Deduction of Marks for accuracy:
Error up to 5% - 18, 6 - 10% - 15, 11-15% - 12, 16-20% - 09, above 20% - 01

Recommended Books/References

1. Advanced Practical Chemistry, agadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
2. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
3. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.
4. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
5. An introduction to electrochemistry by Samuel Glasstooen 2011
6. Photochemistry by Gurdeep Raj, 5th edition -2008

B.Sc. Semester – V

DSC-9B: Chemistry (Theory) 9B

Type of Course	Theory/ Practicle	Credits	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -9B	Theory	04	04	60	03	20	80	100

Course title - Chemistry-9B

Course Code: C 5 CHE 2 T 2

Course Outcomes (CO)

After completion of course chemistry (theory) students will able to

CO1: Explain theory of coordination compounds, IUPAC system of nomenclature, calculation of EAN, Isomerism in coordination compounds and Valence bond theory

CO2: Describe Metal carbonyls : Types, nomenclature, preparation, and properties. 18 electron rule, Structure of mononuclear and binuclear carbonyls using VBT, Preparation and structure of methyl lithium, Zeiss salt and ferrocene.

CO3: Understand role of metal ions in biological systems, structures of hemoglobin, myoglobin and chlorophyll, and the roles of metal ions in these pigments.

CO4: Explain classification, source, extraction and general properties, constitution of hygrine, coniine and nicotine.

CO5: Know colour and constitution, synthesis and applications of different dyes used in food and their safety concern and organic pigments.

CO6: Define spectroscopy and different regions of electromagnetic spectrum. Basics of UV/visible spectroscopy. Different kind of transitions that can take place within molecule.

CO7: Explain the origin of IR spectrum. Describe different types of vibrational modes of simple molecules. Explain the principles of different types of IR instruments. Outline different applications of UV, IR.

CO8: Describe classification, raw materials used and manufacture. Composition, properties and applications of glass and cement. Setting and hardening of cement and RCC.

CO09: Understand types of soaps, manufacture, ccomparison of soaps and detergents, classification of detergents, preparation of detergents, Mechanism of cleansing action of soap and detergents

CO10: Understand instrumental technique, methodology and applications of Flame Emission Spectroscopy, Thermal methods of analysis & electrogravimetry.

DSCC -9B: Chemistry (Theory) 9B (C 5 CHE 2 T 2)	60 hrs
UNIT-I: COORDINATION CHEMISTRY-II : ORGANOMETALLIC COMPOUNDS & BIOINORGANIC CHEMISTRY	15 hrs
Coordination chemistry-II Crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, calculation of CFSE in octahedral and tetrahedral complexes, crystal field effects in weak and strong field ligands. Factors affecting the magnitude of crystal field splitting. Tetragonal distortion of octahedral geometry, John Teller distortion. Explanation of colour and magnetic moments of complexes. Determination of magnetic susceptibility by Gouy's method. Stability of metal complexes (thermodynamic and kinetic), stepwise and overall stability constant and their relationship. Factors affecting the stability of metal complexes. (**8Lectures)** **Organometallic compounds** Definition and classification with examples, concept of hapticity of organic ligands with examples. Metal carbonyls: Types, nomenclature, preparation, and properties. 18-electron rule, electron count in metal carbonyls of Cr, Mn, Fe, Co and Ni. Structure of mononuclear ($Cr(CO)_6$, $Fe(CO)_5$ & $Ni(CO)_4$) and binuclear carbonyls ($Mn_2(CO)_{10}$, ($Co_2(CO)_8$ & ($Fe_2(CO)_9$ using VBT. **(4 Lectures)** **Bioinorganic chemistry** Role of metal ions in biological systems with special reference to Na^+, K^+ , Ca^{2+} and Mg^{2+} ions. Structures of hemoglobin, myoglobin and chlorophyll, and the roles of metal ions in these pigments. Role of Ca^{2+} in blood clotting. **(3 Lectures)**	
UNIT-II: ALKALODS, DYES AND UV & IR SPECTROSCOPY AND ORGANIC REAGENTS	15 hrs
Alkaloids: Classification, source, extraction and general properties, Hofmann's exhaustive methylation, constitution and synthesis of hygrine, coniine and nicotine. **(3 Lectures)** **Dyes:** Colour and constitution, synthesis and applications of congo red, malachite green, phenolphthalein and alizarin, dyes used in food and their safety concern, organic pigments with examples. **(3 Lectures)** **Ultraviolet Spectroscopy:** Types of electronic transitions, λmax, chromophores and auxochromes, bathochromic and hypsochromic shifts, intensity of absorption, Woodward rules for calculating λmax of α,β-unsaturated aldehydes, ketones, carboxylic acids, esters. applications of UV spectroscopy. **(4 Lectures)** **Infrared Spectroscopy:**	

