# DEPARTMENT OF CHEMISTRY
# COURSE CURRICULUM

## PART- A: Introduction

| Program: Bachelor in Science *(Honors/Honors with research)* | | Semester - VII | Session: 2024-25 |
|---|---|---|---|
| 1 | Course Code | CHSC-07T | |
| 2 | Course Title | INORGANIC & PHYSICAL CHEMISTRY-II | |
| 3 | Course Type | DSC | |
| 4 | Pre-requisite (if, any) | *As per Program* | |
| 5 | Course Learning. Outcomes (CLO) | ➢ *Study the formation, stability and electronic spectra of complexes*<br>➢ *Analyze the chemistry of metal carbonyls and metal nitrosyls.*<br>➢ *Solve the Schrodinger equation for the hydrogen atom and utilize Huckel theory for conjugated systems.*<br>➢ *Analyze collision theory and transition state theory to understand chemical reactions.* | |
| 6 | Credit Value | 3 Credits | *Credit = 15 Hours - learning & Observation* |
| 7 | Total Marks | Max. Marks: 100 | Min Passing Marks: 40 |

## PART -B: Content of the Course

**Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| Unit | Topics (Course contents) | No. of Period |
|---|---|---|
| I | **MOT & Electronic Spectra of Complexes**<br>Electronic spectra and MO theory of Transition Metal complexes , M.O. Theory for octahedral, tetrahedral and square planar complexes with and without π-bonding Determining the Energy terms, Spin-orbit (L-S) coupling scheme, Hund's rule for term symbol, Hole formalism, Determination of the term symbol (ground and excited states) for d 1 to d 9 configurations, Electronic spectra of transition metal complexes, Types of transitions, Laporte 'orbital' selection rule, spin selection rule. Orgel diagrams for octahedral metal complexes. Charge transfer spectra, Racah parameters, calculations of 10Dq, B, β parameters. Tanabe- Sugano Diagrams of octahedral complexes with d 2 and d8 configuration. | 12 |
| II | **Metal – Ligand Equilibria**<br>A) Metal – Ligand Equilibria in Solution: Stepwise and overall formation constants; trends in stepwise formation constants; factors affecting stability of metal complexes with reference to nature of metal ion, ligand, chelate effect and thermodynamic origin. Determination of formation constant by: (1) spectrophotometric method (Job's and Mole ratio method) (2) Potentiometric method (Irving-Rossotti Method)<br>B) **Reaction Mechanism of Transition metal complexes**-: Energy Profile of a reaction, reactivity of metal complexes, Inert and Labile complexes, Kinetics of Octahedral substitution<br>C) **Metal carbonyls**: vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, synthesis and structures.<br>D) **Metal nitrosyls**: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation. | 11 |
| III | **Advanced Quantum Mechanics**<br>Discussion of solutions of the Schrodinger equation to three - dimensional box, concept of degeneracy, the harmonic oscillator, the rigid rotor, the hydrogen atom.<br>**Approximate Methods** | 11 |

| | | |
|---|---|---|
| | The variation theorem and perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to hydrogen and helium atom.<br>**Angular Momentum**<br>Ordinary angular momentum, eigen functions and eigen values of angular momentum, ladder operator, concept of spin, antisymmetry and Pauli's exclusion principle.<br>**Molecular Orbital Theory**<br>Huckel theory of conjugated systems, Applications to ethylene, butadiene and cyclobutadiene. | |
| **IV** | **Advanced Chemical Dynamics**<br>**A)** Methods of determining rate laws, Temperature dependence of chemical reaction rates, Arrhenius equation, Energy of activation, pre-exponential factor and its limitations, Collision theory and its limitations, steric factors, Transition State theory of gas and liquid phase bimolecular reactions, comparison of three theories of reaction rates, kinetic salt effects. Kinetics of Photochemical reactions (Hydrogen-bromine and hydrogen - chlorine reactions).<br>**B)** Bodeinstein steady state approximation and its application in consecutive reactions, Dynamics of unimolecular reactions :Lindeman-Hinshelwood mechanism, RRKM theory, Thermodynamic formulation of transition state theory, Enthalpy, Gibbs free energy and enthalpy of activation. | **11** |
| ***Keywords*** | ***Electronic spectra, MO theory, Complex stability, Spectrophotometry, Vibrational spectra, Bonding, Metal nitrosyls, Schrodinger equation, Huckel theory , Collision theory, Transition state theory*** | |

