UNIVERSITA' DEGLI STUDI DI CATANIA

DOTTORATO DI RICERCA IN SCIENZA DEI MATERIALI E NANOTECNOLOGIE

COURSE DESCRIPTION

Name	Electrochemical Sensing and Quality by Design for Advanced Materials
Teacher(s)	Luigi Falciola
Email	luigi.falciola@unimi.it
CFU* (lecture+lab [h])	2 (12+0)
Assessment **	Students will prepare a written report on an international scientific publication chosen from a list provided by the teacher. The report should provide a critical discussion of the paper and evaluate the relevance and potential application of the concepts, methodologies, and techniques presented in the publication and covered during the course to the student's own PhD research activities.

* 1 CFU = 6 h lectures OR 12 h in lab OR a combination (3h lectures+6h lab, or 4+4, or 2+8, …)

** it must be within the course duration. Please, indicate: written, oral, by slide presentation.

PROGRAM

This course will provide students with advanced knowledge and practical skills in electrochemical, electroanalytical, and sensor-based techniques, as well as the related instrumentation and procedures commonly employed in research laboratories in the fields of chemistry, physics, and materials science, and in analytical, quality control, and materials characterization laboratories. Particular emphasis will be placed on the theoretical and practical foundations of conductometric, potentiometric, and voltammetric methodologies. Students will also develop expertise in the design and optimization of experimental methodologies through the application of Design of Experiments (DoE) approaches within the Quality by Design (QbD) framework for a wide range of scientific and technological applications.

Expected Learning Outcomes

- Demonstrate comprehensive and advanced knowledge of the principles, methodologies, instrumentation, and applications of electrochemical, electroanalytical, and sensor technologies.
- Critically understand the operating principles, performance characteristics, and practical use of advanced electrochemical and electroanalytical instrumentation employed in materials analysis, characterization, and quality control laboratories.
- Select and apply appropriate electrochemical and sensor-based techniques to solve analytical and materials science problems.
- Design, optimize, and validate experimental protocols using Design of Experiments (DoE) methodologies within a Quality by Design (QbD) approach.
- Analyze, interpret, and critically evaluate experimental data obtained from electrochemical and electroanalytical measurements.

REFERENCES

- C.M.A. Brett; A.M. Oliveira Brett , "Electrochemistry" - Oxford University Press
- A.J. Bard, L. Faulkner, "Electrochemical Methods" – Wiley-VCH
- R.G. Compton; C.E. Banks, "Understanding Voltammetry" - World Scientific
- F. Scholz – casa editrice Springer: Electroanalytical Methods
- P.M.S. Monk – casa editrice Wiley-VCH: Fundamentals of Electroanalytical Chemistry
- V. Mirceski, S. Komorsky-Lovric, M. Lovric, "Square-Wave voltammetry" – Springer
- F.G. Banica, "Chemical Sensors and Biosensors", Wiley
- J.N. Miller, J.C. Miller; Statistics and Chemometrics for Analytical Chemistry (Pearson – Prentice Hall)
- Phil Kay, Smarter experimentation for chemists, Chemistry World Webinars, RSC
- G. Marrubini, C. Melzi; Trattamento dei dati e progettazione degli esperimenti per le scienze chimiche e farmaceutiche (Mc Graw Hill)

TENTATIVE SCHEDULE

End of January / February; Four 3-hours-lessons in two/three consecutive days