Introduction to infrared spectroscopy, intensity of absorption band, position of absorptions, C-H, >C=O, O-Hand N-H absorption bands with explanation for variation in stretching frequencies. Identification of Hydrogen bonding in alcohols, phenols and carboxylic acids using IR spectroscopy. **(5 Lectures)**	
UNIT-III: ROTATIONAL, VIBRATIONAL AND ELECTRONIC SPECTROSCOPY	15 hrs
Interaction of electromagnetic radiation with matter, electromagnetic spectrum. **(a). Rotational Spectroscopy:** Rotation of molecules, diatomic: rigid rotator, selection rule : derivation for expression of energy and bond length (HCl), problems on bond length, polyatomic molecules: linear, symmetric top, asymmetric top molecules(qualitative approach). **(3 Lectures)** **(b). Vibrational Spectroscopy:** Vibrating diatomic molecules - energy of diatomic molecules, force constant, vibrational spectra: harmonically vibrating diatomic molecules (HCl) and anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies, and problems on force constants. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. **(5 Lectures)** **Raman Spectroscopy:** Classical theory, Rotational Raman spectroscopy (Linear and symmetric top molecules for S and R branch), Vibration - rotational Raman spectra (Rotational fine structures), complementary of Raman and IR vibrations. **(4 Lectures)** **(c). Electronic Spectroscopy:** Diatomic molecules: Born- Oppenheimer approximation, vibrational course structure of electronic transition and intensity, Franck – Condon principle, pre-dissociation, 'g' and 'u' transitions and their applications in organic molecules. **(3 Lectures)**	
UNIT-IV INDUSTRIAL CHEMISTRY & INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS	15 hrs
Industrial chemistry: **Glass and Cement:** General properties, silicate and non silicate glasses and manufacture. Composition, properties and applications of soda lime glass, lead glass, armored glass, safety glass, borosilicates glass, coloured glass, photosensitive glass. Classification with properties & manufacture of Portland cement. Setting and hardening of cement. RCC and quick setting cements. **Soaps and detergents:** Composition , types & preparation of soaps & detergents (sodium alkyl sulphate, sodium alkyl benzene sulphonates). Comparison of soaps and detergents. Mechanism of cleansing action of soap and detergents (Concept of micelles and CMC). Detergents builders and additives (only examples). **(8 Lectures)** **Instrumental methods of chemical analysis:** **Flame Emission Spectroscopy (FES):** Principle, flames and flame temperature, instrumentation, interferences, applications, and limitations of FES. Determination of Na/K in soil sample. **Thermal methods of analysis:** **Thermogrametric analysis (TGA):** Theory, thermograms, instrumentation, factors affecting thermograms. Applications of TGA. **Differential thermal analysis (DTA):** Theory, instrumentation and applications	

Electrogravimetry: Theory & Instrumentation. Determination of copper **(7 Lectures)**	

Recommended Books/References

1. Concise Inorganic Chemistry-J. D. Lee, 5th Edn, New Age International (1996)
2. Modern Inorganic Chemistry Sathya Prakash's by R.D.Madan, S.Chand and Co.Ltd, New Delhi.
3. Inorganic Chemistry-Principles of Structure and Reactivity, 4thEdn-J. E. Huheey, E.A. Keiter, R. L. Keiter and O.K. Medhi. Pearson Education (2009).
4. Advanced Inorganic Chemistry-Agarwal & Keemtilal, 11th edition, Pragathi publication, 2012.
5. A Guidebook to Mechanism in Organic Chemistry Sykes, P., Orient Longman, New Delhi (1988).
6. Organic Chemistry Morrison, R.T. & Boyd, R.N., Pearson, 2010.
7. Advanced Organic Chemistry Bahl, A. & Bahl, B.S., S. Chand, 2010.
8. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
9. Organic Chemistry- Mehta and Mehta, 2005.
10. Physical Chemistry P.W. Atkins:, 2002.
11. Fundamental of molecular spectroscopy by C N Banwell-2008
12. Spectroscopy by H. Kaur, A pragati edition-9th edition 2014.
13. Molecular structure and spectroscopy by G. Aruldhas, 2nd edition-2014
14. Physical Chemistry W.J. Moore: 1972.
15. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
16. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
17. Analytical Chemistry-S Usharani, Macmillian India Limited, 2000
18. Industrial Chemistry, B.K. Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks

Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**
Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

Type of Course	Theory/Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC 10B	Practical	02	04	56	03	10	40	50

B.Sc. Semester – V

DSC-10B: Chemistry (Practical) 10B

Course title - Chemistry-10B

Course Code: C 5 CHE 2 P 2

Course Outcomes (CO)

After completion of course, chemistry (Practical) students will able to

CO1: Identify nature of solid – solid organic mixtures and analyse any one of the separated compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant.

CO2: Understand the – conductivity cell, cell constant & conductivity measurement. Electrodes & its potential, reference electrodes and measurement of electro motive force. pH cell and measurement of pH of a solution. Beer- Lambert law, optical density & molar extinction coefficient. Developing skills to handling the instruments for the measurement of conductance, emf, pH and optical density.

DSCC -10B: Chemistry (Practical) 10B (Code : C 6 CHE 2 P2)		
Expt. No,	**Title: ORGAIC CHEMISTRY EXPERIMENTS**	56 hrs
1 to 6	**Qualitative analysis of solid – solid organic binary mixtures** **Experiments 1 to 6** Identification of nature and separation of mixture. Analysis of any one compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant. **Acids:** Salicylic, Cinnamic and Phthalic acid **Phenol:** β–naphthol. **Base:** m-nitroaniline and p-nitroaniline. **Neutral:** Naphthalene, Acetanilide, Benzamide, Thiourea & Parabromoacetanilide	

PHYSICAL CHEMISTRY EXPERIMENTS		
1	Determination of i) HCl & ii) CH_3COOH solutions using standard NaOH solution by conductometric titration.	
2.	Determination of HCl using standard NaOH solution by potentiometric titration.	
3	Determination of HCl using standard NaOH solution by pH titration.	
4	Verification of Beer- Lambert law by colorimetric method and calculation of molar extinction coefficient of tetraamminecopper (II) complex.	
5	Determination of equivalent conductance of strong electrolyte (NaCl) at infinite dilution (λ_∞).	
6	Determination of Fe^{2+} using standard $KMnO_4$ solution by potentiometric titration.	

Examination

In a batch of twenty students in the practical examination, ten students may be given organic experiments and other ten students may be given physical chemistry experiments. Selection of experiments may be done by the students based on the lots.

Organic Chemistry

In a batch of ten students, not more than two students should get the same mixture in the practical examination. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. During practical examination chart is not allowed.

Distribution of marks:
Nature & Separation- 6, Preliminary test and Elemental analysis test- 6 marks, Physical Constant- 3, Functional Group test -5, Confirmative test -5, preparation of the derivative -3, systematic presentation -2, Journal -5, Viva-voce -5.

Physical chemistry

In a batch of ten students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:
Accuracy-18, Technique and Presentation -3 Calculation and graph- 9 (5+4), Journal-5, Viva-Voce-5, **Total=40.**

Deduction of Marks for accuracy:

Error up to 5% - 18, 6 - 10% -15, 11-15%- 12, 16-20% - 09, above 20% - 01

Recommended Books/References

1. Advanced Practical Chemistry, agadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
2. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
3. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.
4. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
5. An introduction to electrochemistry by Samuel Glasstooen 2011
6. Photochemistry by Gurdeep Raj, 5th edition -2008

B.Sc. Semester – VI

(Student shall select DSC 11A & 12A or 11B & 12B for 6 credits only)

DSC-11A: Chemistry (Theory) 11A

Course title - Chemistry-11A

Course Code: C 6 CHE 2 T 1

Type of Course	Theory/Practicle	Credits	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -11A	Theory	04	04	60	03	20	80	100

Course Outcomes (CO)

After completion of course chemistry (theory) students will able to

CO1: Understand principle, instrumentation, methodology and applications of Flame Emission Spectroscopy, Thermal methods of analysis & Electrogravimery

CO2: Learn the structure and constitution of Carbohydrates, Ring Size determination and properties, Structures of disaccharides and polysaccharides and biological importance.

CO3: Study the classification of amino acids, stereochemistry of amino acids. Zwitter ion and explanation to isoelectric point, Synthesis of amino acids and diptides, biological importance, primary, secondary structure of proteins (α-helical, β-sheet), classification,isoprenerule,specialisopreneruleconstitutionandsynthesisof citral and α-terpinol.

