KARNATAK UNIVERSITY, DHARWAD

Four - Year B.Sc. (Hons.) Program

SYLLABUS FOR SEM I & II

Course: CHEMISTRY

SEMESTER - I

DISCIPLINE SPECIFIC CORE COURSES(DSCC)

DSCC – 1 : Chemistry (Theory) - I (Code:031CHE011)

DSCC – 2 : Chemistry (Practical) - II (Code:031CHE012)

OEC- 1 : Chemistry in daily life (Code: 001CHE051)

SEMESTER - II

DSCC – 3 : Chemistry (Theory) - III (Code:032CHE011)

DSCC- 4 : Chemistry (Practical) - IV (Code:032CHE012)

OEC- 2 : Molecules of life (Code:002CHE051)

Effective from 2021-22

AS PER N E P - 2020

Karnatak University, Dharwad

Sem	Type of Course	Course Code	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks	Credits
I	DSCC -1 Chemistry (Theory) - I	031CHE011	04	56	02	40	60	100	04
	DSCC -2 Chemistry (Practical) - II	031CHE012	04	52	03	25	25	50	02
	OEC- 1 Chemistry in daily life	001CHE051	03	42	02	40	60	100	03
	SEC-I : Soil analysis	031CHE061	03	30	02	25	25	50	02
II	DSCC -3 Chemistry (Theory) - III	032CHE011	04	56	02	40	60	100	04
	DSCC -4 Chemistry (Practical) - IV	032CHE012	04	52	03	25	25	50	02
	OEC- 2 Molecules of life	002CHE051	03	42	02	40	60	100	03

Programme Specific Outcome (PSO):

On completion of the 03/ 04 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 To 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 To prepare students effectively for professional employment or research degrees in chemical sciences.

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

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

PO 12 To develop an independent and responsible work ethics.

B.Sc. Semester – I

DSCC-1 : Chemistry (Theory) I (Code: 031CHE011)

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. Quantum mechanics. Derivation of Schrodinger's wave equation. 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 electronegativity, discuss the factors affecting atomic radii, describe the relationship of atomic radii with ionization energy and electron affinity, describe the periodicity in atomic radii, ionization energy, electron affinity and electronegativity.

CO3: Explain bond properties, electron displacement effects (inductive effect, electrometric effect, resonance effect and Hyper conjugation effect). steric effect and their applications in explaining acidic strength of carboxylic acids, basicity of amines. Understand basic concept of organic reaction mechanism, types of organic reactions, structure, stability and reactivity of reactive intermediates.

CO4: Describe important characteristics of configurational and conformational isomers. Practice and write conformational isomers of ethane, butane and cyclohexane. Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E,Z notations and R& S notations. Explain D and L configuration and *threo* and *erythro* nomenclature. Explain racemic mixture and racemisation, resolution of racemic mixture through mechanical separation, formation of diastereomers, and biochemical methods, biological significance of chirality.

CO5: Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of the particles. Explain the laws governing behavior of ideal gases and real gases. Understand cooling effect of gas on adiabatic expansion. Describe the conditions required for liquefaction of gases. Realize that there is continuity in gaseous and liquid state. Explain properties of liquids in terms of intermolecular attractions.

CO6: Understand principles of titrimetric analysis. Understand principles of different type's titrations. Titration curves for all types of acids – base titrations. Gain knowledge about balancing redox equations, titration curves, theory of redox indicators and applications.

CO7: Understand titration curves, indicators for precipitation titrations involving silver nitrate-Volhard's and Mohr's methods and their differences. Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water.

Syllabus- DSCC-1 : Chemistry (Theory) I (Code: 031CHE011)	Total Hrs: 56
Unit-I : ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS	**14 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. Quantum mechanics. Derivation of Schrodinger's wave equation for hydrogen atom and meanings of various terms in it. 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 and their significance. Quantum numbers and their significance. Orbital shapes of *s, p, d and f* atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms (atomic number up to 54). Concept of exchange energy. Anomalous electronic configurations. IUPAC nomenclature of elements with atomic number greater than hundred. **(10 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. Effective nuclear charge, screening effect, Slater's rules, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity, Pauling/ Allred-Rochow scales**.** Numerical problems are to be solved wherever applicable. **(04 Lectures)**	
Unit-II FUNDAMENTALS OF ORGANIC CHEMISTRY & STEREOCHEMISTRY	**14 hrs**
Fundamentals of Organic Chemistry: Review of hybridization, *sigma* and *pi* bonds. IUPAC Nomenclature of poly functional organic compounds, comparative study of bond lengths, bond angles, bond energies and dihedral angles, bond polarity, dipole moment and illustration with examples of organic compounds, delocalization, electron displacement effects and their applications: inductive effect, electrometric effect, resonance effect, hyperconjugation, and steric effect. **Organic reaction Mechanism**: Definition, classification of organic reactions: substitution, addition, elimination, rearrangement, oxidation and reduction reactions	

with suitable examples. Use of curved arrows, types of bond fission, electrophiles, nucleophiles, nucleophilicity, nucleofugacity and basicity. Reactive intermediates: Energy profile diagrams, structure, formation and stability and reactions of carbocations, carbanions, free radicals and carbenes. **(7 Lectures)** **Stereochemistry:** **Stereoisomersim**: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions. **Geometrical isomerism:** Definition, reason for geometrical isomerism, E and Z notation -CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, *syn* and *anti* isomers in compounds containing C=N. **Optical isomerism:** Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and *threo* and *erythro* nomenclature, racemic mixture and racemization, Resolution: Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. Problems are to be solved wherever applicable. **(7 Lectures)**	
Unit-III GASES & LIQUIDS	**14 hrs**
Gaseous state: Review of kinetic theory of gases, van der Waals equation of state Boyle temperature. Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation not required), law of equipartition of energy. Collision frequency, collision diameter, 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), continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable. **(7 Lectures)** **Liquid state:** Molecular forces and general properties of liquids**.** **Surface tension:** surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of	

surface tension by capillary rise method, drop weight and drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone. **Viscosity**: Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature, size, weight, 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. **(7 Lectures)**	
Unit-IV ANALYTICAL CHEMISTRY	**14 hrs**
Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Accuracy, precision, selectivity and sensitivity. Method validation. Types and sources of errors in analytical measurements. Presentation of experimental data and results from the point of view of significant figures. **Titrimetric analysis**: Principle, classification, normality, molarity, molality, mole fraction, ppm, ppb etc. Standard solutions, preparation and dilution of reagents/solutions using $N_1V_1 = N_2V_2$, preparation of ppm level solutions from source materials (salts). **Acid-base titrimetry**: Theory, titration curves for all types of acids – base titrations. **Redox titrimetry**: Theory, balancing redox equations, titration curves, theory of redox indicators and applications. **Precipitation titrimetry:** Theory, titration curves, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences. **Complexometric titrimetry:** 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. Numerical problems are to be solved wherever applicable. (**14 Lectures)**	

Recommended Books/References

Inorganic Chemistry

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. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
4. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C. B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.

15. Organic Chemistry- Mehta and Mehta, 2005.

Physical Chemistry

1. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, 2007.
2. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi, 2009.
4. P.W. Atkins: Physical Chemistry, 2002.
5. W.J. Moore: Physical Chemistry, 1972.
6. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
7. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
8. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
9. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
10. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
11. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York, 1981.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.
6. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.

