



**VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY**  
**JNANASAGARA CAMPUS, BALLARI-583105**

**Department of Studies in Chemistry**

**III Semester Syllabus**

Bachelor of Science

With effect from 2022-23 and onwards

**DSC 3: Analytical and Organic Chemistry**

<b>Course Title:</b> Analytical and Organic Chemistry	<b>Course code:</b> 21BSC3C3CHL
<b>Total Contact Hours:</b> 56	<b>Course Credits:</b> 4
<b>Internal Assessment Marks:</b> 40	<b>Duration of SEE:</b> 3hrs
<b>Semester End Examination Marks:</b> 60	

**Course Outcomes (CO's):**

1. Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
2. Principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught
3. Fundamentals of separation methods and principles of paper, thin layer and column chromatography will be taught
4. Principle, types and applications of solvent extraction will be taught
5. Principle and mechanism of ion-exchange, types of resins and domestic and industrial applications of ion-exchange chromatography will be taught
6. The concept of mechanism and its importance will be taught to the student
7. Concept and importance of intermediates in organic chemistry will be taught taking proper examples
8. The various techniques for identification of reaction mechanism will be taught to the student taking proper examples
9. Concept of stereochemistry and its importance will be taught.
10. The various projection formulae and the techniques of designating the molecules into R, S, D, L will be taught taking proper examples
11. The theory and concept of Cis-, Trans- isomerism and its importance and the techniques to differentiate between them will be taught taking examples

**At the end of the course, students will be able to:**

1. Understand the importance of fundamental law and validation parameters in chemical analysis
2. Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.
3. Understand the requirement for chemical analysis by paper, thin layer and column chromatography.
4. Apply solvent extraction method for quantitative determination of metal ions in different samples
5. Utilize the ion-exchange chromatography for domestic and industrial applications
6. Explain mechanism for a given reaction.
7. Predict the probable mechanism for a reaction Eexplain the importance of reaction intermediates, its role and techniques of generating such intermediates
8. Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.

9. Predict the configuration of an organic molecule and able to designate it.
10. Identify the chiral molecules and predict its actual configuration

### DSC 3: Analytical and Organic Chemistry

Unit	Description	Hours
1	<b>Quantitative analysis</b> -Instrumental methods Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and $\text{PO}_4^{3-}$ ) and numerical problems on application of Beer's law.	11 hrs
2	<b>Nephelometry and Turbidimetry:</b> Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry and turbidimetry (determination of $\text{SO}_4^{2-}$ and $\text{PO}_4^{3-}$ ) <b>Separation methods Fundamentals of chromatography:</b> General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version.	10hrs
3	<b>Paper chromatography:</b> Theory and applications <b>Thin layer chromatography (TLC):</b> Mechanism, $R_f$ value, efficiency of TLC plates, methodology-selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications. <b>3 hrs</b> <b>Solvent Extraction:</b> Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper. <b>4hrs</b> <b>Ion exchange chromatography:</b> resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion exchange chromatography (softening of hard water, separation of lanthanides, industrial applications). <b>3Hrs</b>	11 hrs
4	<b>Reaction Intermediates:</b> Generation, Stability and Reactions of, i) Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement. ii) Carbanions : Perkin Reaction, Aldolcondensation, Claisen-Schmitt condensation. iii) Free Radicals : Sandmeyer Reaction iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions v) Arynes: Formation, detection etc. <b>7 hrs</b> <b>Methods for Identifying Reaction Mechanism:</b> Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies. <b>5 hrs</b>	12hrs
4	<b>Stereochemistry of Organic Compounds:</b> Fischer projection, Newmann and Sawhorse projection formulae and their interconversions. <b>Geometrical isomerism:</b> Cis-trans and syn-anti isomerism, E/Z notations with C.I.P rules. Optical Isomerism :Optical activity, Specific rotation,	12hrs

	Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral centres, Diastereoisomers, meso structures, Racemic mixtures and Resolution, Relative and absolute configuration, D/L and R/S designations	
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York, 2005.</li> <li>2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India, 2007.</li> <li>3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt Ltd. New Delhi, 2009.</li> <li>4. 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.</li> <li>5. Organic Reaction Mechanism by V.K.Ahluwalia and R.K.Parashar (Narosa Publishers), 4<sup>th</sup> Edn., 2011</li> <li>6. Organic Chemistry by S.M.Mukherji,S.P.Sinh and R.K.Kapoor (Narosa Publishers), Vol III, 2<sup>nd</sup> Edn., 2018</li> <li>7. Morrison R.N and Boyd R.N,Organic Chemistry, Darling Kindersley(India) Pvt. Ltd Pearson Education), 7<sup>th</sup> Eddn., 2010</li> <li>8. Finar I.L,Organic Chemistry(Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products.,Dorling Kindersley(India)Pvt.Ltd.(Pearson Education), 2002</li> <li>9. Kalsi P.S., Stereochemistry, conformation and Mechanism, New age International, 2009</li> <li>10. Eliel E.L and Wilen S.H, Stereochemistry of Organic Compounds, Wiley,(London), 2008</li> </ol>		

