HAVERI UNIVERSITY, HAVERI

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

SYLLABUS FOR SEM III & IV

Course: CHEMISTRY

DISCIPLINE SPECIFIC CORE COURSE (DSCC)

FOR SEM V &VI,

SKILL ENHANCEMENT COURSE (SEC) FOR SEM V SEM

AS PER NEP - 2020

Haveri University, Haveri

B.Sc.in Chemistry

Effective from 2023-24

Sem.	Type of Course	Theory/Practical	Course Code	CourseTitle	Instruction hour/week	Total hours / sem	Duration Of Exam	Marks			Credits
								Formative	Summative	Total	
V	DSCC-9	Theory	**035 CHE 011**	Chemistry (Theory) -IX	04hrs	56	02hrs	40	60	100	04
	DSCC-10	Practical	**035 CHE 012**	Chemistry (Practical) - X	04hrs	56	03hrs	25	25	50	02
	DSCC-11	Theory	**035 CHE 013**	Chemistry (Theory) -XI	04hrs	56	02hrs	40	60	100	04
	DSCC-12	Practical	**035 CHE 014**	Chemistry (Practical) - XII	04hrs	56	03hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	SEC-3	Practical	**035 CHE 061**	**Employability skills in Chemistry**	04hrs	56	03hrs	25	25	50	02
	Total										**26**
VI	DSCC-13	Theory	**036 CHE 011**	Chemistry (Theory) -XIII	04hrs	56	02hrs	40	60	100	04
	DSCC-14	Practical	**036 CHE 012**	Chemistry (Practical) - XIV	04hrs	56	03hrs	25	25	50	02
	DSCC-15	Theory	**036 CHE 013**	Chemistry (Theory) -XV	04hrs	56	02hrs	40	60	100	04
	DSCC-16	Practical	**036 CHE 014**	Chemistry (Practical) - XVI	04hrs	56	03hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	Internship-1	--	**036 CHE 091**	**Chemistry Internship**				50	0	50	02
	Total										**26**

Haveri University, Haveri
B.Sc. Chemistry

Programme Specific Outcomes (PSO):

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

- Demonstrate, solve and understand the major concepts in all the disciplines of chemistry.
- Provide students with broad and balanced knowledge and understanding of key chemical concepts.
- Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
- To apply standard methodology to the solutions of problems in chemistry.
- Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.
- Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
- Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
- Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.
- To prepare students effectively for professional employment or doctoral degrees in chemical sciences.
- To cater to the demands of chemical industries of well-trained graduates.
- To build confidence in the candidate to be able to work on his own in industry and institution of higher education.
- To develop an independent and responsible work ethics.

B.Sc. Semester–V

Discipline Specific Course (DSC) -9

Course Title: Chemistry (Theory) IX

Course Code : 035CHE011

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No.of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-9	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

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

CO2: Understand 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 and industrial applications of organometallic compounds.

CO3: 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.

CO4: Describe constitution of hygrine, coniine and nicotine. Classification and biological significance, source and structure of Vitamin A, Vit-B1, B2, B6, K1 and C and functions and diseases by the deficiency of hormones.

CO5: Explain the ionization of electrolyte, migration and transport number of ions and its determinations. Enable to explain the conductivity of ions, variation with dilution, differentiating specific, equivalent and molar conductivity. Describe the application of conductivity measurement for concentration, dissociation of weak electrolyte.

CO6: Explain the degree of dissociation for strong and weak electrolytes and their conductivity with concentrated and dilute solution.

CO7: Explain the laws of absorption and photochemistry. Quantum yield significance. Explain the photosensitization and photophysical processes.

CO8: Aware about the importance of energy sources, alternative energy from various sources. Explain about the working principle and applications of different batteries and fuel cells.

CO9: Understand Basic definitions, degree of polymerization, classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, thermoplastic and thermosetting polymers.

CO10: Understand about molecular weight in simple and polymer molecules. Explain about the various

methods applied to determine molecular weight of polymers.

Unit	Title: Chemistry (Theory) IX	56 hrs/ Sem
Unit I	**Coordination chemistry-I** Classification of ligands. Werner's theory of coordination compounds with reference to Cobalt ammine complexes. Methods of detection of complex formation. IUPAC system of nomenclature. Sidgwick's theory and calculation of EAN in different complexes. Isomerism in coordination compounds (ionisation, hydrate, linkage, coordination, coordination-position, geometrical and optical) with respect to coordination number 4 and 6. Valence bond theory, inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu with coordination number 4 and 6. Limitations of VBT. Chelates and their applications. (**8 hrs**) **Organometallic compounds** Definition and classification with appropriate examples. Concept of hapticity of organic ligands with examples. Metal carbonyls: Types, nomenclature, preparation, and properties. 18-electron rule. Structure of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behavior of carbon monoxide. Preparation and structure of methyl lithium, Zeiss salt and ferrocene. Industrial applications of organometallic compounds. **(6 hrs)**	14 hrs
Unit II	**Heterocyclic Compounds** Classification and Nomenclature, Aromaticity of 5-membered and six member rings containing one hetero atom, synthesis of pyrrole, furan (Paal-Knorr synthesis), pyridine (Hantzsch synthesis), Mechanism of Electrophilic substitution reactions of furan, pyrrole and pyridine, (Formylation, Nitration, Bromination, Friedel Craft's reaction). Indole (Fischer's synthesis) quinoline (Skraup's synthesis) aminoquinoline(Bischler-Napieraskisynthesis). **(5 hrs)** **Alkaloids:** Classification, extraction, general properties, Hoffman's exhaustive methylation. Constitution and synthesis of Hygrine, Coniine and Nicotine. **(4 hrs)** **Vitamins** Classification and biological significance, sources and structure of Vitamin A, Vit-B1 (thiamine), Vit-B2 (riboflavin), Vit-B6 (pyridoxine), tocopherol (Vit-E), Vit-K1 (phylloquinone), Vit-C (ascorbic acid). Synthesis of Vitamin C from D-glucose. **Hormones:** Definition, classification with examples and functions. Diseases caused due to deficiency of hormones. Synthesis of Adrenaline. **(5 hrs)**	14 hrs