CO4: Understand basic principles of NMR, molecular structure signals, interpretation of NMR structure of simple organic molecules. Understand basic principle of mass spectroscopy, instrumentation, definitions of parent peak and base peak.

CO5: Explain the spectral distribution of block body radiation, Plank's radiation law, Photoelectric effect, Compton effect.

CO6: Describing Schrödinger's wave equation, wave functions, Eigen function and Eigen values, normalization and orthogonality

CO7: Interpretation of equations of motion, elementary wave motion and operators

CO8: Derive expression of solutions of Schrödinger equations of a free particle, particle in a box.

CO9: Explain the dimensions, degeneracy, reflection and penetration of a particle in a one dimensional box of semi-infinite barrier, a particle in a box of finite walls.

CO10: Distinguish between reversible and irreversible cells. Concept of EMF and its measurement.

CO11: Describing the electrode potential, types, applications for pH and EMF determinations.

CO12: Types, construction and applications of batteries & fuel cells.

CO13: Types of adsorption isotherms. Derivation of Langmuir and Freundlich adsorption isotherm

DSC -11A: Chemistry (Theory) 11A (C 6 CHE 2 T 1)	60 hrs
UNIT-I: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS & ENVIRONMENTAL CHEMISTRY	15 hrs
Instrumental methods of chemical analysis **Flame Emission Spectroscopy (FES):** Principle, flames and flame temperature, instrumentation, interferences, applications, and limitations of FES. Determination of Na/K in soil sample. **Thermal methods of analysis:** Thermogrametric analysis (TGA), Theory, thermograms, instrumentation, factors affecting thermograms. Applications of TGA. Differential thermal analysis (DTA): Theory, instrumentation and applications **Electrogravimetry:** Theory & Instrumentation. Determination of copper **(7 Lectures)** **Environmental chemistry** **Air pollution**: Chemical and photochemical reactions in atmosphere. Types and sources of air pollutants . Control measures of air pollution. Green house effect and ozone depletion. Estimation of CO, NOx & SOx in the atmosphere. **Water pollution:** Water pollutants and their sources. Industrial effluents and their treatment (primary and secondary treatment). Sludge disposal. Water purification methods (ion exchange, reverse osmosis & electro dialysis) Disposal of nuclear waste **(8 Lectures)**	
UNIT-II: CARBOHYDRATES, AMINOACIDS NMR & MASS SPECTROMETRY	15 hrs
Carbohydrates: Definition, classification, osazone formation, epimers and epimerisation, inter conversion of fructose and glucose, Kiliani synthesis and Ruff degradation, ring structure of D-glucose, mutarotation, and determination of ring size of D-glucose by Haworth–Hirst method, Disaccharides: structure of sucrose and lactose (mention hydrolysis product, glycoside linkage and reducing properties). Polysaccharides: partial structure of starch and cellulose. **(4 Lectures)** **Amino acids and proteins:** Classification of amino acids, stereochemistry of amino acids, Zwitter ion and explanation to isoelectric point, synthesis of amino acids from Gabriel phthalimide synthesis, Strecker's synthesis, ninhydrin reaction. Peptides: definition and Bergman's synthesis of dipeptides. Protiens: biological importance, primary, secondary structure of proteins (α-helical, β-sheet). **(4 Lectures)** **Nuclear Magnetic resonance (NMR):** Basic principles of NMR, nuclear shielding and deshielding, chemical shift, Instrumentation (continuous wave NMR Spectrometer). Spin-spin splitting & coupling constant and areas of signals. Interpretation of NMR spectra of ethylbromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone, phenol, paracetamol and acetanilide. **(5 Lectures)** **Mass Spectrometry** Principle, instrumentation, molecular ion peak and base peak, McLafferty rearrangement with respect to 2-hexanone, hexenoicacid and methylhexanoate **(2 Lectures)**	
UNIT-III: QUANTUM CHEMISTRY	15 hrs
Quantum Chemistry: Black body radiation, Spectral distribution of black body radiation, Plank's theory, derivation of Planck's radiation law, photoelectric effect, Compton effect. **(4 Lectures)** Wave nature of electron, derivation of Schrödinger's wave equation, wave function and its significance, Eigen function and Eigen values, normalization and orthogonality. **(3 Lectures)**	

