

## CHE-815 Nano Catalysis

**Credit Hours:** 3

**Pre-requisites:** Nil

**Course Objectives:**

- Know the fundamental concepts related to catalysis.
- Interpret different phenomena related to catalysts; activation and deactivation processes.
- Be able to propose appropriate active phases to carry out different catalytic reactions.
- Know the different synthesis methods as a function of the catalyst to be prepared.
- Identify the characterization techniques appropriate to be used in solving a specific problem.
- Interpret the information obtained from the application of different characterization techniques and relate it with the behavior of the catalysts

**Course Contents:**

**Introduction:**

Concepts in catalysis, Classification of catalysts, Approach to nano-catalysis from molecular and nanostructured systems.

**Surface of solids:**

Adsorption processes, Elemental steps of the catalytic reactions

**Catalysts:**

Theory in catalysis, Components, Active phase, support, promoter Activation and deactivation processes, Catalytic differential phenomena associated to the nanostructure

**Preparation of catalysts:**

Use of molecular precursors in the preparation of catalysts and supported nanoparticles, Impregnation and precipitation methods, Preparation of nanoparticles by electron beam lithography, Other methods of preparation of nanostructured catalysts.

**Characterization of catalysts:**

Chemisorption methods, Temperature Programmed processes, Transmission electron microscopy (TEM), FTIR and Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Catalytic reactions as a characterization tool. Other techniques of characterization.

**Model catalysts:**

Nano-catalysis for oxidation, hydrogenation, and other related reactions. Nano-catalysis for various organic transformations in fine chemical synthesis.

Nano-catalysis for carbon-carbon and carbon-heteroatom coupling reactions

Nanomaterial-based photo catalysis and biocatalysts.

Nano-catalysts and nano-biocatalysts in the chemical industry. Nano-catalysts to produce non-conventional energy such as hydrogen and biofuels.

**Recommended Reading (including Textbooks and Reference books)**

- Nanocatalysis: Synthesis and Applications, Vivek Polshettiwar (Editor), Tewodros Asefa (Editor), Graham Hutchings (Foreword by) ISBN: 978-1-118-14886-0, Hardcover, 736 pages, November 2013.
- Nanocatalysis 2006, H.Heiz, U.Landman, Springer Wiley, 2007.
- Complementary: Spectroscopy in catalysis, J. W. Niemantsverdriet, Wiley-VCH, (2000)