Unit III	**Electrochemistry-I** Arrhenius 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 its importance. Applications of conductivity measurementsin various acid base titrations. Advantages of conductometric titration. Determination of solubility and solubility product of sparingly soluble salts. Determination of dissociation constant of weak acid. **Theory of strong electrolytes**: Degree of dissociation, Ostwald's dilution law and its limitations. Debye–Huckel theory of strong electrolytes, relaxation effect, electrophoretic effect, Debye–Huckel-Onsager equation and its significance (no derivation). **(8 hrs)** **Photochemistry** Absorbance, transmittance, Beer-Lambert's law and its limitations, Calculation of molar extinction coefficient. Laws of photochemistry - Grotthus-Draper law, Stark – Einstein's law of photochemical equivalence, differences between photochemical and thermal reactions. Quantum yield - definition, reasons for high and low quantum yields with examples. Determination of quantum yield by thermo-couple method and using chemical actinometer. Photosensitization with examples. Photophysical process - definition, fluorescence, phosphorescence, inter system crossing. Chemiluminescence and bioluminescence with examples, Difference between photophysical and photochemical process. **(6 hrs)**	14 hrs
Unit IV	**Solutions:** Introduction-liquid-liquid mixtures (miscible, immiscible and partially miscible), Raoult's law-definition, equation. Duhem – Margules equation and its applications, Principle of distillation of binary miscible liquids-Konowaloff's rule, derivation. Distillation of binary miscible liquids-type-I, II and III solutions.Azeotropes-definition, minimum and maximum boiling point azeotropes. Immiscible liquids-definition, Steam distillationPartially miscible liquids-definition, conjugate solutions, CST, types I (phenol-water system), II (triethylamine-water system) and III (nicotine-water system). Solutions of solid in liquids, solid solutions (qualitative treatment). **(5 hrs)**	14 hrs

	Phase Equilibria Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapor and solid-vaporequilibria, phase diagram for one component systems (H_2O and S), with applications. Phase diagrams for two component systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points. **(5 hrs)** **Polymers:** Introduction, definition, degree of polymerization and classification.Mechanism of addition and condensation polymerization: Molecular weight of polymers: Number average molecular weight and weight average molecular weight, Determination of molecular weight by Viscometry, and Osmotic pressure method. **(4 hrs)**	

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/Assignment/Small Project	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Course(DSC)-10

Course Title: Chemistry (Practical) X

Course Code:035CHE012

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No.of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-10	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

Course Outcomes (COs):At the end of the course, students will be able to:

CO1: Understand the qualitative analysis of inorganic mixtures containing two anions and two cations containing carbonates and bicarbonate, two halides, borate, phosphate, ferrous/ ferric salts & less common element (Mo, Ce or Li).

CO2: Perform the various steps involved in Gravimetric Analysis of metal ions.

1. Semi micro qualitative analysis of inorganic mixtures containing two anions and two cations

a) Mixture containing carbonate and bicarbonate

b) Mixture containing two halides

c) Mixture containing borate

d) Mixture containing phosphate

e) Mixture containing ferrous /ferric salt

f) Mixture containing less common element (Mo, Ce or Li)

2. Gravimetric Analysis:

1. Determination of barium as $BaSO_4$.
2. Determination of iron as Fe_2O_3
3. Determination of aluminum as Al_2O_3
4. Determination of aluminum (III) using oxine .
5. Separation of Fe (II) and Ni (II) from the solution. Determination of Fe (II) gravimetrically and Ni (II) volumetrically.
6. Separation of Fe (II) and Ni (II) from the solution. Determination of Ni (II) gravimetrically and Fe (II) volumetrically.

Examination

In a batch of ten students in the practical examination, five students may be given Semi micro qualitative analysis and other five students may be given gravimetric estimation. 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:

For Semi micro qualitative analysis:

Preliminary test and presentation - 03 marks

Anions (group test + C.T. + ionic reactions) (1+1+1) x 2 = 6 marks.

Cations(group test + C.T. + ionic reactions) (1+2+1) x 2 = 8 marks.

Journal - 3 marks, Viva-voce - 5marks, **Total = 25 marks.**

Gravimetric Determination:

Accuracy-12marks, Technique and Presentation-2marks Calculation and reactions 3 marks, Journal-3 marks, Viva-Voce-5 marks, Total=25 marks.

