Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-2(M.SC.IC.)

**Subject**: Analytical Chemistry-MSCIN12511

**Type of course:** Minor

**Prerequisite:** Students should have a basic knowledge of Analytical Chemistry.

**Rationale**: The Prerequisite provides the foundation for understanding the concepts and principles of spectroscopic techniques.

## Teaching and Examination Scheme:

| Teaching Scheme | | | Credits | Examination Marks | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | CA | |
| CI | T | P | C | ESE | MSE | V | P | ALA | |
| 3 | 0 | 0 | 3 | 60 | 30 | 10 | 00 | 50 | 150 |

*Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.*

## Course Content:

| Unit No. | Course content | Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to spectroscopic techniques**<br>Introduction of instrumental methods and their classification, an overview of spectroscopic methods based on wavelength regions of electromagnetic radiation, and properties of electromagnetic radiation.<br>**UV Spectroscopy**<br>Introduction, theory of ultra violate spectra, instrumentation, type of transition inorganic molecules; auxochrome, chromophore; explanation of bathochromic shift and hypsochromic shift, hyperchromic effects, types of bands, the effect of solvent, application of UV spectra. Calculation of λ-max (1) dienes and conjugated dienes (2) enones and dienones (ie.unsaturated carbonyl compounds) (3) aromatic carbonyl system. | 15 | 30 |

| | | | |
|---|---|---|---|
| 2 | **Mass Spectroscopy**<br>Introduction, principle, theory and components of mass spectrometers, different ionization and detection techniques, recording and resolution of mass spectrometer, types of ions produced in mass spectrometer, interpretation of mass spectra of selected compounds /API, Applications of Mass spectrometry, Introduction to ICPMS. | 15 | 30 |
| 3 | **Nuclear Magnetic Resonance**<br>Introduction, NMR active nuclei, Basic Theory, NMR Spectrometer, internal Standard & solvent.<br>**$^1$H NMR:** Principle, Chemical shift, Magnetic anisotropy, spin-spin coupling (multiplicity), applications.<br>**$^{13}$C NMR**: Introduction, Principle, chemical shift, application and problems<br>**2D NMR:** Application of COSY, NOESY, HSQC,HMBC<br>**Infrared Spectroscopy:** Introduction to IR and FTIR, principle & theory of Infrared absorption spectrometry, infrared sources and transducers, sample handling, instrumentation, interpretation of IR spectra, applications, and limitations of IR spectroscopy. | 15 | 40 |
| | | **45** | **100** |

## Continuous Assessment:

| Sr. No | Active Learning Activities | Marks |
|---|---|---|
| 1. | **Real-life Applications Research**<br>Faculty will assign students a research project where they investigate real-life applications of UV spectroscopy. Students can prepare report and upload it on GMIU web portal. | 10 |
| 2. | **Molecular Identification Challenge**<br>Faculty provides students with a set of unknown compounds and their IR and mass spectra. Students will identify the functional groups in the IR spectra and determining the molecular formula from the mass spectra. Upload it on GMIU web portal. | 10 |
| 3. | **Structural Elucidation Game**<br>Faculty will provide partial information about a compound (e.g., molecular formula, mass spectra) and must use NMR spectra to propose the structure. Find out the structure and upload it on the GMIU web portal. | 10 |
| 4. | **Mystery Chromatogram Challenge**<br>Faculty will provide "mystery" chromatograms to students where the compounds and conditions are unknown. Students must use their knowledge | 10 |

| | | |
|---|---|---|
| | of chromatography principles to deduce information about the compounds and separation conditions. Find out the sample and upload it on GMIU web portal. | |
| 5. | **Product Label Investigation**<br>Ask students to bring in product labels from common household items such as cleaning products, personal care items, or packaged foods. They will analyze the chemical ingredients listed on the labels and discuss their potential uses and applications and will upload the same on GMIU web portal. | 10 |
| | **Total** | **50** |

## Suggested Specification table with Marks (Theory):60

| Distribution of Theory Marks (Revised Bloom's Taxonomy) | | | | | | |
|---|---|---|---|---|---|---|
| Level | Remembrance (R) | Understanding (U) | Application (A) | Analyze (N) | Evaluate (E) | Create (C) |
| Weightage | 30% | 30% | 20% | 20% | 00 | 00 |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## Course Outcome:

| After learning the course the students should be able to: | |
|---|---|
| CO1 | Illustrate the properties and application of spectroscopy. |
| CO2 | Define the concepts related to infrared and mass spectroscopy. |
| CO3 | Summarize about NMR and its application. |
| CO4 | Revise the study of chromatographic techniques. |

## Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory
The internal evaluation will be done on the basis of Active Learning Assignment
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

## Reference Books:

[1] Elementary Organic Spectroscopy; Principles And Chemical Applications Y.R. Sharma.

[2] Symmetry and Spectroscopy: An Introduction to Vibrational and Electronic Spectroscopy Daniel C. Harris.

[3] Instrumental Methods of Chemical Analysis B.K. Sharma.

[4] Elementary Organic Spectroscopy Book By Y.R. Sharma.