B.Sc. Semester – I

DSCC-2 : Chemistry II (Practical) (Code: 032CHE012)

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: Basic concepts involved in titrimetric analysis, primary standard substances, preparation of standard solutions.

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

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

CO5: Based on principles of titrimetric analysis student can perform

CO6: Describe the significance of organic quantitative analysis.

CO7: Determine the amount of phenol, aniline, amide, ester and formaldehyde in a given solution by performing blank titration and main titrations.

CO8: Determine aspirin in the tablet by hydrolysis method.

Syllabus- **DSCC-2 : Chemistry II (Practical) (Code: 032CHE012)**	**Total Hrs: 52**
Inorganic chemistry experiments Explaination of calibration of glasswares (burette, pipette, volumetric flask), primary and secondary standard solutions, normality, molarity, molality & equivalent mass. (Students should write in the journal regarding the above). 1. Determination of sodium carbonate and sodium bicarbonate in a mixture. 2. Determination of carbonate and hydroxide present together in a mixture. 3. Determination of Mohr's salt and oxalic acid separately using standardized $KMnO_4$ solution. 4. Determination of ferrous and ferric ions in a solution using standard solution of $K_2Cr_2O_7$ by internal indicator method (diphenylamine or N-phenylanthranilic acid). 5. Determination of magnesium using standard EDTA solution (Standardize EDTA solution using standard zinc sulphate solution). 6. Determination of iodine using sodium thiosulphate (Standardize sodium thiosulphate solution using standard potassium dichromate solution). Note : Standard solution is to be prepared by the students for both in regular and in practical examination **Distribution of marks** **1. Accuracy: 12 (6+6)Marks**	

2. Technique and presentation : 02Marks **3. Reactions and Calculations: 03 Marks** **4. Viva: 05 Marks** **5. Journal: 03 Marks** **Total 25 marks** **Deduction of marks for accuracy :** : ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks	
Organic chemistry experiments 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 by sodium sulphite method.	
Distribution of marks **1. Accuracy: 12 (6+6) Marks** **2. Technique and presentation : 02Marks** **3. Reactions and Calculations: 03 Marks** **4. Viva: 05 Marks** **5. Journal: 03 Marks** **Total 25 marks** **Deduction of marks for accuracy :** : ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks	
General instructions: In the practical examination, in a batch of ten students, five students each will be performing inorganic and organic 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 Qualitative and quantitative Inorganic Analysis, G.Svehla, 7th Ed, Longman (2001).
2. Advanced Practical Chemistry, Pragathi, Publications, Jagadamba Singh,
3. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut

B.Sc. Semester – I

OEC- 1 : Chemistry in daily life (Code: 001CHE051)

Course Outcome (CO):

After completion of course, students will be able to:

CO1: Understand the chemical constituents in various day to day materials used by a common man like Tooth paste, Cosmetics, Soaps and detergents and Biomolecules .

CO2: Understand the chemical constituents and applications in Food additives, adulterants and contaminants, Artificial food colorants**.**

CO3: Understand the scientific reasons in various aspects and chemotherapy and its applications.

CO4: Understand the basic constituents and applications in polymers, surface coatings, fertilizers, insecticides and pesticides, chemical explosives etc.

Syllabus- **OEC- 1 : Chemistry in daily life (Code: 001CHE051)**	**Total Hrs: 42**
Unit-I	**14 hrs**
Household chemicals: Common chemicals used at home. **Tooth paste** – Contents of toothpaste, chemical name, ingredients, flavor and its role. **Cosmetics** – Contents and uses of Face powder, snow, lipsticks and perfumes. Toxic household chemicals and their effects (antifreeze, bleach, drain cleaners, carpet cleaners, ammonia, air fresheners). **Soaps and detergents**- Types of soaps, synthetic detergents (neutral, anionic and cationic), cleansing action of detergents. Advantages and disadvantages of detergents over soaps. **Biomolecules:** Composition and uses of Carbohydrates, proteins, oils and fats minerals and vitamins. Functions of enzymes and hormones in the human body.	
Unit-II	**14 hrs**
Food additives, adulterants and contaminants: Definition types and applications - Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose and sodium cyclamate. Flavours: Vanillin, alkyl esters (fruit flavours) and monosodium glutamate. **Artificial food colorants:** Coal tar dyes and non-permitted colours and metallic salts. Analysis of pesticide residues in food. **Science behind** emotions, sunscreen, rust formation, rainbow, motion sickness, salt	

harvesting, crystallization of sugar and kidney stones. **Chemotherapy:** Drugs and their classification. Therapeutic action of different classes of the drugs *viz*. analgesics, antibiotics, antacids, antihistamines, antimicrobials, contraceptives, antipyretics, antiseptics and neurologically active drugs.	
Unit-III	**14 hrs**
Polymers: Examples of synthetic polymers and their uses (LDPE, HDPE, PVC, Polypropylene, nylon, teflon, polysiloxanes, polyphosphazenes and polybutadiene). **Surface Coatings:** Classification and brief introduction to surface coatings. Paints and pigments - formulation, composition and related properties. Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, Metallic coatings (electrolytic and electroless), metal spraying and anodizing. **Fertilizers:** Composition of fertilizers, uses of Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, superphosphate of lime. **Insecticides, weedicides and pesticides**: Examples, content and uses. **Chemical explosives:** Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.	

Recommended Books/References

1. Hawley's Condensed Chemical Dictionary by Richard J. Lewis. Call Number: REF 540.3 H31.
2. Van Nostrand's Encyclopedia of Chemistry by Glenn D. Considine, Call Number: REF 540.3 V33C 2005.
3. Macmillan Encyclopedia of Chemistry by Joseph J. Lagowski.
4. NCERT 12th Standard Book and references therein.
5. Chemistry in Daily Life: Third Edition Paperback – 1 January 2012 by Singh K.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weight age for total marks

Type of Assessment	Weight age	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10marks

Part-B

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

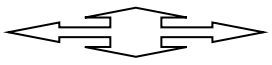
Part-C

3. Question number 12-15 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: 60 Marks

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



B.Sc. Semester - I

Subject: Chemistry

SKILL ENHANCEMENT COURSE (SEC)-I

SEC-I : Soil Analysis: (031CHE061)

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Mode of Examination	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
SEC-I	Practical	02	03hrs	30	Practical	2hr	25	25	50

Course Outcome (CO)

After completion of Skill Enhancement course, students will be able to:

CO1: Acquire skills for Laboratory management and routine analysis of Soil.

CO2: Improve working ability in analytical laboratory.

CO3: Helpful for obtaining jobs in various fields.

CO4: The student can start his own business /laboratory or can associate with any kind of laboratory or associated jobs with confidence.

List of the Experiments for 30 hrs / Semesters (Theory and Practical= 3Hours/Week)

1. Introduction: Soil, Physical properties of Soil,
2. Chemical Properties of soil: chemistry of clays, ionic exchange, acidity, alkalinity, pH, salinity, reactions in liming and acidification.
3. Soil organic matter, C: N relationships, nitrogen-transformation, soil organisms, sulfur transformation.
4. Fertility of soil. Soil deficiency with respect to macro and micro nutrient components.
5. Brief study of micronutrient & macronutrient sources & importance

Practical

6. Visit to soil testing laboratory & report writing. Visit to farmers fields for collection of different types of soil samples.
7. Determination of pH of different types of soil samples
8. Determination of electrical conductivity of different types of soil samples
9. Determination of alkalinity and salinity of the soil samples.
10. Determination of total organic matter in the soil Samples.
11. Determination of Ca (II) ions from soil samples.
12. Determination of Mg(II) ions from soil samples.
13. Determination of Fe (II) and Fe (III) ions from soil sample.
14. Determination of Na from soil samples by flame photometry.
15. Determination of K from soil samples by flame photometry.