Deduction of Marks for accuracy:

±6mg -12 marks, ± 8mg-10 marks, ±10mg -8 marks, ±12mg-06 marks, ±14mg-04 marks, ±16mg-02marks, above ±16 mg -zero marks.

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–V

Discipline Specific Course(DSC)-11

Course Title: Chemistry (Theory) XI

Course Code:035CHE013

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No.of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-11	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understand the types, theory,technique and applications of separation techniques like solvent extraction and chromatography,dyes and colors used in day-to-day life.

CO2: Know color and constitution, classification, synthesis and applications of different types of dyes.

CO3: Define spectroscopy and different regions of electromagnetic spectrum.Basics of UV/visible spectroscopy. Different kind of transitions that can take place within molecule

CO4: 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.

CO5: Importance Air pollution and Water Pollution, techniques for measuring water pollution, effluent treatment plant, water purification methods, sludge disposal, disposal of nuclear wastes and Water quality parameters for waste water, industrial water and domestic water. Understand about types of soil, physical, chemical and biological properties of soil, soil organisms, micro and macronutrients

CO6: Know about Chemical explosives and Rocket propellants.

Unit	**Title: Chemistry (Theory) XI**	**56 hrs/ sem**
Unit I	**Solvent extraction**: Types, theory and mechanism. Extraction by ion-association and Chelation. Synergistic extraction, techniques and applications. Determination of Uranium using oxine. **(3hrs)** **Chromatography**: Classification, techniques and development of chromatograms. **Paper chromatography**: Theory, R_f value, factors affecting R_f value and its	14 hrs

	calculations, techniques and applications. Separation of Pb^{2+}, Ag^{+} and Hg_2^{2+} and calculation of R_f value. **Column chromatography**: Theory, techniques and applications. Separation of methylene blue and malachite green. **Thin-layer chromatography**: Superiority of TLC, theory methodologyand applications **Ion exchange chromatography**: Properties and types of ion exchangers. Action of cation and anion exchange resins, techniques and applications. Separation of amino acids from its mixture. **Gas Chromatography and High-Performance Liquid Chromatography:** Principles and applications. **(11hrs)**	
Unit II	**Ultraviolet Spectroscopy:** Types of electronic transitions, chromophores and auxochromes, bathochromic shift and hypochromic shift, intensity of absorption, Woodward-Fieser rules for calculating λ_{max}Conjugateddienes such as alicyclic, homoannular and heteroannulardienes. Applications of UV spectroscopy. **(5 hrs)** **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 H- bonding in alcohols, phenols and carboxylic acids using IR spectroscopy. **(5 hrs)** **Dyes:** Theory, color and constitution, classification, mordant and wet dyes, synthesis and applications of congo red, malachite green, phenolphthalein, eosin and indigo. Dyes used in food and their safety, organic pigments with examples. **(4 hrs)**	14 hrs
Unit III	**Molecular Spectroscopy:** Interaction of electromagnetic radiation with matter, electromagnetic spectrum. **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).	14 hrs

	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. **Raman spectra:** Classical theory, Rotational Raman spectroscopy (Linear and symmetric top molecules for S and R branch), Vibrational Raman spectroscopy; vibration - rotational Raman spectra (Rotational fine structures), complementary of Raman and IR. **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.	
Unit IV	**Environmental Chemistry** **Air pollution:** Review of major regions of atmosphere. Chemical and photochemical reactions in the atmosphere. Sources, effects and control measures of air pollutants (CO, CO_2, NO_x, SO_x and H_2S). Methods of determination of CO, NO_x and SO_x. **Water Pollution:** Water pollutants and their sources. Techniques for measuring water pollution. Effluent treatment plant (primary, secondary and tertiary treatment).Water purification methods (reverse osmosis, electrodialysis and ion- exchange) Sludge disposal. Industrial waste management. Disposal of nuclear wastes. Water quality parameters. **(7 hrs)** **Soil chemistry**: Types of soil, physical, chemical and biological properties of soil, soil organisms, nitrogen and sulphur transformation. A brief account of micro- and macronutrients (sources and importance) Determination of pH, alkalinity, total organic matter, Ca (II) and Mg (II) ions in soil samples. **(4 hrs)** **Chemical explosives**: Preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to Rocket propellants. **(3 hrs)**	14 hrs

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/Assignment/Small Project	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Course (DSC) -12

Course Title: Chemistry (Practical) XII

Course Code:035CHE014

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-12	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

Course Outcomes (COs):At the end of the course, students will be able to:

CO1: Understand to apply the knowledge of conductivity, emf and absorbance to performing the experiments.

CO2: Acquire skills for handling analytical instruments like potentiometer, conductometer, pH meter & colorimeter.