***Signature of Convener & Members (CBoS) :***

## PART–C: Learning Resources

**Text Books, Reference Books and Others**

***Text Books Recommended:***

1. *Bali, R. (2014). Principles of inorganic chemistry (5th ed.). New Age International.*
2. *Prasad, R. K. (2012). Quantum mechanics (3rd ed.). New Age International.*
3. *Puri, B. R., Sharma, L. R., & Rastogi, V. D. (2012). A textbook of physical chemistry. Vishwa Prakashan.*
4. *Rakshit, P. C. (2014). Elements of physical chemistry. S. Chand & Company.*

***Reference Books Recommended:-***

1. *Lee, J. D. (2008). Inorganic chemistry (4th ed.). Wiley India.*
2. *Greenwood, N. N., & Earnshaw, A. (2012). Chemistry of the elements (2nd ed.). Elsevier.*
3. *Laidler, K. J. (1987). Chemical kinetics (3rd ed.). Pearson Education.*
4. *Cotton, F. A., Wilkinson, G., Boch, P. L., & Bailar, M. Bailar Jr. (2018). Inorganic chemistry (6th ed.). John Wiley & Sons.*
5. *Mathews, P. M., & McFarlane, F. W. (2014). A textbook of quantum mechanics (2nd ed.). Mc Graw Hill Education.*
6. *Houston, P. L. (2001). Chemical kinetics and reaction dynamics. Dover Publications.*

**Online Resources–**

- https://nptel.ac.in/courses/115106066
- https://nptel.ac.in/
- https://onlinecourses.nptel.ac.in/noc23_cy02/preview
- https://swayam.gov.in/

## PART -D: Assessment and Evaluation

**Suggested Continuous Evaluation Methods:**

**Maximum Marks:** **100 Marks**

**Continuous Internal Assessment (CIA):** **30 Marks**

**End Semester Exam (ESE):** **70 Marks**

| | | |
|---|---|---|
| **Continuous Internal Assessment (CIA):** **(By Course Teacher)** | Internal Test / Quiz-(2): **20** +**20**<br>Assignment / Seminar - **10**<br>Total Marks - **30** | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks |
| **End Semester Exam (ESE):** | **Two section – A & B**<br>Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks**<br>Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks** | |

***Name and Signature of Convener & Members of CBoS:***

# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
## DEPARTMENT OF CHEMISTRY
## COURSE CURRICULUM

| **PART- A: Introduction** | | | | |
|---|---|---|---|---|
| **Program: Bachelor in Science** *(Honor/Honors with Research)* | | | **Semester - VII** | Session: **2024-2025** |
| 1 | **Course Code** | **CHSC-07P** | | |
| 2 | **Course Title** | **CHEMISTRY LAB. COURSE-VII** | | |
| 3 | **Course Type** | **DSC** | | |
| 4 | **Pre-requisite** (if, any) | ***As per Program*** | | |
| 5 | **Course Learning. Outcomes (CLO)** | ➢ *Master separating and estimating acidic and basic radicals in inorganic mixtures.*<br>➢ *Apply qualitative and quantitative analysis skills to real samples. • Inorganic Synthesis & Characterization*<br>➢ *Gain hands-on experience synthesizing inorganic compounds and identify them using spectral analysis.*<br>➢ *Grasp basic physical chemistry concepts through practical experiments and learn to operate basic equipment.* | | |
| 6 | **Credit Value** | **1 Credits** | *Credit =30 Hours Laboratory or Field learning/Training* | |
| 7 | **Total Marks** | **Max. Marks: 50** | | **Min Passing Marks: 20** |

**PART -B: Content of the Course**

**Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)**

| Module | Topics (Course contents) | No. of Period |
|---|---|---|
| **Lab./Field Training/ Experiment Contents of Course** | **Qualitative analysis of mixture containing eight radicals including two less common metals from among the following by semi micro method.**<br>**Basic Radicals:**<br>Ag, Pb, Hg Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt.<br>**Acidic Radicals:**<br>Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Fluoride, Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferricyanide, Sulphocyanide, Chromate, Arsinate and Permanganate.<br>**Separation and determination of two metal ions in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.**<br>**Estimations**<br>(a) Phosphoric acid in commercial orthophosphoric acid.<br>(b) Boric acid in borax.<br>(c) Ammonia in an ammonium salt.<br>(d) Manganese dioxide in pyrolusite.<br>(e) Available chlorine in bleaching powder.<br>(f) Hydrogen peroxide in a commercial sample.<br>**Preparations**<br>Preparation of selected inorganic compounds and their study by I.R. Electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds. Theoretical study of structure and their identification of some preparations by spectral analysis | **30** |

