

CONTENTS FOR CM3011

Academic Year	AY2023/2024	Semester	1 and 2
Course Coordinator	See Han Sen, Tan Choon Hong		
Course Code	CM3011		
Course Title	Chemical Spectroscopy and Applications		
Pre-requisites	CM2021 and CM2031 or by permission		
No of AUs	3		
Contact Hours	Lectures: 39 hours (3 hours per week)		
Proposal Date	24 April 2023		

Course Aims

This course aims to introduce the principles and applications of chemical spectroscopic methods, including mass spectrometry (MS), nuclear magnetic resonance (NMR) spectroscopy, infrared (IR) spectroscopy, Raman spectroscopy, UV-visible-NIR spectroscopy, photoluminescence spectroscopy, X-ray photoelectron spectroscopy, and X-ray absorption spectroscopy as invaluable tools for the structural identification and determination of organic and inorganic compounds as well as for the study of their electronic properties, stabilities and dynamic behaviors at the molecular level. You will learn about the basic principles and techniques of these spectroscopic methods and their applications in the context of organic and inorganic chemistry. Specifically, you will develop the ability to interpret spectra for given molecules, relate their spectral behavior to chemical phenomena/concepts, and to deduce the molecular structure of unknown from given spectra.

Intended Learning Outcomes (ILO)

Upon successful completion of this course, you should be able to:

1. Identify the symmetry elements and symmetry operations on molecules.
2. Use group theory to work out the point groups of molecules and generate the irreducible representations of normal vibrational modes.
3. Employ group theory to predict the expected number and symmetry of IR- and Raman-active vibrational modes.
4. Use basic quantum mechanics to explain the selection rules of electronic transitions.
5. Explain the basic principles of infrared (IR) spectroscopy and characteristic functional groups studied by this method.
6. Analyze IR spectra of organic molecules. Specifically, identify the presence (and absence) of characteristic functional groups in the molecule through spectral analysis.
7. Draw and interpret Jablonski diagrams.
8. Apply the Tanabe-Sugano diagrams to predict the expected number of UV-vis-NIR absorption bands for octahedral complexes.
9. Use the Beer-Lambert law to predict intensities of UV-vis-NIR absorption bands.
10. Explain the nature of fluorescence and phosphorescence.
11. Identify the common forms of electronic transitions.
12. Apply UV-vis-NIR spectroscopy for diagnostic characterisation.
13. Employ UV-vis-NIR spectroscopy in catalysis and kinetics.
14. Use photoluminescence spectroscopy to detect intermediates.

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M Tight



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