General instructions:

In the practical examination, in a batch of ten students, minimum three sets of experiments may be given. Selection of experiment 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*

Scheme of Practical Examination (distribution of marks)

For internal and Semester end examination

1. **Three questions on the theory may be given.**
   Student has to answer any two questions: 06 Marks
2. **Accuracy in the practical : 08 Marks**
3. **Reactions and Calculations: 03 Marks**
4. **Viva: 05 Marks**
5. **Journal: 03 Marks**

   Total 25 marks

Deduction of marks for accuracy: : ±0.2 CC -08 marks, ± 0.4 CC- 06 marks, ±0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±0.9 CC or above - 01 marks.

Recommended Books/References

1. Laboratory manual for Environmental Chemistry: Sunita Hooda and Sumanjeet Kaur by S. Chand & Company 1999.
2. Soils and soil fertility, Troch, F.R. And Thompson, L.M. Oxford Press.
3. Fundamentals of soil science, Foth, H.D. Wiley Books.
4. Soil Science and Management, Plaster, Edward J., Delmar Publishers.
5. Principles of Soil Chemistry (2Wed.) Marcel Dekker Inc., New York.
6. Handbook of Agricultural Sciences, S.S. Singh, P. Gupta, A. K. Gupta, Kalyani Publication.
7. Introduction to soil laboratory manual - J. J. Harsett Stipes.
8. Introduction to soil science laboratory manual, Palmer and troch – Iowa State.

B.Sc. Semester – II

DSCC-3 : Chemistry (Theory) III (Code: 032CHE011)

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. State VSEPR theory, hybridisation and shapes of various molecules. Understand the concept of resonance and write resonating structures of NO_3^-, CO_3^{2-} and SO_4^{2-}.

CO2: Explain MO Theory and draw the MO diagrams for homonuclear diatomic molecules and ions of 1^{st} and 2^{nd} periods and heteronuclear diatomic molecules such as CO, NO and NO^+. Compare MO and VB theory.

CO3: Learn preparation and reactions of alkanes, alkenes and alkynes. Clear the concept learning mechanism of Free radical mechanism of halogenations of alkanes. Understand the mechanisms of addition reactions of alkenes and alkynes.

CO4: Learn the concept of polymerization, ozonolysis in alkenes and alkynes. Learn acidity of alkynes, formation of metal acetylides and their applications. Explain cycloalkanes and their relative stability. Explain conformational analysis of cyclohexane with Karplus energy diagram. Axial and equatorial bonds. Relative stability of mono substituted cycloalkanes.

CO5: Expected to learn symmetry elements, unit cells, crystal systems. Learn Bravais lattice, types and identification of lattice planes. Explain laws of crystallography - law of constancy of interfacial angles, law of rational indices.

CO6: Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Explain defects in crystals. Learn the applications of liquid crystals. Learn the concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates.

CO7: Understand the concept of order and molecularity of a reaction and their applications. Define half–life of a reaction. Explain methods for determination of order of a reaction by half life period and differential equation method. Understand the concept of activation energy and its calculation from Arrhenius equation. Explain theories of reaction rates: Collision theory and activated complex theory of bimolecular reactions.

CO8: Learn principles of gravimetric analysis. Learn the precipitation, mechanism of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. Learn structure, specificity, conditions and applications of organic reagents. Advantages of organic reagents over inorganic reagents.

CO9: Learn about quality of surface water, ground water. Impurities in water, standards of water quality (color, pH, hardness, TDS, sulphate, fluoride, chloride) for potable, domestic, industrial and agricultural purpose. Learn Water treatment technologies – house hold water treatment, municipal water treatment, industrial treatment (primary and secondary treatment of industrial effluent), softening of water, and disinfection of water. Determinations of DO, BOD and COD, and their significance.

Syllabus- **DSCC-3 : Chemistry (Theory) III (Code: 032CHE011)**	**Total Hrs: 56**
Unit-I: CHEMICAL BONDING & MOLECULAR STRUCTURE	**14 hrs**
Ionic Bonding*:* General characteristics of ionic compounds. Energy considerations in ionic bonding, 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. **Polarizing power and polarizability**: Fajan's rules, ionic character in covalent compounds and percentage of ionic character. **Covalent bonding:** General characteristics of covalent compounds. VB approach, shapes of some 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^-, CO_3^{2-} and SO_4^{2-}. **Molecular Orbital Theory:** LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules and ions of 1^{st} and 2^{nd} periods and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. Numerical problems are to be solved wherever applicable.	
Unit-II : ALIPHATIC HYDROCARBONS	**14 hrs**
Alkanes: Methods of preparation by catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis and from Grignard reagent. Free radical mechanism of halogenations, relative reactivity and selectivity of halogenation. Conformational analysis of ethane and butane. **Alkenes**: Methods of preparation by dehydration of alcohols and dehydrohalogenation of alkyl halides. Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. *cis* Alkenes by partial catalytic hydrogenation and *trans*	

alkenes by Birch reduction. Reactions: Addition of HX (Markownikov's and anti-Markownikov's addition) Stereospecificity of halogen addition, regioselectivity and relative rates of addition reaction. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes. Oxidative cleavage of alkenes with $KMnO_4$. Ozonolysis, mechanism of ozonolysis in propene and polymerization. **Alkadienes:** Classification, mechanism of addition of halogen and hydrogen halides in 1,3-diene, kinetically and thermodynamically controlled addition of HBr to 1,3-butadiene, polymerization and Diels-Alder reaction. **Alkynes:** Preparation: Acetylene from CaC_2 and conversion into higher alkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: Acidity of 1-alkynes and formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. **(11 Lectures)** **Cycloalkanes:** Types of cycloalkanes and their relative stability. Baeyer strain theory and theory of strainless rings. Conformational analysis of cyclohexane with Karplus energy diagram. Axial and equatorial bonds. Relative stability of mono substituted cyclohexanes. **(3 Lectures)**	
Unit-III : SOLIDS & CHEMICAL KINETICS	**14 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 CsCl. Defects in crystals. **Liquid Crystals:** Explanation, classification with examples- Smetic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. Numerical problems are to be solved wherever applicable. **(7 Lectures)** **Chemical Kinetics:** Review of reaction rates, order and molecularity. Factors affecting rates of reaction: concentration pressure, temperature, catalyst, etc. Examples for different orders of reactions. Derivation of integrated rate equations for zero and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction (numerical problems). Methods for determination	

of order of a reaction by half life period and differential equation 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). Numerical problems are to be solved wherever required. **(7 Lectures)**	
Unit-IV ANALYTICAL CHEMISTRY	**14 hrs**
Gravimetric Analysis: Stages in gravimetric analysis, requisites of precipitation, theories of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. Structure, specificity, conditions and applications of organic reagents such as salcylaldoxime, oxine, dimethyl glyoxime, cupron and cupferron in inorganic analysis. Advantages of organic reagents over inorganic reagents. **(6 Lectures)** **Water analysis:** Water availability, requirement of water. Quality of surface water and ground water. Impurities in water. Standards of water quality for potable, domestic, industrial and agricultural purpose (color, pH, alkalinity, hardness, TDS, sulphate, fluoride, chloride etc.) **Water treatment technologies**: House hold water treatment, municipal water treatment and industrial treatment (primary and secondary treatment of industrial effluent). Softening of water. Disinfection of water. Definition and determinations of DO, BOD and COD, and their significance. Numerical problems are to be solved wherever required. **(8 Lectures)**	

Recommended Books/References

Inorganic Chemistry

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. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

5. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Rodgers, G. E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
10. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi, 2004.
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
4. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C. B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F. A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983.
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985.
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
15. Organic Chemistry- Mehta and Mehta, 2005.