1. $VO(acac)_2$
2. $TiO(C_9H_8NO)_2 2H_2O$
3. Cis-K $[Cr(C_2O_4)_2(H_2O)_2]$
4. $Na[Cr(NH_3)_2(SCN)_4]$
5. $Mn(acac)_3$
6. $K_3[Fe(C_2O_4)_3]$
7. Prussian Blue, Turnbull's Blue.
8. $[Co(NH_3)_6][Co(NO_2)_6]$
9. Cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
10. $Hg[Co(SCN)_4]$
11. $[Co(Py)_2Cl_2]$
12. $[Ni(NH_3)_6]Cl_2$
13. $Ni(DMG)_2$
14. $[Cu(NH_3)_4]SO_4.H_2O$

**Adsorption**

1. To study surface tension – concentration relationship for solution (Gibb's equation).
2. To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm.

**Chemical Kinetics**

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

**Polarimetry**

1. Determine the specific and molecular rotation of optically active substance.
2. To determine the concentration of a solution of an optically active substance.

**Solutions**

1. Determination of molecular weight of non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
2. Determination of molecular weight of non-volatile substances by Landsberger's method.

**Spectrophotometry**

1. Verification of Beer-Lambert law and determination of concentration of unknown solution.
2. Effect of pH in aqueous coloured system.

**Potentiometry/pH metry**

1. Determination of temperature dependence of EMF of a cell.
2. To determine pKa of the given monobasic acid by pHmetric titration.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert- Serjeant method.

| *Keywords* | ***Qualitative Analysis, Separation and Determination, Estimations, Preparations, Spectroscopic Techniques, Adsorption, Chemical Kinetics, Polarimetry, Solutions, Instrumental Methods*** |
|---|---|

***Signature of Convener & Members (CBoS) :***

## PART–C: Learning Resources

**Text Books, Reference Books and Others**

*Text Books Recommended*

1. *Das, R. C., & Behra, B. (2009). Experimental Physical Chemistry (1st Ed.). Tata Mcgraw-Hill Education.*
2. *Chatwal, G. R., & Sharma, A. (2019). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*

*Reference Books Recommended*

1. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1974). Vogel's Textbook of Qualitative Chemical Analysis (5th Ed.). ELBS.*
2. *Jolly, W. L. (1970). Synthesis and Characterization of Inorganic Compounds. Prentice Hall.*
3. *James, A. M., & Prichard, F. E. (1981). Practical Physical Chemistry (4th Ed.). Longman.*
4. *Plevitt, B. (1974). Findlay's Practical Physical Chemistry (9th Ed.). Longman.*

**Online Resources–**

- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/0297998979)**

**Online Resources–**

- **e-Resources / e-books and e-learning portals**

## PART -D: Assessment and Evaluation

**Suggested Continuous Evaluation Methods:**

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|---|---|
| **Maximum Marks:** | **50 Marks** |
| **Continuous Internal Assessment (CIA):** | **15 Marks** |
| **End Semester Exam (ESE):** | **35 Marks** |

| | | |
|---|---|---|
| **Continuous Internal Assessment (CIA):** **(By Course Teacher)** | Internal Test / Quiz-(2): **10 & 10**<br>Assignment/Seminar +Attendance - **05**<br>Total Marks - **15** | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks |
| **End Semester Exam (ESE):** | **Laboratory / Field Skill Performance:** **On spot Assessment**<br>**S. Performed the Task based on lab. work - 20 Marks**<br>**T. Spotting based on tools & technology (written) – 10 Marks**<br>**U. Viva-voce (based on principle/technology) - 05 Marks** | **Managed by Course teacher as per lab. status** |

***Name and Signature of Convener & Members of CBoS:***

# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
## DEPARTMENT OF CHEMISTRY
## COURSE CURRICULUM

| **PART- A: Introduction** | | | | |
|---|---|---|---|---|
| **Program: Bachelor in Science** *(Honors/Honors with Research)* | | | **Semester - VIII** | Session: **2024-2025** |
| 1 | **Course Code** | **CHSC-08T** | | |
| 2 | **Course Title** | **ORGANIC & INORGANIC CHEMISTRY-II** | | |
| 3 | **Course Type** | **DSC** | | |
| 4 | **Pre-requisite** (if, any) | ***As per Program*** | | |
| 5 | **Course Learning. Outcomes (CLO)** | ➢ *Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.*<br>➢ *Understand and predict regioselectivity in aromatic electrophilic substitution reactions.*<br>➢ *Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.*<br>➢ *Understand and classify supramolecular chemistry* | | |
| 6 | **Credit Value** | **3 Credits** | *Credit = 15 Hours - learning & Observation* | |
| 7 | **Total Marks** | **Max. Marks: 100** | | **Min Passing Marks: 40** |

