**Department of Chemistry Syllabus**

This syllabi is advisory only. For details on a particular instructor's syllabus (including books), consult the instructor's course page. For a list of what courses are being taught each quarter, refer to the Courses page. *Every instructor has prerogative to teach the course as they see fit and ultimately the instructor's syllabus supersedes all others.*

***CHE 222: CHEMISTRY OF NANOPARTICLES (graduate level)***

Approved:

Suggested Textbook: (actual textbook varies by instructor; check your instructor)

Guozhong Cao, Nanostructures & nanomaterials: synthesis, properties & applications, Imperial College Press, London, 2004, paperback, ISBN010: 1860944809, $48.60

Suggested Schedule:

1. Introduction to Nanotechnology

Emergence of Nanotechnology

Bottom-up and Top-Down Approaches

Relation to Colloid Science

2. Physical Chemistry of Solid Surfaces

Surface Energy

Electrostatic Forces

Van Der Waals Forces

DLVO Theory

Colloids: Electrostatic and Steric Stabilization

3. Zero-Dimensional Nanostructures Nanoparticles)

Synthesis via Homogeneous Nucleation

Metallic Nanoparticles

Semiconductor Nanoparticles

Metal Oxide Nanoparticles

Synthesis via Heterogeneous Nucleation

Kinetically Confined Syntheses

4. One-Dimensional Nanostructures

Spontaneous Growth

Template Based Syntheses

5. Two-Dimensional Nanostructures

Thin Films

Self-Assembled Monolayers

Nanosheets

6. Special Nanomaterials

Fullerenes and Carbon Nanotubes

Molecular Clusters

Association Colloids

Viruses

Micro- and Mesoporous Materials

7. Nanostructures Fabricated through Physical Techniques

Photolithography

Probe Microscopy

Soft Lithography

8. Characterization of Nanomaterials

X-ray Diffraction and Small Angle X-ray Scattering

Electron Microscopy

Scanning Probe Microscopy

Dynamic Light Scattering

9. Physical Properties of Nanomaterials

Melting Points

Mechanical Properties

Optical Properties

Quantum Size Effects

Electrical Properties

Coulomb Staircase Behavior

Single Electron Tunneling Magnetic Properties

Catalytic Properties

10. Chemical Manipulation of Nanoparticles

Ligand Exchange

Aggregation and Assembly

Size-Selective Precipitation

Critical Coagulation Concentration

Dialysis

11. Applications of Nanomaterials Nanoelectronics

Field Effect Transistor (FET)

Chemical Sensors

Biological Probes

Catalysis

Nanomechanics

Carbon Nanotube Emitters

Band Gap Engineered Quantum

Devices

Photoelectrochemical Cells

Photonic Crystals and

Waveguides

Magnetothermal Therapy

Additional Notes: Evaluation consists of an in-class presentation and one written proposal on approved research or teaching topic. The proposal counts 60% and the presentation counts 40% towards grade.

Learning Goals:

CHE222 is an introduction to the chemistry, preparation, structure and physical properties of inorganic nanoparticles. Students will learn about methods to synthesize inorganic nanoparticles, and learn to evaluate particle size and shape distributions. They will be introduced to concepts that will allow them to predict the stability of nanoparticles in solution, and to understand the nucleation and growth of nanoparticles. They will learn to analyze the size-dependent physical properties of nanoparticles, and they will be made familiar with different techniques (electron microscopy, X-ray diffraction) to study nanoparticles. Applications of nanoparticles will also be discussed. It is expected that students enrolled in this class have a basic understanding of physical chemistry.