**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.