**PART -B: Content of the Course**

**Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)**

| Unit | Topics (Course contents) | No. of Period |
|---|---|---|
| I | **MECHANISTIC ORGANIC CHEMISTRY**<br>Unit I: A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases.<br>B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration.<br>C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation.<br>D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe– Schmitt reaction | 12 |
| II | **SUBSTITUTION REACTIONS**<br>A) Aliphatic nucleophilic substitution: The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction<br>B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude.<br>C) Aromatic Nucleophilic Substitution: A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms, | 11 |

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| | arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions | |
| **III** | **Symmetry and Group Theory in Chemistry**<br>Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the $C_n$, $C_{nv}$, $C_{nh}$, $D_{nh}$ etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy. | **11** |
| **IV** | **Supramolecular Chemistry:** Concepts and language, Molecular recognition<br>Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis.<br>**Transport processes and carrier design.** Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry.<br>**Metal Clusters:**<br>Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds.<br>**Isopoly and Heteropoly Acids and Salts.** | **11** |
| *Keywords* | ***Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry*** | |

***Signature of Convener & Members (CBoS) :***

## PART–C: Learning Resources

**Text Books, Reference Books and Others**

***Text Books Recommended -***

**Textbooks Recommended**

1. *Soni, P. L., Bahl, B. S., & Bahl, A. (2019). Organic Chemistry.S. Chand & Company Ltd.*
2. *Morrison, R. T. & Boyd, R. N. (2012). Organic Chemistry. Pearson Education.*
3. *Kumar, A. (2004). Elements of Group Theory for Chemists. New Delhi, India: Affiliated East-West Press.*
4. *Mukherji, S. M. & Chakrabarti, S. P. (2007). Reaction Mechanisms in Organic Chemistry. Macmillan India Ltd.*

**Reference Books Recommended**

1. *Carey, F. A. & Sundberg, R. J. (2007). Advanced Organic Chemistry. Springer.*
2. *Ahluwalia, V. K. & Aggarwal, R. (2010). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Carruthers, W. (1987). Modern Organic Synthesis. Springer.*
4. *Smith, M. B. & March, J. (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. John Wiley & Sons.*
5. *Grossman, R. B. (2004). The Art of Writing Reasonable Organic Reaction Mechanisms. Oxford University*

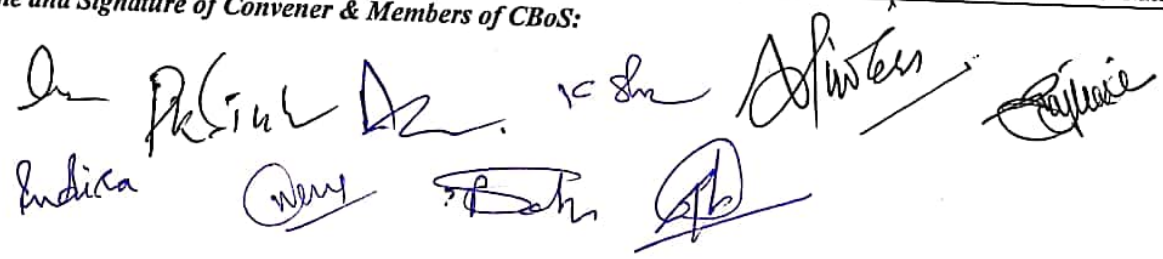
**Online Resources–**

- https://onlinecourses.nptel.ac.in/noc20_cy30/preview
- https://swayam.gov.in/
- https://www.coursera.org/
- https://www.edx.org/
- https://onlinecourses.nptel.ac.in/noc20_cy30/preview

## PART -D: Assessment and Evaluation

| | | |
|---|---|---|
| **Suggested Continuous Evaluation Methods:**<br>**Maximum Marks:** **100 Marks**<br>**Continuous Internal Assessment (CIA):** **30 Marks**<br>**End Semester Exam (ESE):** **70 Marks** | | |
| **Continuous Internal Assessment (CIA):**<br>**(By Course Teacher)** | Internal Test / Quiz-(2): **20 +20**<br>Assignment / Seminar - **10**<br>Total Marks - **30** | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks |
| **End Semester Exam (ESE):** | **Two section – A & B**<br>Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks**<br>Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks** | |