Date

Course Coordinator

Subject Committee Chairperson

## DSC: Analytical and Organic Chemistry PRACTICALS

<b>Course Title:</b> Analytical and Organic Chemistry	<b>Course code:</b> 21BSC3C3CHP
<b>Total Contact Hours:</b> 4 hrs	<b>Course Credits:</b> 2
<b>Internal Assessment Marks:</b> 25 marks	<b>Duration of SEE:</b> 3
<b>Semester End Examination Marks:</b> 25 marks	

### Course Outcomes (CO's):

1. To impart skills related to preparation of stock and working solutions and handling of instrumental methods
2. To know the principle of colorimetric analysis and construction of calibration plot
3. To understand the chemistry involved in colorimetric determination of metal ions and anions
4. To determine R<sub>f</sub> values of different metal ions present in a mixture
5. To impart knowledge on the importance of functional groups in organic compounds.
6. Techniques to identify the functional groups in an compound by performing physical and chemical tests
7. To record its melting point/boiling point.
8. To prepare suitable derivative for that compound and to characterize it.

### At the end of the course, students will be able to:

1. Understand the importance of instrumental methods for quantitative applications
2. Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples
3. Understand how functional groups in an compound is responsible for its characteristic property
4. Learn the importance of qualitative tests in identifying functional groups.
5. Learn how to prepare a derivative for particular functional groups and how to purify it

## DSC: Analytical and Organic Chemistry PRACTICALS

### List of Experiments

Sl No	Name of the Experiment	Time, hrs
<b>PART-A (Analytical Chemistry)</b>		
1	Colorimetric determination of copper using ammonia solution	2
2	Colorimetric determination of iron using thiocyanate solution	2
3	Colorimetric determination of nickel using DMG solution	4
4	Colorimetric determination of titanium using hydrogen peroxide	4
5	Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent)	4
6	Colorimetric determination of phosphate as ammonium phosphomolybdate	4
7	Determination of R <sub>f</sub> values of two or three component systems by TLC	2
8	Separation of different metal ions by paper chromatography/ Solvent extraction of iron using oxine solution (demonstration)	4
<b>PART-B (Organic Chemistry)</b>		
Qualitative analysis of bifunctional Organic compounds such as		
1	Salicylic acid ,p-Nitro benzoic acid,Antranilicacid,p-Chloro benzoic acid	8

2	o-Cresol,p-Cresol,Resorcinol,oNitrophenol,p-nitophenol	8
3	o-Nitro aniline, p-Nitroaniline, p-Toluidine, p- Chloroaniline, p-Bromoaniline,	8
4	Ethyl Salicylate, Salicylaldehyde, Actophenone, p-Dichlorobenzene, p-Nitro toluene, Benzamide etc.	8
<p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. 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</li> <li>2. Vogel's Textbook of Practical Organic Chemistry, Including Qualitative Organic analysis, A.I Vogel and B.S. Furniss, Longman Publishers, 1978</li> </ol>		

Date

Course Coordinator

Subject Committee Chairperson

### OEC 3: Agro Chemistry

<b>Course Title:</b> Agro Chemistry	<b>Course code:</b> 21BSC303CH3
<b>Total Contact Hours:</b> 42	<b>Course Credits:</b> 3
<b>Internal Assessment Marks:</b> 40	<b>Duration of SEE:</b> 3 hrs
<b>Semester End Examination Marks:</b> 60	

**Course Outcomes (COs):**

1. Gain knowledge on the composition and importance of fertilizers, pesticides for agriculture
2. Understand the importance of usage of organic farming and vermicompost
3. Able to recognize the importance of nutritious food

### OEC 3: Agro Chemistry

Unit	Description	Hours
1	<b>Soil fertility</b> Micronutrients and macronutrients in soil, Importance of Nutrients for plants Different nutrients for different crops Analysis and required amounts of micronutrients: nitrogen, potassium, phosphorus. Nitrogen fixation and Leguminous plants Crop rotation and multi crops- Importance and advantages	10 hrs
2	<b>Fertilizers;</b> Different types, Composition and applications, Effects of excess use of fertilizers, pollution by fertilizers Bio-based fertilizers/manures and advantages Preparation of organic manure and organic farming Vermicompost- applications and applications Case studies of excess usage of fertilizers and its side-effects	10 hrs
3	<b>Insecticides:</b> Composition and applications, side effects <b>Pesticides:</b> Composition and applications, side effects <b>Weedicides:</b> Composition and applications, side effects <b>Preservative chemicals:</b> Composition and side effects Case studies of side effects and pollutions of above chemicals	8 hrs
4	<b>Chemicals used for Ripening:</b> Composition, uses and side effects <b>Food adulteratives and contaminants:</b> Difference and side effects with examples Milk, butter, oils, etc, measurement and consumer laws against adulteration <b>Rancidity of oil-</b> Definition, toxic effect	8 hrs
5	<b>Nutritious food and diet:</b> Constituents of nutritious food-Importance and function of each component- Vitamins, proteins, carbohydrates, minerals, fats and water. Examples of food items containing nutritious components Comparison of nutritious food and balanced food Side effects/diseases of deficiency of nutritious components Malnutrition-Reasons and measures to overcome	8 hrs