Expt. No,	Title: PHYSICAL CHEMISTRY EXPERIMENTS	56 hrs/ Sem
1	Determination of concentration of HCl using standard NaOH solution by conductometric titration.	
2.	Determination of concentration of CH_3COOH using standard NaOH solution by conductometric titration.	
3	Determination of concentration of HCl using standard NaOH solution by potentiometric titration.	
4	Determination of concentration of FAS using standard $KMnO_4$ solution by potentiometric titration.	
5	Verification of Beer- Lambert law by colorimetric method and calculation of molar extinction coefficient of $Cu^{2+.}$	
6	Determination of critical solution temperature of two partially miscible liquids (water and phenol).	
7	Determination of equivalent conductance of strong electrolyte (NaCl) and equivalent conductance at infinite dilution (λ_∞).	
8	Determination of dissociation constant (K_a) of weak acid by potentiometrically.	
9	Determination of second order rate constant for the hydrolysis of ethyl acetate by NaOH conductometrically.	
10	Determination of dissociation constant of acetic acid by conductometrically.	
11	Verification of Beer- Lambert law by colorimetric method and determination of unknown concentration of ferric (Fe^{3+}) ions.	
12	Preparation of standard acidic buffer solutions using 0.1M acetic acid & 0.1M sodium acetate using Henderson-Hasselbatch and determination of mole ratio of buffer solutions of unknown pH	

NOTE: 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. During practical examination chart is not allowed, wherever necessary simple procedure may be given.

Distribution of Marks:

Accuracy-10 marks, Technique and Presentation-2, Calculation and graph-5 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

Recommended Books/References

1. Vogel's Qualitative Inorganic Analysis, G.Svehla, 7th Ed, 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. 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.
6. Findlay's practical physical chemistry -revised by levitt, Longman's, London,(1968).
7. Experiments in Physical chemistry - Shoemaker and Garland, McGraw Hill International edn (1996).

B.Sc. Semester–V

Skill Enhancement Course: SEC-3

Course Title: Employability skills in chemistry

Course Code: 035CHE061

Type of Course	Theory /Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	TotalMarks
SEC-3	**Practical**	**02**	**04**	**56 hrs.**	**3hrs.**	**25**	**25**	**50**

Employability skills in chemistry will have Paper A, B and C. Students will choose experiments either from Paper A or B or C but not mixture of all. Principal of the college can also suggest the selection of Paper based on availability of Chemicals, instruments etc.

Paper A: Separation techniques and pharmaceutical analysis

1. Separation of amino acids by paper chromatography and measuring R_f values.
2. Compare the aspirin prepared in the laboratory with the ingredients of an aspirin tablet by thin layer chromatography.
3. Separation of Co^{2+} and Ni^{2+} by paper chromatography and measuring R_f values.
4. Separation of Ni(II) and Fe(II) by complexation with DMG, extracting the Ni(II)-DMG complex in chloroform and determine its concentration by colorimetry.
5. Separation of amino acids from organic acids by ion exchange chromatography,
6. Separation of Mg (II) and Fe (II) by ion exchange chromatogrphy.
7. Determination of aspirin present in tablets conductometrically /titrimetrically
8. Determination cholesterol colorimetrically.
9. Determination of amino acids colorimetrically using ninhydrin.
10. Determination of Glucose /Sucrose colorimetrically using Fehling's Solution.
11. Preparation of magnesium bisilicate (Antacid)

Paper B: Industrial Chemistry

1. Safety practices in the Chemistry laboratory.
2. Determination of calcium in CAN fertilizer.
3. Determination of water of crystallization and Fe (II) in Mohr's salt by titrating with standard $KMnO_4$.
4. Preparation of phenol formaldehyde Resin.
5. Preparation of urea formaldehyde resin.
6. Nitration of salicylic acid by green method (Using calcium nitrate and acetic acid).
7. Preparation of aspirin from salicylic acid.
8. Analysis of Cement. (Moisture, Silica and Calcium (II))
9. Analysis of food adulterants in Tea Powder, Coffee Powder, turmeric powder, Chili Powder, oil / fat, milk, etc.
10. IR peak analysis for functional groups using recoded IR Spectra
11. Preparation and characterization of biodiesel from vegetable oil/waste cooking oil.

Paper C: Soil, Water and Food Analysis (With effect from 2024-25 and onwards)

1. Qualitative detection of nitrate, phosphate, Fe (II) and Ca (II) in soil samples.
2. Determination of pH of different types of soil samples.
3. Determination of total alkalinity of soil samples.
4. Determination of total organic matter in the given soil samples.
5. Determination of Ca (II) ions from soil samples.
6. Determination of TDS in water samples.
7. Determination of chloride and sulfate of water samples by precipitation titration ($AgNO_3$ and K_2CrO_4).
8. Determination of pH, acidity and alkalinity of polluted water samples.
9. Qualitative analysis of carbohydrates, proteins and lipids (minimum to samples).
10. Determination of proteins colorimetrically using biuret reagent.

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

1. **Preparation experiment:** Reaction – 03 marks, Calculation of theoretical Yield- 02 mark, Observed yield-12 marks, Journal- 03 marks, Viva- voce – 05 marks, **Total= 25 marks**

   Deduction of Marks for accuracy:

   Less than 10% yield- 5 marks, 11-15%- 4 marks, 16-20%-3 marks, 21-25%- 2 marks, above 25%- zero marks

2. **Analysis experiments: a)** In the Analysis food adulteration, Identification of adulterants in each sample carries 4 marks. Four different samples may be given, 4 x 4 = 16 marks,

   b) In the analysis cement, moisture content - 04 marks, Silica content - 6 marks and Calcium content – 6 marks = 16 marks

   c) In the analysis of IR spectra, the spectra of 4 different compounds may be given. The analysis of each carries 4 marks, 4 x 4 = 16 marks

   Systematic presentation = 1 mark, Journal-3 marks, Viva-Voce-5 marks, Total = 25 marks.

