



**Lead City University, Ibadan**  
**Faculty of Sciences**  
**Department of Biochemistry**

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**COURSE PARTICULARS**

Course Title: Instrumental methods of analysis  
Course code: CHM 312  
No. of Units: 2  
Status: Compulsory

**LECTURER DETAILS**

Name: Mrs. Oni O.S.  
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Area of Specialization: Analytical/Industrial chemistry

Name: Dr. A. Oladimeji  
Qualifications:  
Phone:  
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Area of Specialization:

**COURSE DESCRIPTION**

- Introduction to electromagnetic radiation
- Spectroscopic techniques
- Quantitative analysis
- Nuclear Magnetic resonance
- Fluorescence
- Polarimetry
- Polarography

**COURSE OBJECTIVES**

- To understand the theory of each instrument technique
- To have an understanding of how the instrument works.

**ASSESSMENT**

Class Attendance	5marks
Test(s) and Assignments	25marks
Final Examination	70marks

## LECTURE PLAN

Week	Topic
1	Introduction to electromagnetic radiation and course content
2	Quantitative analysis
3 – 5	Spectroscopic techniques ( UV,AAS)
6 – 7	Nuclear Magnetic resonance
8 – 9	Emission spectroscopy
10	Fluorescence
11 – 12	Polarimetry& Polarography

## READING LIST

1. Holler, J. F and Grouch S. Fundamentals of Analytical Chemistry 9<sup>th</sup>edition(2013).
  - a. Skoog and West.
2. Christian G, Analytical Chemistry 6<sup>th</sup> edition ( 2004) Wiley International edition.

## TUTORIAL QUESTIONS

1. What is the difference between fluorescence and phosphorescence?
  - b. By how many kilojoules per mole is the energy of increased when it absorbs ultraviolet radiation with a wavelength of 147 nm?
  - c. How much is the energy of increased when it absorbs infrared radiation with a wavenumber of  $2300\text{ cm}^{-1}$ ?
2. Pure hexane has negligible ultraviolet absorbance above a wavelength of 200 nm. A solution prepared by dissolving 25.8 mg of benzene in hexane and diluting to 250.0 mL had an absorption peak at 256 nm and an absorbance of 0.266 in a 1.000-cm cell. Find the molar absorptivity of benzene at this wavelength.
  - b. Explain the difference between transmittance, absorbance, and molar absorptivity Which one is proportional to concentration?
3. Draw and explain a flow scheme of the fluorescence Spectrometer.
  - b. A sample of hexane contaminated with benzene had an absorbance of 0.070 at 256 nm in a cuvet with a 5.000-cm pathlength. Find the concentration of benzene in mg/L.
4. A  $3.96 \times 10^{-4}$  solution of compound A exhibited an absorbance of 0.624 at 238 nm in a 1.000-cm cuvet; a blank solution containing only solvent had an absorbance of 0.029 at the same wavelength. Find the molar absorptivity of compound.
  - b. What is the difference between luminescence and chemiluminescence?

5. What is the difference between a fluorescence excitation spectrum and a fluorescence emission spectrum? Which one resembles an absorption spectrum?
- b. A  $5.00 \times 10^{-4}$  M solution of an analyte is placed in a sample cell that has a pathlength of 1.00 cm. When measured at a wavelength of 490 nm, the absorbance of the solution is found to be 0.338. What is the analyte's molar absorptivity at this wavelength.
6. The transmittance of a solution is found to be 85.0% when measured in a cell whose pathlength is 1.00 cm. What is the percent transmittance if the pathlength is increased to 10 cm.
- b. What is an absorption spectrum?
- c. The IR spectrum is split into regions. What are these regions and what part do they play in the reading of the spectrum.
7. The accuracy of a spectrophotometer can be evaluated by preparing a solution of 60.06-ppm  $K_2Cr_2O_7$  in 0.0050 M  $H_2SO_4$  and measuring its absorbance at a wavelength of 350 nm using a cell with a pathlength of 1.00 cm. The absorbance should be 0.640. What is the molar absorptivity of  $K_2Cr_2O_7$  at this wavelength?
- b. What are the limits to Beer and Lamberts Law.
8. What is the main advantage of fluorescence over other absorption measurements
- a. b.State the principles underlying the following spectroscopic methods.
- Refractometry
  - Polarimetry
  - NMR
9. A  $7.25 \times 10^{-5}$  M solution of potassium permanganate has a transmittance of 44.1% when measured in a 2.10-cm cell at a wavelength of 525 nm. Calculate the absorbance of this solution and the molar absorptivity of  $KMnO_4$ .
- b.Discuss extensively on the instrumentation of Atomic Absorption Spectroscopy.
10. Elaborate on the electronic transition of element in Ultra Violet and Visible radiation.
- b. Differentiate an atomic emission spectrophotometer from an absorption emission spectrophotometer.