Equation of motion for a particle, Newtonian, Lagrangian and Hamiltonian equations of motion (Derivations not required), elementary wave motion. Operators, Eigen values, commuting operators, linear operator, Laplacian operator, Hamiltonian operator and Hermitian operators. **(4 Lectures)** Solutions of Schrödinger equations of a free particle: in one and three dimensions, degeneracy, reflection and penetration of a particle in a one-dimensional box of semi-infinite barrier, a particle in a box of finite walls. **(4 Lectures)**	
UNIT-IV ELECTROCHEMISTRY-II AND SURFACE CHEMISTRY	15 hrs
Electrochemistry-II **Electro Motive Force(EMF)** Electrochemical cells, Reversible and irreversible cells, EMF of a cell and its measurement using potentiometer, standard cell (Weston standard cell), salt bridge. Types of electrodes, reference electrode- SHE, calomel electrode, sign conventions, Nernst equation, electrochemical series and its applications. Determination of pH of a solution using hydrogen, quinhydrone and glass electrodes. Concentration cell with and without transference, liquid junction potential. Numerical problems. Applications of EMF measurements- i. Determination of solubility and solubility product of sparingly soluble salts. ii. Potentiometric titrations: acid–base and redox titrations. iii. Determination of redox potentials. Numerical problems are to be solved wherever applicable. **Batteries & Fuel cells-** Primary and secondary batteries, construction and applications of Zn-MnO_2 cell, Pb-acid battery, nickel-cadmium cell and Li-Battery. Fuel cells-hydrogen-oxygen and hydrocarbon–oxygen fuel cells and their applications. **(9 Lectures)** **Surface chemistry:** Adsorption: Types of adsorption isotherms, Freundlich adsorption isotherm and its limitations. Langmuir adsorption isotherm and its derivation. BET equation (no derivation) and calculation of surface area of the adsorbent, numerical problems. Catalysis**:** Types of catalysis. Theory of catalysis: Intermediate compound formation theory and adsorption theory (Heterogeneous catalysis). Theory of acid-base catalysis: Enzyme catalysis, mechanism of enzymatic reaction with derivation of kinetic rate equation (Michaelis-Menten equation). Applications of catalysts. Autocatalysis with examples. **(6 Lectures)**	

Recommended Books/References

1. Analytical Chemistry-S Usharani, Macmillian India Limited, 2000
2. Modern Inorganic Chemistry Sathya Prakash's by R.D.Madan, S.Chand and Co.Ltd, New Delhi.
3. Advanced Inorganic Chemistry-Agarwal & Keemtilal, 11th edition, Pragathi publication, 2012.
4. A Guidebook to Mechanism in Organic Chemistry Sykes, P., Orient Longman, New Delhi (1988).
5. Organic Chemistry Morrison, R.T. & Boyd, R.N., Pearson, 2010.
6. Advanced Organic Chemistry Bahl, A. & Bahl, B.S., S. Chand, 2010.
7. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
8. Organic Chemistry- Mehta and Mehta, 2005.
9. Physical Chemistry P.W. Atkins:, 2002.
10. Fundamental of molecular spectroscopy by C N Banwell-2008
11. Spectroscopy by H. Kaur, A pragati edition-9th edition 2014.
12. Molecular structure and spectroscopy by G. Aruldhas, 2nd edition-2014
13. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.

14. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.

B.Sc. Semester – VI

DSC-12A : Chemistry (Practical) 12A

Type of Course	Theory/Practical	Credits	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC 12A	Practical	02	04	56	03	10	40	50

Course title - Chemistry-12 A

Course Code: C 6 CHE 2 P 1

Course Outcomes (CO)

After completion of course chemistry (Practical) XIV students will able to

CO1: Separate liquid – liquid mixtures (in semi micro scale) and analyse any one of the separated compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant.

CO2: To understand the – conductivity cell, cell constant & conductivity measurement. Electrodes & its potential, reference electrodes and measurement of electro motive force. pH cell and measurement of pH of a solution. Beer- Lambert law, optical density & molar extinction coefficient. Developing skills to handling the instruments for the measurement of conductance, emf, pH and optical density.