3. **Determination experiments:**

   Accuracy-10 marks, Technique and Presentation-2, Calculation and reaction/graph-5 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

4. **Chromatographic / Ion-exchange Techniques**

   Distribution of Marks:

a. Preparation of paper chromatography / Column for ion-exchange method: 8 marks
b. Spotting : 03 marks, Identification of Spots: 03 marks, R_f Calculation: 03 marks
c. Separation by ion-exchange and determination: 09 marks

   Journal – 03 marks, Viva-Voce-5 marks

   Marks for Accuracy: Error up to 10% -17 marks, 11-15%- 14 marks, 16-20%- 10 marks, 21-25% - 07 marks, 26 – 30 % - 05 marks and above 30% nil.

References

1. Vogel's Qualitative Inorganic Analysis, G.Svehla, 7th Ed, 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. 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.
6. Findlay's practical physical chemistry -revised by Levitt, Longman's, London,(1968)
7. Experiments in Physical chemistry - Shoemaker and Garland, McGraw Hill International Edn (1996)

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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., Mc Daniel, D. H .& Alexander,
4. J. J.Concepts and Models in Inorganic Chemistry, John Wiley& Sons.
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. Shriver, D.F.& Atkins,P.W. Inorganic Chemistry,Oxford University Press.
7. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt.Ltd.
8. Rodgers, G. E. Inorganic & Solid-State Chemistry, Cengage Learning India Ltd., 2008.
9. G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
10. Mahan, B.H. University Chemistry3rd Ed. Narosa (1998).
11. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co., New York (1985).

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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.OrganicChemistry,Pearson,2010.
7. Bahl,A.&Bahl,B.S.AdvancedOrganicChemistry,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. Text Book of Physical Chemistry - P. L. Soni, S. Chand & Co., 1993.
2. Fundamental of electrochemistry by Vladimir S. Bagotsky · 2005
3. An introduction to electrochemistry by Samuel Glasstooe 2011
4. Photochemistry by Gurdeep Raj, 5th edition -2008
5. Principles of Physical Chemistry - B. R. Puri, L. R. Sharma and M. S. Patania, 1987.
6. The Elements of Physical Chemistry (3rd edition) - Peter Atkins, Oxford Univ. Press, 2000
7. Essentials of Physical Chemistry by Bahl and Bahl, Revised edition-2009
8. Polymer Science. V. R. Gowariker, Viswanathan jayadev Sreedhar 2nd edition-2015
9. Text Book of Polymer Science - Bilmeyer, Jr. F.W. John Wiley & Sons, 1984

B.Sc. in Chemistry

VI Semester

With effect from 2023-24

B.Sc. Semester–VI

Discipline Specific Course (DSC)-13

Course Title: Chemistry (Theory) XIII

Course Code:036CHE011

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-13	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

Course Outcomes (COs):At the end of the course students will be able to:

CO1: Understand Crystal field theory, crystal field splitting, calculation and comparison of CFSE in octahedral, tetragonal, tetrahedral and square planar complexes.

CO2: Study the Stability of metal complexes (thermodynamic and kinetic), stepwise and overall stability constant and their relationship. Factors affecting the stability of metal complexes.

CO3: Learn the structure and constitution of Carbohydrates, Ring Size determination and properties, Structures of disaccharides and polysaccharides and biological importance.

CO4: 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, isoprene rule, special isoprene rule constitution and synthesis of citral and α-terpinol.

CO5: Describe the Role of metal ions in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions. Na/K pump and Structure of hemoglobin, myoglobin and chlorophyll.

CO6: Know the Solvent properties and typical reactions in liquid ammonia and liquid Sulphur dioxide.

CO7: Distinguish between reversible and irreversible cells. Concept of EMF and its measurement.

CO8: Describing the electrode potential, types, applications for pH and EMF determinations.

CO9: Explaining free energy change for ideal solution, theory of distillation process for separating liquid mixtures.

CO10: Distinguish between miscible and immiscible liquids. Explain the critical solution

temperature, liquid-solid solution, solid solutions.

CO11: Learn to develop and demonstrate knowledge pertaining to the background and development of Green Chemistry, Learn about green chemistry and its necessity, choice of solvents, atom economy, and sustainable raw materials, about the examples of green reactions and future trends in green reaction.

Unit	Title: Chemistry (Theory) XIII	56 hrs/ Sem
UnitI	**Coordination Chemistry-II** Crystal field theory, crystal field splitting, calculation and comparison of CFSE in octahedral and tetrahedral complexes, crystal field effects in weak and strong field ligands. Pairing energies. Factors affecting the magnitude of crystal field splitting. Spectrochemical series. Tetragonal distortion of octahedral geometry, John Teller distortion. Crystal field splitting in square planar complexes. Explanation of color 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 hrs)** **Bioinorganic Chemistry** Role of metal ions in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions. Na/K pump. Structures of hemoglobin and chlorophyll, and the role of Fe(II) and Mg(II) metal ions in these pigments. Role of Ca^{2+} in blood clotting. **(3 hrs)** **Non-aqueous solvents** Solvent properties and typical reactions studied in liquid ammonia and liquid sulphur dioxide. **(3 hrs)**	14 hrs
UnitII	**Carbohydrates:** Definition, classification, osazone formation and its mechanism, epimers and epimerization, interconversion 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, conformational analysis of monosaccharides (example: Glucose). Disaccharides: structure of sucrose and lactose (mention hydrolysis product, glycoside linkage and reducing properties). Polysaccharides: partial structure of starch and cellulose. Photosynthesis of carbohydrates. **(8 hrs)**	14 hrs

