

Course Content

Introduction:

1. Course Introduction: (Dr. U.V.R. VIJAYASARATHI, Scientist-F)
Following the official inauguration of the course, the course coordinator will present the primary content, outlining detailed plans for various lectures and practical training, which will encompass synthesis, characterization, and sample analysis.

Technical Sessions-1 – Organic Synthesis and Characterization (Three Weeks)

2. Overview of Organic Synthesis: (Dr. D. Srinivasa Reddy, Director, CSIR-IICT/ Dr. A. Manjula, Scientist-G/ Dr. K. Srinivas, Scientist-G)

A comprehensive introduction to the synthesis of organic compounds, advanced synthetic techniques, and the essential requirements for performing effective synthesis in chemical laboratories.
3. Organic Synthesis Protocols, Laboratory Requirements, and Safety: (Dr. G V Karunakar, Scientist-F)

An introduction to the procedures of organic synthesis, necessary glassware, and laboratory requirements for effective synthesis; an overview of the safety protocols to be adhered to during synthesis, along with the use of safety equipment.
4. Organic Reactions and Named Reactions: (Dr. Rajesh Chandra)

Introduction on various commonly used named reactions in organic synthesis, along with an introduction to the synthesis of hazardous chemicals.
5. Synthesis of Organophosphorus, Sulfur, Nitrogen, and Arsenic Compounds: (Dr. A. Manjula/ Dr. K. Srinivas, Scientist-G)

Procedures for synthesizing various organophosphorus pesticides and related toxic substances, as well as organo-sulfur, nitrogen-based chemicals, and organo-arsenic compounds.
6. Introduction to Microsynthesis and Combinatorial Chemistry: (Dr. P. Nagender/ Dr. Ravitej Singh)

Demonstration of microsynthesis protocols for the synthesis of chemicals at very low levels, along with the combinatorial approach for synthesizing a series of chemicals.
7. Practical Demonstration of Organic Molecule Synthesis: (Scientists from FAC Group).

8. Analytical Techniques for the Characterization of organic molecules: (Dr. T. Jagadeswar Reddy, Scientist-F)

Common Analytical Techniques that are generally used for the characterization of organic molecules will be introduced

9. Introduction to Chromatography – Theory (Dr. U.V.R. Vijayasarithi, Scientist-F)
10. Introduction to Nuclear Magnetic Resonance Spectroscopy (Dr. A.V.S. Sarma, Scientist-G)
11. Introduction to Two-Dimensional NMR techniques (Dr. G. Jithender Reddy, Scientist-E)
12. Introduction to Hetero-nuclear NMR and their applications (Dr. A. Ravi Sankar, Scientist-G)
13. Introduction to Mass Spectrometry, theory, tandem mass Spectrometry, high resolution mass spectrometry, and structural interpretation: (Dr. T. Jagadeswar Reddy, Scientist-G)
14. Gas chromatography and Gas Chromatography – Mass Spectrometry, and characterization of analytes using GC and GC-MS techniques: (Dr. Debasish Swain, Scientist - D)
15. Introduction to Liquid Chromatography, Detection techniques, and Preparative Liquid Chromatography for isolation of pure chemicals: (Dr. Karthika Anoop, Scientist - C)
16. Introduction to Liquid Chromatography – Mass Spectrometry, ionization techniques, and application to the characterization of organic molecules: (Dr. Nagaraju Rajana, Scientist-C)
17. Introduction and application of ion chromatography and Inductively coupled plasma Mass Spectrometry and their applications (Dr. Alegete Pallavi, Scientist-D)
18. Introduction to UV-VIS and FT-IR techniques and application to the characterization of organic molecules: (Dr. Prakriti Ranjan Bangal, Scientist-F)
19. Introduction to X-ray diffraction techniques and its application to characterization of organic molecules (Dr. B. Sridhar, Scientist-G)

20. Practical demonstration of Analytical Techniques:

NMR – Dr. Rama Krishna and Dr. Rekha

Mass – Mr. G. Sai Krishna, Ms. Santwana Dhongade, and Dr. V.V.S. Lakshmi

FTIR – Mr. Shamnad

HPLC – Ms. N. Manjula & Dr. G.N.V. Satyanarayana

IC & ICP-MS – Dr. A. Pallavi

Technical Sessions – 2: Trace level analysis of Toxic Chemicals (Three Weeks)

21. Introduction to toxic chemicals (Dr. U.V.R. Vijayasarithi)

A formal introduction to various classes of toxic chemicals and their classification,

22. Nomenclature of various classes of toxic chemicals (Dr. T. Jagadeswar Reddy)

Degradation products/Reaction products and Contamination products of toxic chemicals and Challenges in toxic chemical analysis

23. Use of Gas Chromatographic techniques for selective identification of toxic chemicals (Dr. U.V.R. Vijayasarithi)

Introduction of Gas Chromatography, its validation, use of element specific detectors for identification of various toxic chemicals present in the environmental, food, and biological samples

24. Gas Chromatography – Mass Spectrometry for the identification of toxic chemicals: (Dr. T. Jagadeswar Reddy)

Detailed introduction of GC-MS along with various ionization mechanisms, their role in detection and identification of toxic chemicals, the use of standard NIST, and other databases for identification of chemicals, AMDIS software for rapid identification of toxic chemicals.

25. Sample preparation techniques for the analysis of toxic chemicals in environmental, food, and biological Samples: (Dr. U.V.R. Vijayasarithi)

The sample preparation protocols involved in preparation of the samples under various scenarios, extraction procedures for the isolation of toxic chemicals present in the samples, clean-up methods and preparation of the samples for GC-MS and LC-MS analysis.

26. Derivatization methods for the analysis of polar organic molecules using GC-MS
(Dr. T. Jagadeswar Reddy)
27. LC-MS/MS and LC-HRMS/MS techniques for the trace level detection of toxic chemicals: (Dr. U.V.R. Vijayasarithi)
28. Practical hands-on training on the extraction and analysis of chemicals: (Dr. V.V.S. Lakshmi & Team)
29. Introduction to ISO IEC 17025:2017 requirements for testing laboratories: (Dr. U.V.R. Vijayasarithi)
30. Data mining, identification of chemicals using AMDIS database, and reporting according to the standard protocols: (Dr. T. Jagadeswar Reddy)