

2.12 COURSE OUTLINE

2.12.1 PHM 3402: INSTRUMENTAL METHODS OF ANALYSIS

Pre-requisites: CHE 2302; CHE 2303; PHY 2333

Credit Units: 3

2.12.2 Purpose of the course;

This course introduces the student to basic laboratory techniques in analytical chemistry and spectroscopy. It reviews some theory learnt in **CHE 2302**, but covers mostly instrumentation and application of modern instruments in chemical procedures.

2.12.3 Expected Learning Outcomes of the Course;

At the end of the course, the student should be able to:

- Describe the principles of spectroscopic methods and their instrumentation,
- Explain solutions conductivity, fundamentals of conductometric analysis,
- Describe the main methods of electrochemical analysis, their classification and instrumentation,
- Describe potentiometric analysis, instrumentation and electrode types,
- Describe and classify amperometric methods and explain their fundamentals,
- Explain the principles of coulometric and electrogravimetric analysis.

2.12.4 Course Content;

Spectroscopy: Principles, Instrumentation and Applications. Vibrational and Electronic. Theory of Electronic spectroscopy, Frank Condon principle. **UV-Vis and IR Spectroscopy:** Photometric Titrations, Spectrophotometric Kinetic methods, Nephelometry and Turbidimetry; Fluorescence and Phosphorescence; IR spectrophotometry; X- Ray Diffraction, Bravais lattices and Miller indices. Fundamentals of Electron and Neutron diffraction and structure determination. **Nuclear Magnetic Resonance;** Electron Paramagnetic Resonance; **Mass spectroscopy;** Mossbauer and Photo-Electron spectroscopy. Detectors.

Electroanalytical methods: Principles, Classification, Instrumentation and Applications; Amperometry, Bulk electrolysis, Chronoamperometry, Coulometry, Electrogravimetry, Hydrodynamic technique, Polarography, Potentiometry. **Instrumentation:** Electrodes, Electrolytic cells, pH meter, Reference electrodes, Voltmeter, Working electrode.

2.12.5 Mode of Delivery;

Lectures, power point presentations, and class discussions. These will take a participatory approach. **Laboratory learning and Experiments:** The lecturer, together with the laboratory technical staff, will take the students through practical sessions, beginning with **demonstrations**. The students will thereafter be expected to use pre formulated laboratory manuals to carry out various practical exercises then write out their findings in their laboratory workbooks. **Video demonstrations and/or CD-Roms** on Instrumental Methods of Analysis when available, after the relevant topic has been

covered. **Assignment criteria:** Students will be given several individual or group research assignments on topics relevant to the course. These could include lectures, discovery learning, problem-based learning, experimental learning, group-based learning, independent studies and e-learning.

2.12.6 Instructional Materials and/or Equipment;

Lecture notes or power points for presentation; Tutorials; Video demonstrations; CD-Roms; Text books; Laboratory demonstrations; analytical equipment and apparatus; Standard Operating Procedures for each equipment; chemical charts and atlases. Laboratory Manual.

2.12.7 Course Assessment;

2.12.7.1 Distribution of Marks

Attendance & Participation	5%
Continuous Assessment Tests /Quizzes	5%
Term Paper	10%
Oral examination	10%
Mid-Quarter Exam	15%
Final Exam	25%
Laboratory exercises	30%
Total	<u>100%</u>

2.12.7.2 Grading

90 - 100	A
87 - 89	A ⁻
84 - 86	B ⁺
80 - 83	B
77 - 79	B ⁻
74 - 76	C ⁺
70 - 73	C
67 - 69	C ⁻
64 - 66	D ⁺
62 - 63	D
60 - 61	D ⁻
00 - 59	F

2.12.8 Core Reading Materials for the Course;

Bard, A. J. (2011). *Electrochemical Methods: Fundamentals and Applications*. 2nd Edition. Wiley Science, Hoboken, NJ, USA

Skoog, D. A., Holler, F. J., Crouch, S. R. (2013). *Principles of Instrumental Analysis*. 9th Edition. Brooks/Cole, Belmont, CA

2.12.9 Recommended Reference Materials;

Hage, D. S., Carr, J. R. (2010). *Analytical Chemistry and Quantitative Analysis: international edition*. 1st Edition. Pearson Education, Upper Saddle River, New Jersey, USA

Katz, E. (2009). *Quantitative Analysis Using Chromatographic Techniques*. 2nd Edition. CBS Publishers & Distributors, New Delhi, India

Lambert, L., Gronert, S., Shurvell, H., Lightner, D., Cooks, R. G. (2010). *Organic Structural Spectroscopy: International Edition*. 2nd Edition. Pearson Higher Ed., USA

Mohrig, J. R., Hammond, C. N., Schatz, P. F. (2010). *Techniques in Organic Chemistry*. 3rd Edition. W. H. Freeman, New York

Scholz, F. (Ed. 2010). *Electroanalytical Methods: Guide to Experiments and Applications*. 2nd Edition. Springer, Berlin, Germany