	Amino Acids, Peptides and Terpenes: 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, synthesis of dipeptides by N-protecting (t-butoxycarbonyl and phthaloyl) & C-activating groups. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. **Terpenes:** Classification, isoprene rule, constitution and synthesis of Citral and ∝-terpinol **(6 hrs)**	
UnitIII	**Electrochemistry-II** **Electro Motive Force(EMF)** Electrochemical cells, Reversible and irreversible cells, EMF of a cell and its measurement by potentiometer, standard cell (Weston standard cell), types of electrodes, reference electrode- calomel electrode, sign conventions, Nernst equation, electrochemical series and its applications, salt bridge and its applications. Determination of pH of solution by hydrogen electrode, quinhydrone electrode and glass electrode methods, 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 potential **(7hs)** **Energy sources:** Non-conventional energy sources. Solar energy, thermal energy, wind energy, geothermal energy, photovoltaic cells, biofuels and their applications. **Batteries & Fuel cells-** Primary and secondary batteries – Construction and Applications of Pb-acid battery, Li-Battery, Lithium-polymer cell, and nickel-cadmium cell. **Fuel cells**-hydrogen-oxygen and Hydrocarbon–Oxygen fuel cells and their applications. **(4hrs)** **Micelle:** Emulsions, micro emulsions or micellar emulsions, and its stability, properties of micro emulsions: electro kinetic effects. Colloidal electrolytes or association colloids, types of colloidal electrolytes. Micelles: surface-active agents or surfactants. **(3 hrs)**	14 hrs

UnitIV	**Green Chemistry** Basics of Green Chemistry. Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy. Green solvent Supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solvent less processes, immobilized solvents and how to compare greenness of solvents. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. **(8hrs)** **Examples of Green Synthesis/ Reactions** Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis) Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; Microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction. Ultrasound assisted reactions: Sono chemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine). **(6hrs)**	14 hrs

FormativeAssessmentforTheory	
AssessmentOccasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Quiz/Assignment/SmallProject	10
Seminar	10
Total	**40Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course(DSC)-14

Course Title: Chemistry (Practical) XIV

Course Code:036CHE012

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-14	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**25**	**25**	**50**

ORGANIC CHEMISTRY EXPERIMENTS

Course Outcomes (COs):At the end of the course, students will be able to:

CO1: Qualitative analysis of solid – solid organic mixtures, Identification, nature and separation of mixture. Analysis of any one separated compound through preliminary tests, element test, physical constant, functional Group test and preparation of suitable derivative and its physical constant, distillation of Liquid-Liquid mixtures containing low boiling and high boiling liquids and their analysis.

Expt. No.	ORGANIC CHEMISTRY EXPERIMENTS	56hrs/ Sem
1	**Qualitative analysis of solid – solid organic binary mixtures and liquid-liquid binary mixture (by distillation)** Identification, nature and separation of mixture. Analysis of any one of the separated compound or a fresh compound through preliminary tests, element test, physical constant, functional group test and preparation of suitable derivative and its physical constant. **Acids:** Salicylic, Cinnamic andPhthalic. **Phenol:** β–naphthol. **Base:** m-nitroaniline and p-nitroaniline. **Neutral:** Naphthalene, Acetanilide, Benzamide. **Low Boiling:** Ethyl acetate, acetone **High Boiling:** Phenol, aniline, acetophenone, toluene	
	NOTE: In a batch of ten students, not more than two students should get the same mixture in the practical examination. Preparation of derivative is not needed at the time of 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 and Separation: (5 marks), Preliminary test and Elemental analysis test: (4marks), Physical Constant:(3 marks), Functional Group test (5 marks), Journal: (3marks), Viva-voce: (5marks). **Total 25marks**	

Recommended Books/References

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

B.Sc. Semester–VI

Discipline Specific Course (DSC) -15

Course Title: Chemistry (Theory) XV

Course Code:036CHE013

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No.of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-15	**Theory**	**04**	**04**	**56 hrs.**	**2 hrs.**	**40**	**60**	**100**

Course Outcomes (COs):At the end of the course, students will be able to:

CO1: Understand manufacture, applications and hazards in handling of chemicals and preparation, properties and uses of useful chemicals and complexes

CO2: Know nuclear particles, nuclear instability, nuclear fission and fusion, nuclear reactors, nuclear reactions and applications of radioisotopes

CO3: Learn about requirement of an ideal drug and classification, Synthesis and therapeutic uses of different chemotherapeutic agents.

CO4: 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.