Physical Chemistry

1. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill, 2007.
2. Castellan, G.W. Physical Chemistry, 4th Ed. Narosa, 2004.
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi, 2009.
4. P.W. Atkins: Physical Chemistry, 2002.
5. W.J. Moore: Physical Chemistry, 1972.
6. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.

7. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
8. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
9. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
10. Physical Chemistry - G. M. Barrow, McGraw Hill, 1986.
11. Physical Chemistry (3rd Edition) - Gilbert W. Castilian, Narosa Publishing House, 1985.
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York, 1981.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; Analytical Chemistry, VI Ed. John Wiley & Sons, New York, 2004.
4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed, 2017.
6. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.

B.Sc. Semester – II

DSCC-4 : Chemistry (Practical) IV (Code: 032CHE012)

Course Outcome (CO)

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

CO1: Learn regarding errors, types of errors, accuracy, precision, significant figures and standard deviation. To determine the total alkalinity in antacids, Vitamin C in lemon juice/formulations. To determine free alkali present in different soaps/detergents. Learn analysis of DO in waste water sample.

CO2: To determine Chemical Oxygen Demand (COD) in waste water sample.

CO3: To determine temporary, permanent and total hardness of water by collecting different samples of water.

CO4: Enable to understand the applications of experiments like methods of determination of viscosity, surface tension, refractive index.

Syllabus- **DSCC-4 : Chemistry IV (Practical) (Code: 032CHE012)**	**Total Hrs: 52**
Analytical chemistry experiments Explanation regarding errors, types of errors, accuracy, precision, significant figures and standard deviation (students should write in the journal regarding the above). 1. Determination of total alkalinity in antacids in terms of calcium carbonate (two different samples). 2. Determination of Vitamin C in fruit juice / formulations by iodate method (two different samples). 3. Determination of alkali present in soaps / detergents (two different samples). 4. Determination of DO in water sample, pond water and river water and compare the DOs (two different samples). 5. Determination of Chemical Oxygen Demand (COD) in waste water sample. 6. Determination of temporary, permanent and total hardness of water using standard EDTA solution 7. Determination of Ni (II) using DMG by gravimetric method.	
Distribution of marks **1. Accuracy: 6+6 Marks** **2. Technique and presentation : 02Marks** **3. Reactions and Calculations: 03 Marks** **4. Viva: 05 Marks** **5. Journal: 03 Marks** **Total 25 marks** **Deduction of marks for accuracy :** : ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks	

Physical chemistry experiments

1. Determination of surface tension and parachor of $-CH_2$ in alcohol series.
2. Determination of surface tension for different concentrations of soap solutions (Sodium laurate) and calculation of Critical Miceller Concentration(CMC) graphically.
3. Determination of the viscosity of liquids (ethyl acetate & ethyl alcohol / toluene, & chlorobenzene or any other two non hazardous liquids) using Ostwald's viscometer.
4. Study of the variation of viscosity for different concentration of sucrose solution and calculation of radius of sucrose by graphical method.
5. Determination of specific and molar refraction by Abbes refractometer (ethyl acetate, methyl acetate, ethylene chloride)
6. Determination of the composition of liquid mixture by Abbes refractometry (toluene & alcohol, water & sucrose solution).

Dstribution of marks

1. **Accuracy:** **12 Marks**
2. **Graphs and Calculations:** **05 Marks**
3. **Viva:** **05 Marks**
4. **Journal:** **03 Marks**

Total 25 marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 or above 3 marks.

General instructions:

In the practical examination, in a batch of ten students, five students each will be performing analytical and physical 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 Qualitative and quantitative Inorganic Analysis, G.Svehla, 7th Ed, Longman (2001).

Advanced Practical Chemistry, Pragathi, Publications, Jagadamba Singh,

Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut

B.Sc. Semester – II

OEC-2: Molecules of Life (Code: 002CHE051)

Course Outcome (CO)

After completion of course, students will be able to:

CO1: Acquire knowledge about different types of sugars and their chemical structures. Identify different types of amino acids and determine the structure of peptides.

CO2: Explain the actions of enzymes in our body and interpret enzyme inhibition. Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication. Explain production of energy in our body.

Syllabus- OEC-2: **Molecules of Life (Code: 002CHE051)**	**Total Hrs: 42**
Unit-I	**14 hrs**
Carbohydrates: Sugars, non sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers. Disaccaharides: Occurance of disaacharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring structures of sucrose, maltose and lactose. Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen– monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates. **(8 Lecturers)** **Amino Acids, Peptides and Proteins :**α- amino acids , general formula, zwitter ion form of α- amino acid, general formula. Isoelectric point and its importance. Classification of amino acids as essential and non-essential- examples. Configuration of optically active α-amino acids (found in proteins). Peptide bond. Proteins: classification based molecular shape –fibrous and globular, examples. Structure ofprotein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required). Denaturation of protein. **(6 lectures)**	
Unit-II	**14 hrs**
Enzymes and correlation with drug action: Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity),	

Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Noncompetitive inhibition including allosteric inhibition). **(6 lectures)** **Drug action**- Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring. **(3 lectures)** **Oils and fats** Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value. Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(5 lecturers)**	
Unit-III	**14 hrs**
Nucleic Acids : Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **(8 lectures)** **Vitamins and Hormones:** Classification and biological significance, source and structure of Vitamin A, B1 (thiamine), B2 (riboflavin), B6 (pyridoxine), α-tocopherol, K1 (phylloquinone), C (ascorbic acid). Deficiency diseases of vitamins. **Hormones:** definition, classification with examples, functions and deficiency diseases of hormones. **(6 lectures)**	

Recommended Books/References

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, 2002.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weight age for total marks

Type of Assessment	Weight age	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10marks

Part-B

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

Part-C

3. Question number 12-15 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: 60 Marks

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

KARNATAK UNIVERSITY, DHARWAD

Four - Year B.Sc. (Hons.) Program

SYLLABUS FOR SEM III & IV

Karnatak University, Dharwad

Sem	Type of Course	Course Code	Instruction hour per week (hrs)	Total hours of Syllabus / Sem	Duration of Exam (hrs)	Formative Assessment Marks	Summative Assessment Marks	Total Marks	Credits
III	DSCC -5 Chemistry (Theory) - V	033CHE011	04	56	02	40	60	100	04
	DSCC -6 Chemistry (Practical) - VI	033CHE012	04	52	03	25	25	50	02
	OEC- 3 Industrial & Environmental Chemistry	003CHE051	03	42	02	40	60	100	03
IV	DSCC -7 Chemistry (Theory) - VII	034CHE011	04	56	02	40	60	100	04
	DSCC -8 Chemistry (Practical) - VIII	034CHE012	04	52	03	25	25	50	02
	OEC- 4 Analytical Chemistry	004CHE051	03	42	02	40	60	100	03
Details of the other Semesters will be given later									

Programme Specific Outcome (PSO):

After the completion of 03/ 04 years Degree in Chemistry , students will be able to:

PO 13: Demonstrate, solve and an understanding of major concepts in all the disciplines of chemistry.