***Name and Signature of Convener & Members of CBoS:***



# FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
## DEPARTMENT OF CHEMISTRY
## COURSE CURRICULUM

| **PART- A: Introduction** | | | | |
|---|---|---|---|---|
| **Program: Bachelor in Science** *(Honors/Honors with Research)* | | | **Semester - VIII** | Session: **2024-2025** |
| 1 | **Course Code** | **CHSC-08P** | | |
| 2 | **Course Title** | **CHEMISTRY LAB. COURSE-VIII** | | |
| 3 | **Course Type** | **DSC** | | |
| 4 | **Pre-requisite** (if, any) | ***As per Program*** | | |
| 5 | **Course Learning. Outcomes (CLO)** | ➢ *To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.*<br>➢ *To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.*<br>➢ *To learn about separation and purification of organic mixtures by chromatography*<br>➢ *To identify and characterize prepared and separated compounds by IR spectral analysis.* | | |
| 6 | **Credit Value** | **1 Credits** | *Credit =30 Hours Laboratory or Field learning/Training* | |
| 7 | **Total Marks** | **Max. Marks: 50** | **Min Passing Marks: 20** | |

| **PART -B: Content of the Course** | | |
|---|---|---|
| **Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)** | | |
| **Module** | **Topics (Course contents)** | **No. of Period** |
| **Lab./Field Training/ Experiment Contents of Course** | **Organic Synthesis**<br>(i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.<br>(ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate.<br>(iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol<br>(iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid<br>(v) Aldol condensation: Dibenzalacetone from benzyldehyde<br>(vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid.<br>(vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.<br>(viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol.<br>(ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.<br>(x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline.<br>(xi) Clemmenson reduction: Hydrocarbons from ketones.<br>(xii) Nitration: Picric acid from phenol<br>(xiii) Reduction: Acetic acid from ethanol.<br>(xiv) Esterification: Oil of Wintergreen from salicylic acid.<br>(xv) Sulphonation: Sulphanilic acid from aniline.<br><br>**Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.**<br>Identification of functional group of organic compounds by FTIR<br>Separation, purification and identification of compounds of binary mixtures TLC | **30** |

| | | |
|---|---|---|
| | and column chromatography. | |
| *Keywords* | *Organic Synthesis, Separation techniques (column chromatography, TLC), Identification techniques (FTIR), Volumetric analysis, Chromatography (paper, column), Flame photometry, Spectrophotometry (UV-Vis), Conductometry, pH-metry.* | |

***Signature of Convener & Members (CBoS) :***

## PART–C: Learning Resources

**Text Books, Reference Books and Others**

**Textbooks Recommended:**

1. Basavarajaiah, S. M., Nagesh, G. Y., & Ramakrishna Reddy, K. (2016). *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*. New Age International.
2. Manna, A. K. (2011). *Practical Organic Chemistry*. Books & Allied (Publishers) Pvt. Ltd.
3. Peesapati, V. (2017). *Practical Organic Chemistry – A Primer*. BSP Books.

**Reference Books Recommended:**

1. Vogel, A. I. (**1957**). *Practical Organic Chemistry*. Longman Scientific & Technical.
2. Mann, F. G., & Saunders, B. C. (**2004**). *Practical Organic Chemistry* (4th Ed.). Longman.
3. Jeffery, G. H., Mendham, J., Denney, R. C., & Barnes, J. (**2000**). *Vogel's Textbook Of Quantitative Chemical Analysis* (6th Ed.). Longman.
4. Harris, D. C. (**1998**). Quantitative Chemical Analysis (5th Edition). W H Freeman & Co

**Online Resources–**

- **e-Resources / e-books and e-learning portals**
- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

**Online Resources–**

- **e-Resources / e-books and e-learning portals**

## PART -D: Assessment and Evaluation

**Suggested Continuous Evaluation Methods:**

| | |
|---|---|
| **Maximum Marks:** | **50 Marks** |
| **Continuous Internal Assessment (CIA):** | **15 Marks** |
| **End Semester Exam (ESE):** | **35 Marks** |

| | | |
|---|---|---|
| **Continuous Internal Assessment (CIA):** **(By Course Teacher)** | Internal Test / Quiz-(2): **10 & 10**<br>Assignment/Seminar +Attendance - **05**<br>Total Marks - **15** | Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks |
| **End Semester Exam (ESE):** | **Laboratory / Field Skill Performance: On spot Assessment**<br>**V. Performed the Task based on lab. work - 20 Marks**<br>**W. Spotting based on tools & technology (written) – 10 Marks**<br>**X. Viva-voce (based on principle/technology) - 05 Marks** | **Managed by Course teacher as per lab. status** |

***Name and Signature of Convener & Members of CBoS:***