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: Understand instrumental technique, methodology and applications of Flame Emission Spectroscopy, Atomic Absorption Spectroscopy**,** Thermal methods of analysis Electrogravimetry. Nephelometry and Turbidimetry

Unit	Title: Chemistry (Theory) XV	56.hrs/ Sem
Unit I	**Inorganic chemicals** Manufacture, applications and hazards in handling of hydrochloric acid, caustic soda and bleaching powder. Preparation, properties and uses of TiO_2, V_2O_5, $PbCrO_4$, $KMnO_4$, $(NH_4)_2MoO_4$ and complexes of platinum. **(7hrs)** **Nuclear chemistry** 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). Applications of radioisotopes in tracer technique, neutron activation analysis and carbon dating (numerical problems). **(7hrs)**	14 hrs
Unit II	**Drugs** Definition and classification, requirement of an ideal drug, synthesis and therapeutic use of a) Analgesic and antipyretic: Paracetamol, Analgin, ibuprofen and diclofenac sodium, b) Antibacterial: Sulphadiazineand sulphathiazole, c) Antimalarial: Chloroquine, d) Antibiotic:Chloramphenicol, e) Tranquilizers: mysoline and pentothal sodium, f) Local anesthetics: novacaine, g) Antihistamines: Chlorpheniraminemaleate, cetirizine, HCl. **(5 hrs)** **Basics of ^{1}H NMR Spectroscopy** Introduction to magnetic properties of nuclei, concept of nuclear spin: Spin of protons and neutrons, nuclear quantum number for various nuclei (depending upon mass and charge of nuclei, I = 0, ½, 1, 3/2), nuclear angular momentum and magnetic momentum, interaction of magnetic nuclei with applied magnetic field, Larmor precession, nuclear energy levels in applied magnetic fields, concept of resonance and expression for energy, concept of chemical shift, shielding and deshielding effect, typical chemical shift values for different class of compounds, anisotropic effects. Applications of NMR spectroscopy: Interpretation of spectrum of ethyl bromide, ethanol, acetone, 2-chloroethanol, acetaldehyde, ethyl acetate, propanamide, benzene, acetophenone and acetanilide**.** **(7 hrs)** **Mass Spectrometry** Principle, instrumentation, molecular ion peak and base peak, McLaffertyrearrangementwithrespectto2-hexanone, hexenoic acid and methyl hexanoate. **(2 hrs)**	14 hrs

Unit III	**Quantum Chemistry:** Black body radiation, Spectral distribution of black body radiation, Plank's theory, derivation of Planck's radiation law, photoelectric effect, Compton effect, wave nature of electron, derivation of Schrödinger's wave equation, wave function and its significance, Eigen function and Eigen values, normalization and orthogonality. Equation of motion for a particle, Newtonian, Lagrangian and Hamiltonian equations of motion, elementary wave motion. Operators, Eigen values and expectation values, commuting operators, linear operator and Hermitian operators. Solutions of Schrödinger equations of a free particle, particle in a box problem: 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.	14 hrs
Unit IV	**Flame Emission Spectroscopy (FES):** Principle, flames and flame temperature, instrumentation, interferences, applications, and limitations of FES. Determination of Na/K in soil / water samples. **Atomic Absorption Spectroscopy (AAS):** Principle, types of burners (premix and total consumption) and their comparison, instrumentation and applications, Determination of Mg in tap water. Comparison of AAS with FES. **Thermal methods of analysis:** Thermogrametric analysis (TGA), Theory, thermogravimetric curves for one, two and three decomposition steps, instrumentation, factors affecting thermograms. Applications of TGA. Differential thermal analysis (DTA): Theory and applications Differential scanning calorimetry (DSC): Theory and applications **Electrogravimetry:** Theory, instrumentation. Determination of copper. **Nephelometry and Turbidimetry:** Principle, instrumentation and applications.	14 hrs

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Quiz/Assignment/Small Project	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course (DSC)-16

Course Title: Chemistry (Practical) XVI

Course Code:036CHE014

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-16	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

Course Outcomes (COs):At the end of the course, students will be able to:

CO1: Learn the complex preparation skills

CO2: Understand the determination of contents of given organic compounds.

CO3: Understand to apply the knowledge of conductivity, EMF and absorbance to performing the experiments.

CO4: Acquire skills for handling analytical instruments like potentiometer, conductometer, pH meter & colorimeter.

DSCC -16: Chemistry (Practical) XVI (Code : 036CHE014)	
GENERAL CHEMISTRY EXPERIMENTS	52 rs
SET-I 1. Preparation of trans-potassium diaquadioxalatochromate (III) 2. Preparation of tris(thiourea) copper (I) sulphate monohydrate 3. Preparation of hexaamminecobalt(III) chloride 4. Determination of glycine present in the given solution volumetrically 5. Determination saponification value of oil/fat. 6. Determination of iodine number of an oil/fat. **SET-II** 1. Determination of concentrations of given acids in a mixture (HCl + CH_3COOH) using the standard NaOH by conductometric titration method. 2. Determination of solubility of sparingly soluble salt ($BaSO_4$/$PbSO_4$) conductometrically. 3. Determination of redox potentials of Fe^{3+}/Fe^{2+} using of $FeSO_4.7H_2O$ solution by potentiometric titration against the standard solution of $K_2Cr_2O_7$ 4. Determination of solubility and solubility product of sparingly soluble salts (AgCl) potentiometrically. 5. Determination of molecular weight of polymer by viscosity method. 6. Determination of the composition of Fe^{3+} - salicylic acid complex solution by Job's method.	