PO 14: Provide students with broad and balanced knowledge and understanding of key chemical concepts.

PO 15 : Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.

PO 16: Apply standard methodology to the solutions of problems in chemistry.

PO 17: Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.

PO 18: Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.

PO 19: Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.

PO 20: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

PO 21: To prepare students effectively for professional employment or research degrees in chemical sciences.

PO 22: To cater to the demands of chemical industries of well-trained graduates.

PO 23: To build confidence in the candidate to be able to work on his own in industry and institution of higher education.

PO 24: To develop an independent and responsible work ethics.

B.Sc. Semester – III

DSCC-5 : Chemistry (Theory) V (Code: 033CHE011)

Course Outcomes (CO):

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

CO1: Explain **f**ree electron theory, physical properties of metals, distinguish between conductors, insulators, extrinsic and intrinsic semi conductors, Appreciate the importance of Hydrogen bond, applications of hydrogen bonding, van der Waals forces and factors affecting the strength and magnitude of van der Waals forces.

CO2 : Explain anomalous properties of lithium, diagonal relationship among elements preparation, uses, structure and bonding in diborane, borazine, boron nitride, carboranes, classification of silicates and their structures, oxides and oxyacids of nitrogen, oxoacids of phosphorus, sulphur and chlorine, inter halogen compounds and xenon compounds.

CO3: Understand preparation, general mechanism and named reactions of benzene and alkyl benzenes.

CO4: Describe theory of orientation, explanation on the basis of stability of sigma complex using electron withdrawing and electron donating groups.

CO5: Understand relative synthesis, mechanisms and reactivities of halogen in alkyl halides, vinyl halides, allyl halides, aryl halides and aryl-alkyl halides.

CO6: Know different methods of synthesis of primary, secondary and tertiary their reactions and mechanisms.

CO7:. Understand different thermodynamic processes, first law of thermodynamics, work done, significance of enthalpy, Joule-Thomson effect and applications Kirchhoff's equation

CO8: Derive Nernst distribution law and under different molecular states.

CO9: Acquaint with the industrial applications of Nernst distribution law.

CO10: Learn the law of chemical equllibrium, Le-Chatelier's principle, relations between Kp, Kc and Kx, ionic equilibria, hydrolysis, pH, common ion effect, solubility and solubility product.

CO11: Understand the principles and processes of metallurgy, extraction of d and f block elements and powder metallurgy.

CO12: Aware of alloys, purpose of making, composition and significance of alloys.

Syllabus **DSCC-5: Chemistry (Theory) - V (Code: 033CHE011)**	**Total Hrs: 56**
UNIT-I : CHEMICAL BONDING & CHEMISTRY OF s- & p- BLOCK ELEMENTS	**14 hrs**
Metallic Bond: Explanation of physical properties of metals **(**conductivity, lustre, malleability, ductility and cohesive force) based on free electron theory. Band theory of metals to explain conductors, insulators, extrinsic and intrinsic semi conductors. **Hydrogen bond:** Definition, properties and types of hydrogen bond. Consequences of hydrogen bonding. **van der Waals forces**: Definition and types of van der Waals forces. Factors affecting the strength and magnitude of van der Waals forces. **(4 Lectures)** **Chemistry of s- and p- block elements**: General characteristics, anomalous properties of lithium. Diagonal relationship of Li with Mg, and Be with Al. Preparation, uses, structure and bonding in diborane, borazine, boron nitride and carboranes. Silicates-Classification and structures. Preparation, properties and structure of oxides and oxyacids of nitrogen. Preparation and bonding in oxoacids of phosphorus, sulphur and chlorine. Inter halogen compounds (preparation and bonding in ClF_3, BrF_5 and IF_7), Xenon compounds- XeF_2, XeF_4, XeF_6, $XeOF_4$ and XeO_3 (preparation and bonding). **(10 Lectures)**	
UNIT-II AROMATIC HYDROCARBONS , ALKYL HALIDES, ARYL HALIDES & ALCOHOLS	**14 hrs**
Aromatic Hydrocarbons Preparation of benzene and alkyl benzenes (Aromatization, cyclic polymerization of ethyne, hydrodealkylation, Wurtz-Fittig reaction). General mechanism for electrophilic aromatic substitution, examples of halogenation, nitration, sulphonation and Friedel-Craft alkylation and acylation reaction. Limitations of Friedel Craft's alkylation. Theory of orientation, explanation on the basis of stability of sigma complex using electron withdrawing and electron donating groups (explain with the energy profile diagram). 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_NAr, S_N1 and *via* Benzyne intermediate along with mechanisms. Effect of nitro substitution on aromatic nucleophilic substitution reactions. **(5 Lectures)** **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, $KMnO_4$, Conc. HNO_3 and dichromate salt and Oppenauer oxidation. Diols**:** Oxidation of diols, Mechanism of Pinacol-Pinacolone rearrangement. **(4 Lectures)**	
UNIT-III: THERMODYNAMICS I, DISTRIBUTION LAW AND SURFACE CHEMISTRY	**14 hrs**
Thermodynamics I: Thermodynamic processes, heat, work and internal energy, 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, numerical problems, Joule-Thomson effect and its derivation. Joule-Thomson co-efficient and its derivation. Effect of temperature on enthalpy of reaction (Kirchhoff's equation). **(5 Lectures**) **Distribution law:** Nernst distribution law and thermodynamic derivation of partition co-efficient. Distribution law for changes in molecular state. (association and dissociation). Applications in solvent extraction- simple and multiple extractions. Derivation for multiple extractions, numerical problems. **(4 Lectures)** **Chemical and Ionic Equilibria:** Law of chemical equilibrium and its thermodynamic derivation. Factors affecting equilibria (Le-Chatelier's principle). Relations between Kp, Kc and Kx for reactions involving ideal gases. Ionization of acids and bases, hydrolysis of three types of salts and derivation for determination of pH of their solutions. Numerical problems. Common ion effect, solubility and solubility product of sparingly soluble salts. **(5 Lectures)**	
UNIT-IV: INDUSTRIAL CHEMISTRY-I	**14 hrs**
Principles and processes of metallurgy: Minerals, ores, steps 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. Hydrometallurgy. Extraction of titanium from ilmenite, chromium from chromite, nickel by Mond's process and tungsten from wolframite, Extraction of thorium from monazite sand, and uranium from pitchblende. Powder metallurgy-preparation, uses and advantages. **(11 Lectures)** **Alloys-**Purpose of making alloys, preparation of alloys. Alloy steels-(ferrous alloys) specific effect of alloying elements, applications of alloy steels. Non- Ferrous alloys: composition, characteristics and uses of copper, nickel, zinc and aluminum alloys. **(3 Lectures)**	

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. Concise Inorganic Chemistry: J. D. Lee, , 5th Edn, New Age International (1996)

4. Basic Inorganic Chemistry, Cotton, F.A., Wilkinson, G. & Gaus, P.L., 3rd Ed., Wiley.
5. University Chemistry Mahan, B.H. 3rd Ed. Narosa (1998).
6. A Guidebook to Mechanism in Organic Chemistry Peter Sykes, Orient Longman, New Delhi (1988).
7. Advanced Organic Chemistry, Bahl, A. & Bahl, B.S., S. Chand publications, 2010.
8. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
9. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
10. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
11. Organic Chemistry- Mehta and Mehta, 2005.
12. Physical Chemistry W.J. Moore:, 1972.
13. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
14. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
15. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
16. Physical Chemistry - Alberty R. A. and Silbey, R. J. John Wiley and sons, 1992.
17. Engineering Chemistry, P.C. Jain and Monika Jain, Dhanpad Rai and Sons, Delhi, Jalandhar, 1995.
18. Synthetic Organic Chemistry: Gurudeep R. Chatwal. Himalaya Publishing House – 1990.
19. Industrial Chemistry, Clerk Ranken MJP Publisher.
20. Industrial Chemistry, Vijay Varma, Arjun Publishing House.
21. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

B.Sc. Semester – III

DSCC-6: Chemistry (Practical) - VI (Code: 033CHE012)

Course Outcomes (CO):

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

CO1: Understand solubility, solubility product, common ion effect, their applications. Physico-chemical principles of separation of cations into groups in qualitative analysis of inorganic salts

CO2: Develop the skill to perform Semi-micro qualitative analysis of mixtures of two simple inorganic salts containing two anions and two cations.