DSCC -12A: Chemistry (Practical) 12A (Code : C 6 CHE 2 P1)		
Expt. No,	**Title: ORGANIC CHEMISTRY EXPERIMENTS**	56 hrs
1 to 6	**Qualitative analysis of liquid –liquid organic binary mixtures** **Experiments 1 to 6** separation of liquid mixture by simple distillation, Analysis of any one compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant. **Low Boiling:** ethyl acetate, acetone **High Boiling:** phenol, aniline, acetophenone, toluene, chlorobenzene, benzaldehyde	
PHYSICAL CHEMISTRY EXPERIMENTS		
1	Determination of solubility of a sparingly soluble salt ($BaSO_4$/$PbSO_4$) conductometrically.	
2.	Determination of redox potentials of Fe^{3+}/Fe^{2+} using of $FeSO_4.7H_2O$ solution (0.1N) by potentiometric titration against the standard solution of $K_2Cr_2O_7$ (0.1N)	
3	Verification of Beer- Lambert law for Fe^{3+} - SCN^- complex colorimetrically and determination of Fe^{3+} in the complex.	
4	Determination of second order rate constant for the hydrolysis of ethyl acetate by NaOH conductometrically.	
5	Determination of pK_a of a weak acid using pH meter.	
6	Determination of solubility and solubility product of sparingly soluble salts (AgCl)	

	potentiometrically.	

Examination

In a batch of twenty students in the practical examination, ten students may be given organic experiments and other ten students may be given physical chemistry experiments. Selection of experiments may be done by the students based on the lots.

Organic Chemistry

In a batch of ten students, not more than two students should get the same mixture in the practical examination. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. During practical examination chart is not allowed.

Distribution of marks:
Separation -6, Preliminary test and Elemental analysis test- 6 marks, Physical Constant- 3, Functional Group test- 5, Confirmative test- 5, preparation of the derivative-3, systematic presentation-2, Journal-5, Viva-voce-5.

Physical chemistry

In a batch of ten students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the lots system. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Accuracy-18, Technique and Presentation -3 Calculation and graph- 9 (5+4), Journal-5, Viva-Voce-5, **Total=40.**

Deduction of Marks for accuracy:

Error up to 5% - 18, 6 - 10% -15, 11-15% - 12, 16-20% - 09, above 20% - 01

Recommended Books/References

1. Advanced Practical Chemistry, agadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
2. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
3. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.
4. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
5. An introduction to electrochemistry by Samuel Glasstooen 2011
6. Photochemistry by Gurdeep Raj, 5th edition -2008

B.Sc. Semester – VI

DSC-11B: Chemistry (Theory) 11B

Course title - Chemistry-11B

Course Code: C 6 CHE 2 T 2

Type of Course	Theory/ Practical	Credits	Instruction hour per week (hr)	Total hours of Syllabus / Sem	Duration of Exam (hr)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC -11B	Theory	04	04	60	03	20	80	100

Course Outcomes (CO)

After completion of course chemistry (theory) 11A students will able to

CO1: Understand the types, theory, technique and applications different types of chromatography.

CO2: Know air pollutants, control measures of air pollution, photochemical smog, green house effect and ozone depletion.

CO3: Aware of water pollutants and their sources, industrial effluents and their treatment, sludge disposal, purification of water by different methods, disposal of nuclear waste.

CO4: Understand the classification, biological significance, source and structure of vitamins and hormones.

CO5: Learn about requirement of an ideal drug and classification, Synthesis and therapeutic uses of different chemotherapeutic agents.

CO6: Understand basic principles of PMR, molecular structure signals, interpretation of PMR structure of simple organic molecules, principle, instrumentation, definitions of parent peak and base peak.

CO7: Explain the spectral distribution of black body radiation, Plank's radiation law, Photoelectric effect, Compton effect.

CO8: Describing Schrödinger's wave equation, wave functions, Eigen function and Eigen values, normalization and orthogonality

CO9: Interpretation of equations of motion, elementary wave motion and operators and derive expression of solutions of Schrödinger equations of a free particle, particle in a box.

CO10: Explain the dimensions, degeneracy, reflection and penetration of a particle in a one-dimensional box of semi-infinite barrier, a particle in a box of finite walls.

CO11: Distinguish between reversible and irreversible cells. Concept of EMF and its measurement.

CO12: Understand about electrode potential, types of electrode & their potential, electrochemical series & application of emf measurement Nernst's equation.

CO13 Know the types, construction and applications of batteries & fuel cells.

CO14: Understand types of adsorption isotherms, derivation of Langmuir and Freundlich adsorption isotherm, types theories and applications of catalysis.

