Module title: **Nanomaterial 1**

Module Code: 241270701

Module Credit: 3

Term: First term 99-00

Lecturer: Prof. A. Samimi
a.samimi@eng.usb.ac.ir

Lecturing time: Saturday (9:30-11:30), Tuesday (7:30-9:30)

Objectives of the module:

The main aims of the module, in the first part, are to generally introduce the characteristics of a nanomaterial and their behavior in dry and colloidal forms. The mechanisms regarding transport of nanomaterial including: Brownian motion, thermal diffusion, electro-osmosis, and electrophoresis phenomena are discussed which the two latter mechanisms are related to the surface electrostatic charge and electric double layer covering nanoparticles, as well as the zeta potential. The stability and dispersion of nanoparticles in colloidal form and their stabilizing methods are also described as two main topics which are related to nanoparticle's surface charge. The synthesize of nanomaterials and methods of fabricating including top-down and bottom-up are generally presented at the second part of the module. The nanomaterials application in nanofilter fabrication, fuel cells, nanocatalysts, and photocatalysts are discussed in this section. In the third part of the module, important nano-systems including zeolite, carbon based, and composite nanomaterials are conferred as shown below in subjective details.

First part: General aspects (weeks 1-5)

1- *Introduction to Nanotechnology (history of Nanotechnology)*
2- *Characteristics of nanomaterials, and their physical and chemical properties*
3- *Behavior of nanomaterials in dry and colloidal forms, including: Brownian motion, surface forces including electric double layer, Van der Waals, steric and bridging forces, zeta potential*
4- *Rheology of colloidal nanoparticles in colloidal forms*
5- *Transport phenomena regarding nanoparticles in colloidal forms (i.e. electro-osmosis, electrophoresis)*

Second part: Synthesis methods of nanomaterials (weeks 6-12)

1- *Methods of fabrication of nanomaterials (i.e. top-down and bottom-up methods)*
2- *Particle nucleation and growth and growth kinetics (i.e. diffusion-limited growth, Ostwald ripening)*
3- *Nanomaterials applications including; nanofilter fabrication, fuel cells, nanocatalysts, and nanomaterials application as photocatalysts*

Third Part: Important Nanomaterials (weeks 13-15)

1- *Zeolites as micro- or meso-pore porous material (e.g. zeolites).*
2- *Carbon-based nanomaterials including: Carbon nanotubes, Graphenes, and Fulerrenes*
3- *Polymeric and ceramic nanocomposites*

Seminar presentations by students (week 16)

Assessments:

- *60% final exam*
- *25% preparation of a seminar report*
- *15% power point presentation*

References:

- *Nanomaterial Characterization: An introduction, Ratna Tantra, Wiley, 2016*
- *Nanotechnology: An introduction, Jeremy Ramsden, Elsevier, 2011*
- *All hand over papers*
- *نانو کاتالیست، دکتر مسعود صلواتي نیسریا، دکتر مسعود همدانیان، ۱۳۸۸ ، انتشارات علم و دانش.*
- *فناوری‌های ذرات جامد (جلد اول) خواص ذرات جامد، عبدالرضا صمیمی*