CO3: Able to write the chemical reactions involved in the analysis.

CO6: Study the preparation and mechanism of reactions, recrystallization, determination of melting point and calculation of quantitative yields.

CO7: Prepare the organic compound with bromination, nitration, acetylaton, hydrolysis oxidation and reduction

Syllabus **DSCC-6: Chemistry (Practical) - VI (033CHE012)**	**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). **Experiments 1 to 6:** Systematic semi-micro qualitative analysis of mixtures of two simple inorganic salts containing two anions and two cations**.** Anions: CO_3^{2-}, Cl^-, Br^-, NO_3^-, SO_4^{2-}, $C_2O_4^{2-}$ and BO_3^{3-} Cations: Cu^{2+}, Al^{3+}, Fe^{2+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+. Note: Student has to write ionic reactions for group test and CT for anions and cations **Distribution of Marks:** Preliminary tests and presentation - 03 marks , Anions (group test + C.T +ionic reactions) (1+1+1)×2=6 marks, Cations (group test + C.T+ ionic reactions) (1+2+1)×2=8 marks, Journal-3 marks, Viva-Voce-5 marks, Total=25 marks.	
ORGANIC CHEMISTRY EXPERIMENTS	
Experiment No 7 to 12: Preparation of organic compounds 7. Acetylaton - Synthesis of acetanilide from aniline using Zn Dust/AcOH. (Green method) 8. Bromination – Acetanilide to p-bromo acetanilide. 9. Nitration – Acetanilide to p-nitro acetanilide. 10. Hydrolysis - Benzamide to benzoic acid. 11. Oxidation – Benzaldehyde to benzoic acid.	

12. Reduction – m-dinitrobenzene to m- nitro aniline. Note: Student has to write mechanism of reactions, calculation of quantitative yield, determination of melting point and to perform recrystallization. **Distribution of Marks:** Reaction & Mechanism-04 marks, calculation of theoretical yield – 02 mark, observed yield -08 marks, M.P- 03 marks, Journal – 03 marks , Viva-Voce-5 marks,(Total=25 marks.) **Deduction of marks for observed yield:** Less than 10% - 8 marks, 11-15% - 6 marks, 16-20% - 4 marks, 21-25 % - 2 marks & above 25% - zero mark.	
I **General instructions:** In the practical examination, in a batch of ten students, five students each will be performing inorganic and organic 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 Qualitative Inorganic Analysis, G.Svehla, 7th Ed, Longman (2001).
2. Advanced Practical Chemistry, agadamba Singh, R.K.P. Singh, Jaya Singh, L.D.S.Yadav, I.R. Siddiqui, Pragati prakashan, 7th edition, 2017.
3. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
4. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut.
5. Comprehensive Practical Organic Chemistry: V K Ahluwalia, and Renu Aggarwal, University Press-2000.

B. Sc. Semester – III

OEC- 3: Industrial & Environmental Chemistry (Code: 003CHE051)

Course Outcome (CO):

After completion of course, Industrial Chemistry, students will be able to:

CO1: Understand minerals, ores, steps in metallurgy, extraction of metals of d & f block elements and powder metallurgy-preparation,

CO2: Appreciate purpose of making, preparation, composition and applications of alloys.

CO3: Explain manufacture of glass, ceramics, Portland cement, chemical composition of cement, setting and hardening of Portland cement, Electroplating of nickel and chromium, Primary and secondary batteries, battery components and their role.

CO4: Explain sources of energy, nuclear fusion/fission, solar energy, hydrogen and geo-thermal energy.

CO5: Know air pollutants, control measures of air pollution, photochemical smog, green house effect, global warming and ozone depletion.

CO6: Aware of water pollutants and their sources, industrial effluents and their treatment, sludge disposal, water quality parameters for waste water, industrial water and domestic water, disposal of nuclear waste, nuclear disaster and its management.

Syllabus **OEC- 3: Industrial & Environmental Chemistry (Code: 003CHE051).**	**Total Hrs:** **42**
UNIT-I METALLURGY & ALLOYS	**14 hrs**
Metallurgy: Minerals, ores, steps in metallurgy (crushing, concentration, calcination, roasting, smelting/reduction, refining), Extraction of titanium from ilmenite, chromium from chromite, nickel by Mond's process and uranium from pitchblende. Powder metallurgy-preparation, uses and advantages. **(10 Lectures)** **Alloys-** Purpose of making alloys, preparation of alloys. Alloy steels-(ferrous alloys) specific effect of alloying elements, applications of alloy steels. Non- Ferrous alloys: composition, characteristics and uses of copper, nickel, zinc and aluminum alloys. **(4 Lectures)**	
UNIT-II GLASS, CERAMICS, CEMENT, PROTECTIVE COATINGS & BATTERY	**14 hrs**
Glass and Ceramics: General properties, silicate and non silicate glasses, raw materials used, manufacture, types of glass and their applications**.** Types and manufacture, high-technology ceramics and their applications, super conducting and semi-conducting oxides. **(4 Lectures)** **Cement:** Classification with properties of cement, raw materials used in the manufacture of cement and their functions. Manufacture of Portland cement, chemical composition of cement, setting and hardening of Portland cement. RCC and quick setting cements. **(3 Lectures)**	

Carbon materials: Fullerenes, carbon nanotubes and their applications. **(2 Lectures)** **Protective Coatings:** Metallic coating, electroplating of nickel and chromium. **Battery:** Primary and secondary batteries, battery components and their role. Characteristics of battery. Working of Lead-acid battery, Lithium battery, solid-state electrolyte battery, fuel cells and solar cells. **(5 Lectures**)	
UNIT-III ENERGY AND ENVIRONMENT, AIR, WATER & NUCLEAR POLLUTION AND WATER QUALITY STANDARDS	**14 hrs**
Energy and Environment: Sources of energy: coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen and geo-thermal energy. **(3 Lectures)** **Air pollution**: Major regions of atmosphere, chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature. Control measures of air pollution. Photochemical smog: its constituents and photochemistry. green house effect, global warming and ozone depletion. **(4 Lectures)** **Water pollution, water quality standards:** Water pollutants and their sources. Industrial effluents and their treatment (primary and secondary treatment). Sludge disposal. Water quality parameters for waste water, industrial water and domestic water. **Nuclear pollution:** Disposal of nuclear waste, nuclear disaster and its management. **(7 Lectures)**	

Recommended Books/References

1. Environmental Chemistry, A. K. De, 6th Edn. New Age International (P) Ltd.,(2008).
2. Environmental Chemistry-S. K. Banerji, (Prentice Hall India), 1993
3. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)
4. A Guidebook to Mechanism in Organic Chemistry, 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 Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
9. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998.
10. Organic Chemistry - M. K. Jain, Nagin & Co., 1987.
11. Organic Chemistry- Mehta and Mehta, 2005.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weight age for total marks

Type of Assessment	Weight age	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10marks

Part-B

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

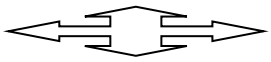
Part-C

3. Question number 12-15 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: 60 Marks

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



B.Sc. Semester – IV

DSCC- 7: Chemistry (Theory) - VII (Code: 034CHE011)

Course Outcome (CO):

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

CO1: Understand the general characteristics of d and f- block elements with reference to electronic configuration, colors, variable oxidation states, magnetic properties etc., separation of lanthanoids by ion-exchange method and preparation of trans-uranic elements (up to Z=103).