Syllabus **DSCC -11B: Chemistry (Theory) 11B (Code: C 6 CHE 2 T 2)**	60 hrs
UNIT-I: SEPERATION TECHNIQUE & ENVIRONMENTAL CHEMISTRY	
Separation technique **Chromatography**: **Paper Chromatography**: Theory, R_f value, and its calculations, techniques and applications. Separation of Pb^{2+}, Ag^{+} and Hg_2^{2+}. **Column Chromatography**: Theory, techniques and applications. Separation of methylene blue and malachite green. **Ion Exchange Chromatography**: Principle, types of ion exchangers. and applications. Separation of amino acids from its mixture. **(7 Lectures)** **Environmental chemistry** **Air pollution**: Chemical and photochemical reactions in atmosphere. Types and sources of air pollutants. Control measures of air pollution. Green house effect and ozone depletion. Determination of CO, NOx & SOx in the atmosphere. **Water pollution:** Water pollutants and their sources. Industrial effluents and their treatment (primary and secondary treatment). Sludge disposal. Water purification methods (ion exchange , reverse osmosis & electro dialysis). Disposal of nuclear waste. **(8 Lectures)**	15 hrs
UNIT-II: VITAMINS AND HORMONES, DRUGS, NMR & MASS SPECTROMETRY	
Vitamins and Hormones: Classification and biological significance, source and structure of Vitamin A, B1(thiamine), B2 (riboflavin), B6(pyridoxine), a-tocopherol, K1 (phylloquinone), C (abscorbic acid). Synthesis of Vitamin C from D-glucose. Hormones: definition, classification with examples, functions and deficiency diseases of hormones (**3 Lectures)** **Drugs:** Definition and classification, requirement of an ideal drug, synthesis and therapeutic uses of (a) Analgesic and antipyretic: ibuprofen and diclofenac sodium, (b) Antibacterial: sulphadiazine and sulphathiazole (c) Antimalarial: chloroquine, (d) Antibiotic: chloramphenicol, (e) Tranquilizers: Mysoline and pentothal sodium **(5 Lectures)** **Nuclear Magnetic resonance (NMR):** Basic principles of NMR, nuclear shielding and deshielding, chemical shift, Instrumentation (continuous wave NMR Spectrometer). Spin-spin splitting & coupling constant and areas of signals. Interpretation of NMR spectra of ethylbromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone, phenol, paracetamol and acetanilide. **(5 Lectures)** **Mass Spectrometry** Principle, instrumentation, molecular ion peak and base peak, McLafferty rearrangement with respect to 2-hexanone, hexenoicacid and methylhexanoate **(2 Lectures)**	15 hrs
UNIT-III: QUANTUM CHEMISTRY	15 hrs
Quantum Chemistry: Black body radiation, Spectral distribution of black body radiation, Plank's theory, derivation of Planck's radiation law, photoelectric effect, Compton effect. **(4 Lectures)** Wave nature of electron, derivation of Schrödinger's wave equation, wave function and its significance, Eigen function and Eigen values, normalization and orthogonality. **(3 Lectures)**	

Equation of motion for a particle, Newtonian, Lagrangian and Hamiltonian equations of motion (Derivations not required), elementary wave motion. Operators, Eigen values, commuting operators, linear operator, Laplacian operator, Hamiltonian operator and Hermitian operators. **(4 Lectures)** Solutions of Schrödinger equations of a free particle: in one and three dimensions, degeneracy, reflection and penetration of a particle in a one-dimensional box of semi-infinite barrier, a particle in a box of finite walls. **(4 Lectures)**	
UNIT-IV: ELCTRODICS AND SURFACE INTERFACES	15 hrs
Electrochemistry-II **Electro Motive Force(EMF)** Electrochemical cells, Reversible and irreversible cells, EMF of a cell and its measurement using potentiometer, standard cell (Weston standard cell), salt bridge. Types of electrodes, reference electrode- SHE, calomel electrode, sign conventions, Nernst equation, electrochemical series and its applications. Determination of pH of a solution using hydrogen, quinhydrone and glass electrodes. Concentration cell with and without transference, liquid junction potential. Numerical problems. Applications of EMF measurements- i. Determination of solubility and solubility product of sparingly soluble salts. ii. Potentiometric titrations: acid–base and redox titrations. iii. Determination of redox potentials. Numerical problems are to be solved wherever applicable. **Batteries & Fuel cells-** Primary and secondary batteries, construction and applications of Zn-MnO_2 cell, Pb-acid battery, nickel-cadmium cell and Li-Battery. Fuel cells-hydrogen-oxygen and hydrocarbon–oxygen fuel cells and their applications. **(9 Lectures)** **Surface chemistry:** Adsorption: Types of adsorption isotherms, Freundlich adsorption isotherm and its limitations. Langmuir adsorption isotherm and its derivation. BET equation (no derivation) and calculation of surface area of the adsorbent, numerical problems. Catalysis**:** Types of catalysis. Theory of catalysis: Intermediate compound formation theory and adsorption theory (Heterogeneous catalysis). Theory of acid-base catalysis: Enzyme catalysis, mechanism of enzymatic reaction with derivation of kinetic rate equation (Michaelis-Menten equation). Applications of catalysts. Autocatalysis with examples. **(6 Lectures)**	