Examination

In a batch of ten students in the practical examination, five students may be given SET–I experiments and remaining 5 students may be given SET-II experiments. In SET-I experiments one preparation and one determination experiment may be given. 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:

SET-I

Preparation experiment: Reaction – 01 mark, Calculation of theoretical Yield- 01 mark, Observed yield-05 marks, = 07 marks

Determination Experiment: Accuracy – 06 marks, Technique and presentation- 02 marks, calculation- 02 marks = 10 marks,

Journal- 03 marks, Viva- voce – 05 marks, **Total= 25 marks**

Deduction of marks for accuracy:

Less than 10% yield- 5 marks, 11-15%- 4 marks, 16-20%-3 marks, 21-25%- 2 marks, above 25%- zero marks

±0.4 cc- 6 marks, ±0.6cc- 04 marks, ±0.8cc-02 marks, ±1cc-01 marks, above ±1cc- Zero marks

SET-II

NOTE: 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. During practical examination chart is not allowed, wherever necessary simple procedure may be given.

Distribution of Marks:

Accuracy-10 marks, Technique and Presentation-2, Calculation and graph-5 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

Recommended books

1. Findlay's practical physical chemistry -revised by Levitt, Longman's, London,(1968)
2. Experiments in Physical chemistry - Shoemaker and Garland, McGraw Hill International Edn. (1996)

B.Sc. Semester–VI

INTERNSHIP

Course Title: Chemistry Internship

Course Code:036 CHE 091

Type of Course	Theory /Practical	Credits	Instruction hour/week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
INTERNSHIP	**Practical**	**02**				**50**	**0**	**50**

Internship:

A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations for 2 credits. Internships involve working with local industry or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

Note:

1. One credit internship is equal to 30hrs on field experience.
2. Internship shall be Discipline Specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Internship may be full-time/part-time (full-time during last 1-2 weeks before closure of the semester or weekly 4 hrs in the academic session for 13-14 weeks). College shall decide the suitable method for programme wise but not subject wise.
4. Internship mentor/supervisor shall avail work allotment during 6^{th} semester for a maximum of 20 hours.
5. The student should submit the final internship report (45-60 hours of Internship) to the mentor for completion of the internship.
6. Method of evaluation: Presentations/Report submission/Activity etc.

Wherever internship is not feasible, the students can to choose the Project Work

Project Work: Plant training in industries/short term work in the College/other Institution:

The project work may include in Educational Institutions/R&D organizations/data mining/review of current literature/theoretical methods/ computer applications.

Experimental work may involve studies on synthesis/measurements/study of properties/ characterization/applications/activities for reported/unreported research or any suitable combination thereof. In case of the students who would work outside the campus, the Supervising Staff member may visit him/her/them.

References:

Inorganic Chemistry

1. Lee, J.D. Concise Inorganic ChemistryELBS,1991.
2. Cotton, F. A, Wilkinson, G.&Gaus, P.L. BasicInorganicChemistry,3rdEd., Wiley.
3. Douglas, B.E., Mc Daniel, 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 EducationIndia, 2006.
5. Shriver, D.F.&Atkins,P.W.InorganicChemistry,OxfordUniversityPress.
6. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
7. Rodgers, G. E. Inorganic &Solid State Chemistry, Cengage Learning India Ltd., 2008.
8. G.L. Miessler& Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
9. Mahan, B.H. UniversityChemistry3rd Ed.Narosa(1998).
10. 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 Guide book 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. AdvancedOrganicChemistry, 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.
16. William Kemp, NMR Chemistry A Multinuclear Introduction.
17. Clyden, Greeves, Warrens, and Wothers, Oraganic Chemistry, 1st Edition.
18. Robert M. Silverstain, Francis X Webster, David J Kiemel and David L Bryce, 18th edition.

Physical Chemistry

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,1987.
3. The Elements of Physical Chemistry(3rd edition) - Peter Atkins, Oxford Univ. Press, 2000
4. Essentials of Physical Chemistry by Bahl and Bahl, Revised edition-2009
5. Engineering Chemistry, P.C. Jain and Monika Jain, Dhanpad Rai and Sons, Delhi, Jalandhar, 1995.
6. Spectroscopy by H. Kaur, APragati edition-9th edition 2014.
7. Molecular structure and spectroscopy by G. Aruldhas, 2nd edition-2014
8. Basic Physical chemistry - Walter J. Moore, Prentice Hall, 1972.

UG programme: 2023-24

GENERAL PATTERN OF THEORY QUESTION COURSE 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 : 10 marks

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

HAVERI UNIVERSITY, HAVERI

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

SYLLABUS FOR SEM III & IV

Course: CHEMISTRY

SEMESTER - III:

DISCIPLINE SPECIFIC CORE COURSE(DSCC)

DSCC – 5 : Chemistry (Theory) - I (Code:033CHE011)

DSCC – 6 : Chemistry (Practical) - II (Code:033CHE012)

OEC- 3 : Chemistry in daily life (Code: 003CHE051)

SEMESTER - IV:

DSCC – 7 : Chemistry (Theory) - III (Code:034CHE011)

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

OEC- 4 : Molecules of life (Code:004CHE051)

Effective from 2022-23

AS PER N E P - 2020

Haveri University, Haveri

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 andinstitution 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

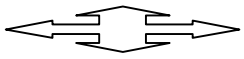
Part-C

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 o f Calcium a n d 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.