CO2: Acquaint with general properties and types of inorganic polymers, silicones and phosphazines.

CO3: Learn Bronsted-Lowry concept, Lux-flood concept, Lewis concept and Usanvich-sandvich concept and their limitations. HSAB concept and its applications.

CO4: Gain knowledge of acidic character, comparative acid strengths of alcohols and phenols and mechanism of named reactions.

CO5: Familiar with Williamson's ether synthesis, epoxides and Crown Ethers formation and properties

CO6: Understand the synthesis of aldehydes and ketones, their properties, named reactions mechanism.

CO7: Appreciate the significance of entropy, second law of thermodynamics, change in entropy and other thermodynamic parameters with respect temperature.

CO8: Know types of **a**dsorption isotherms, types of catalysis and their theories with examples and autocatalysis.

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

CO10: Understand types, composition and manufacture of fertilizers.

CO11: Appreciate the paints and pigments formulations, composition and related properties.

CO12: Learn the types, manufacture of soaps, detergents and their cleansing actions.

Syllabus **DSCC- 7: Chemistry (Theory) - VII (Code: 034CHE011)**	**Total Hrs: 56**
UNIT-I : CHEMISTRY OF d- & f- BLOCK ELEMENTS, INORGANIC POLYMERS AND THEORIES OF ACIDS AND BASES	**14 hrs**
Chemistry of d- and f- block elements: General characteristics with reference to electronic configuration, colors, variable oxidation states, magnetic, catalytic properties and ability to form complexes. 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. Preparation of trans-uranic elements (up to Z=103). **(6 Lectures)**	

Inorganic Polymers: General properties and types of inorganic polymers. Comparison with organic polymers. Silicones: Classifications, preparation, properties, uses and structure. Phosphazines: Preparation, properties, uses and structure. **(4 Lectures)** Modern concepts of acids and bases, Bronsted-Lowry concept, Lux-Flood concept, Lewis concept and Usanvich-Sandvich concept and their limitations. HSAB concept and its applications. **(4 Lectures)**	
UNIT-II : PHENOLS, ETHERS & CARBONYL COMPOUNDS	**14 hrs**
Phenols: Acidic character, comparative acid strengths of alcohols and phenols, Kolbe's reaction, Claisen rearrangement, Fries rearrangement, Ledrer-Mannase reaction, Reimer-Tiemann reaction. Houben–Hoesch reaction, Schotten – Baumann Reaction. (Mechanism to be discussed for all named reactions**)** **(4 Lectures)** **Ethers:** Preparation of ethers, mechanism of Williamson's ether synthesis, mechanism of synthesis of ethers by inter and intra molecular dehydration of alcohols. Reaction of ethers- mechanism of ether cleavage by strong acids. **Epoxides:** Synthesis from alkenes using peroxides, acid and base catalyzed ring opening of epoxides with mechanism and polyether formation. Crown Ethers: Formation and properties (Phase Transfer Catalyst). **(3 Lectures)** **Carbonyl Compounds:** Structure of carbonyl compounds, synthesis of aldehydes and ketones by oxidation of alcohols, aldehydes by reduction of acyl chloride, esters, nitriles and ketones from Gillmann's reagent. General mechanism of nucleophilic addition to the carbonyl compounds, mechanism of addition of hydrogen cyanide and hydroxyl amine, addition of alcohol, amines and phosphorus ylids. 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. **(7 Lectures)**	
UNIT-III THERMODYNAMICS-II & SURFACE CHEMISTRY	**14 hrs**
Thermodynamics II: Concept of entropy and its physical significance, thermodynamic scale of temperature, statements of second law of thermodynamics, molecular and statistical interpretation of entropy, calculation of entropy change for reversible and irreversible processes. Free energy functions: Gibbs and Helmholtz energy, variation of S, G, A with T, V and P. Gibbs-Helmholtz equation, free energy change and spontaneity. Numerical problems. Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. **(8 Lectures**) **Surface chemistry:** Adsorption: Types of adsorption isotherms, Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm and its derivation. BET equation and its derivation, numerical problems. Catalysis**:** Types of catalysis and their theories with examples. Theory of acid-base catalysis, Michaelis-Menten mechanism. Heterogeneous catalysis (unimolecular and bimolecular surface reactions). Applications of heterogeneous catalysts. Autocatalysis with examples. **(6 Lectures)**	

UNIT-IV : INDUSTRIAL CHEMISTRY -II	14 hrs
Glass and Cement: General properties, silicate and non silicate glasses, raw materials used 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 of cement, raw materials used in the manufacture of cement and their functions. Manufacture of Portland cement, chemical composition of cement, setting and hardening of Portland cement. RCC and quick setting cements. **(5 Lectures)** **Fertilizers:** Types of fertilizers, composition of fertilizers, manufacture and uses of urea, calcium ammonium nitrate, ammonium phosphate and super phosphate of lime. Mixed fertilizers (NPK). **(3 Lectures)** **Surface coatings:** Classification of surface coatings. Paints and pigments-formulations, composition and related properties, fillers, thinners, enamels and emulsifying agents. Special paints (heat resistant, fire resistant, eco-friendly and plastics paints). Dyes and wax polishing. **(2 Lectures)** **Soaps and detergents: Composition of soaps, t**ypes of soaps, manufacture of soap(Hot process and modern continuous process. Detergents: Comparison of soaps and detergents, classification of detergents (anionic, cationic and non-ionic). Preparation of detergents (sodium alkyl sulphate, sodium alkyl benzene sulphonates). Mechanism of cleansing action of soap and detergents (Concept of micelles and CMC). Detergents builders and additives (only examples). **(4 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. Text Book of Physical Chemistry - S. Glasstone, Mackmillan India Ltd., 1982.
14. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, S. L. N. Chand & Co. 1987.
15. Engineering Chemistry, P.C.Jain and Monika Jain, Dhanpad Rai and Sons, Delhi, Jalandhar.
16. Industrial Chemistry, Clerk Ranken MJP Publisher.
17. Industrial Chemistry, Dr. Vijay Varma, Arjun Publishing House.
18. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

B.Sc. Semester – IV

DSCC-8: Chemistry (Practical) - VIII (Code: 034CHE012)

Course Outcomes (CO)

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

CO1: Explain regarding errors, types of errors, accuracy, precision, significant figures, standard deviation, and Use of log table

CO2: Determine the percentage of chlorine in bleaching powder, free acidity in ammonium sulphate fertilizer, phosphoric acid in super phosphate fertilizer, calcium in CAN fertilizer/dolomite ore by complexometric method, copper in brass by iodometric method/ calcium in cement by oxalate method.