Recommended Books/References

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14. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
15. Industrial Chemistry, B.K. Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

Formative Assessment for Theory		
Sl. No	Assessment type	Marks
01	Internal Assessment test 1	05
02	Internal Assessment test 2	05
03	Assignment	10
	Total	20
Formative Assessment as per the guidelines		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC

(80 marks for semester end Examination with 3 hrs duration)

Part-A Question number 1-10 carries 2 marks each. Answer any 05 questions : 10marks
Part-B Question number 11- 20 carries 05Marks each. Answer any 08 questions : 40 marks
Part-C Question number 21-24 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary) **Total: 80 Marks**

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.

B.Sc. Semester – VI

DSC-12B: Chemistry (Practical) 12B

Course title - Chemistry-12 B

Type of Course	Theory/Practical	Credits	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC 12B	Practical	02	04	56	03	10	40	50

Course Code: C 6 CHE 2 P 2

Course Outcomes (CO)

After completion of course chemistry (Practical) XIV students will able to

CO1: Identify nature and separate liquid – liquid mixtures (in semi micro scale). Analyse any one separated compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant.

CO2: To understand the – conductivity cell, cell constant & conductivity measurement. Electrodes & its potential, reference electrodes and measurement of electro motive force. pH cell and measurement of pH of a solution. Beer- Lambert law, optical density & molar extinction coefficient. Developing skills to handling the instruments for the measurement of conductance, emf, pH and optical density.

DSCC -12B: Chemistry (Practical) 12B (Code : C 6 CHE 2 P2)		
Expt. No,	**Title: ORGAIC CHEMISTRY EXPERIMENTS**	56 hrs
1 to 6	**Qualitative analysis of liquid –liquid organic binary mixtures** **Experiments 1 to 6** separation of liquid-liquid mixture by simple distillation, Analysis of any one compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant. **Low Boiling:** ethyl acetate, acetone **High Boiling:** phenol, aniline, acetophenone, toluene & benzaldehyde	
PHYSICAL CHEMISTRY EXPERIMENTS		
1	Determination of solubility of a sparingly soluble salt ($BaSO_4$/$PbSO_4$) conductometrically.	
2.	Determination of redox potentials of Fe^{3+}/Fe^{2+} using of $FeSO_4.7H_2O$ solution (0.1N) by potentiometric titration against the standard solution of $K_2Cr_2O_7$ (0.1N)	
3	Verification of Beer- Lambert law for Fe^{3+} - SCN^- complex colorimetrically and determination of Fe^{3+} in the complex.	
4	Determination of second order rate constant for the hydrolysis of ethyl acetate by NaOH conductometrically.	
5	Determination of pK_a of a weak acid using pH meter.	
6	Determination of solubility and solubility product of sparingly soluble salts (AgCl) potentiometrically.	

Examination

In a batch of twenty students in the practical examination, ten students may be given organic experiments and other ten students may be given physical chemistry experiments. Selection of experiments may be done by the students based on the lots.

Organic Chemistry

In a batch of ten students, not more than two students should get the same mixture in the practical examination. Viva questions may be asked on any of the experiments prescribed in the practical syllabus. During practical examination chart is not allowed.

Distribution of marks:
Separation - 6, Preliminary test and Elemental analysis test- 6 marks, Physical Constant- 3, Functional Group test- 5, Confirmative test- 5, preparation of the derivative-3, systematic presentation-2, Journal-5, Viva-voce-5.

Physical chemistry

In a batch of ten students, not more than two students should get the same experiment in the practical examination. Selection of experiments may be done by the students based on the picking up of chits. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:
Accuracy-18, Technique and Presentation -3 Calculation and graph- 9 (5+4), Journal-5, Viva-Voce-5, **Total=40.**

Deduction of Marks for accuracy:

Error up to 5% - 18, 6 - 10% -15, 11-15% - 12, 16-20% - 09, above 20% - 01

Recommended Books/References

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2. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
3. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.
4. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
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