CO3: Understand the effect of acid strength on hydrolysis of methyl acetate using HCl and H_2SO_4, for the pseudo first order reaction.

CO4: Determine the change in enthalpy of solution and ionization.

CO5: Learn the concepts of degree of dissociation, adsorption and distribution law.

Syllabus **DSCC-8: Chemistry (Practical) - VIII (034CHE012)**	**Total** **Hrs: 52**
Unit-I Industrial chemistry experiments	
1. Determination of percentage of available chlorine in bleaching powder (two samples). 2. Determination of free acidity in ammonium sulphate fertilizer (two samples) 3. Determination of phosphoric acid in super phosphate of lime fertilizer (two samples) . 4. Determination of calcium in CAN fertilizer (two samples) /dolomite ore (in duplicate) by complexometric method 5. Determination of copper in brass by iodometric method (two samples) / calcium in cement (in duplicate) by oxalate method 6. Determination of iron in haematite ore (in duplicate) by reduction method ($SnCl_2$) using $K_2Cr_2O_7$ solution **Distribution of marks** 1. Accuracy: (06+06) Marks 2. Technique and presentation : 02Marks 3. Reactions and Calculations: 03 Marks 4. Viva: 05 Marks 5. Journal: 03 Marks Total 25 marks **Deduction of marks for accuracy:** : ±0.4 CC -06 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC- above 1.0 CC - 01 marks.	
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 of HCl and H_2SO_4 on hydrolysis of methyl acetate.	

2. Study the effect of concentration on velocity constant of second order reaction: KI + $K_2S_2O_8$ (a = b). 3. Study the adsorption of acetic acid on animal charcoal (Freundlich adsorption isotherm). 4. Study the distribution of acetic acid/ benzoic acid between water and toluene. 5. Determination of enthalpy of ionization of acetic acid/enthalpy of solution of KNO_3 by calorimetric method. 6. Determination of degree of dissociation of KCl by Landsberger's method. **Distribution of Marks:** Accuracy-10 marks, Technique and Presentation-3marks Calculation and graph- 4 marks, Journal-3 marks, Viva-Voce-5 marks, Total=25 marks. **Deduction of Marks for accuracy:** Error up to 5% - 10 marks, 6 - 10% - 08 marks, 11-15% - 06 marks, 16-20% - 04 marks, above 20% - zero (0) marks	
General instructions: In the practical examination, in a batch of ten students, five students each will be performing Industrial and physical 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.*	

Recommended Books/References

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

B.Sc. Semester – IV

OEC – 4 : Analytical Chemistry (004CHE051).

Course Outcomes (CO)

After completion of course, Analytical Chemistry students will be able to:

CO1: Understand the principle, classification of volumetric analysis, different methods of expression of concentration term, titration curves of all type of acid-base titrations.

CO2: Understand the theory, titration curves, indicators of precipitation and complexometric titration.

CO3: Acquaint with steps involved in gravimetric analysis and advantages of organic reagents over inorganic reagents.

CO4: Learn the Composition of soil and the determination of pH of soil samples. Estimation of Calcium and Magnesium in the soil.

CO3: Identify pure and contaminated water, water sampling & water purification methods and water quality measurements.

CO4: Understand the principle, techniques and applications of chromatography, paper chromatography, Gas chromatography and High Performance Liquid Chromatography.

CO5 : Learn the ion-exchange chromatography. Resins, types with examples, mechanism of cation and anion exchange processes and applications of ion-exchange chromatography in softening of hard water, separation of lanthanides and industrial applications.

CO6: Know the solvent extraction method, its types and factors affecting the solvent extraction.

CO7: Make out the nutritional value of food, food processing, food preservation and adulteration.

Syllabus **OEC – 4 : Analytical Chemistry (Code: 004CHE051).**	**Total Hrs: 42**
Unit-I VOLUMETRIC AND GRAVIMETRIC ANALYSIS	**14 hrs**
Titrimetric analysis: Principle, classification, normality, molarity, molality, mole fraction, ppm, ppb etc. Standard solutions, preparation and dilution of reagents/solutions using $N_1V_1 = N_2V_2$, preparation of ppm level solutions from source materials (salts). **Acid-base titrimetry**: Theory, titration curves for all types of acids – base titrations. **Redox titrimetry**: Theory, balancing redox equations, titration curves, theory of redox indicators and applications. **Precipitation titrimetry:** Theory, titration curves, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences. **Complexometric titrimetry:** Theory, titration methods employing EDTA (direct, back, displacement and indirect determinations). Indicators for EDTA titrations - theory of metal ion indicators. (**10 Lectures**)	

Gravimetric analysis: Steps involved in gravimetric analysis, requisites of precipitation, factors influencing precipitation, co-precipitation and post precipitation. Advantages of organic reagents over inorganic reagents. Determination of Barium and Iron gravimetrically. (**4 Lectures**)	
UNIT-II ANALYSIS OF SOIL, WATER AND FOOD PRODUCTS	**14 hrs**
Analysis of soil : Composition of soil, Concept of pH and pH measurement. Determination of pH of soil samples. Estimation of Calcium and Magnesium by complexometric titration. (**3 Lectures**) **Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods (reverse osmosis, electro dialysis, ionic exchange). Determination of pH, hardness, TDS and alkalinity of a water sample. Determination of dissolved oxygen (DO) and COD of a water sample. (**6 Lectures**) **Analysis of food products:** Nutritional value of food, idea about food processing and food preservation and adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, edible oils etc. Analysis of preservatives and colouring matter (**5 Lectures)**	
UNIT-III SEPERATION METHODS	**14 hrs**
Chromatography: Definition, general introduction on principles of chromatography, classification, selection of stationary and mobile phases. Paper chromatography: principle and applications (separation of mixture of metal ions (Fe^{3+} and Al^{3+}). **Thin layer chromatography:** principle, advantages over other methods, methodology and applications (To compare paint samples by TLC method). **Gas chromatography and High Performance Liquid Chromatography:** Principles and applications. (**6 Lectures)** **Ion-exchange:** Column, ion-exchange chromatography. Resins, types with examples, mechanism of cation and anion exchange processes and applications of ion-exchange chromatography in softening of hard water, separation of lanthanides and industrial applications. (4 **Lectures**) **Solvent extraction** :- Types, batch, continuous, efficiency, selectivity, distribution co efficient, Nernst distribution law, derivation, factors affecting the partition, relationship between percent extraction and volume fraction . Solvent extraction of iron and copper. (**4 Lectures**)	

Recommended Books/References

1. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
2. . Instrumental methods of chemical Analysis, B.K. Sharma, Goel Publishing House, Meerut,
3. .Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).

4. Laboratory manual for Environmental Chemistry: Sunita Hooda and Sumanjeet Kaur by S. Chand & Company 1999.
5. Soils and soil fertility, Troch, F.R. And Thompson, L.M. Oxford Press.
6. Fundamentals of soil science, Foth, H.D. Wiley Books. .
7. Handbook of Agricultural Sciences, S.S. Singh, P. Gupta, A. K. Gupta, Kalyani Publication.
8. Introduction to soil laboratory manual - J. J. Harsett Stipes.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weightage for total marks

Type of Assessment	Weightage	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10marks

Part-B

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

Part-C

3. Question number 12-15 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: 60 Marks

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