MSE 4330: Fundamentals of Nanomaterials and Nanostructures

Credit hours and contact hours: 3-0-0-3

Instructor: Dong Qin

Textbook: Geoffrey Ozin, *Nanochemistry*, Royal Chemistry, 2nd Edition, 2009.

Guozhang Cao, Ying Wang, *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*, World Scientific, 2nd Edition, 2010.

Felice Frankel, George Whitesides, *No Small Matter: Science on the Nanoscale*, Belknap Press, 1st Edition, 2009.

Masaru Kano, *Introductory Nanoscience*, Garland Science, 1st Edition, 2012.

Specific course information

Catalog description: Introduction to nanotechnology. Description of various nanomaterials, their applications and synthesis methods.

Prerequisites: MSE 2001 – Principles & Applications – Engineering Materials

Course: Selected Elective

Specific goals for the course

Outcomes of instruction:

Outcome 1: The student will develop a fundamental knowledge of nanomaterials.

1.1 The student will demonstrate a basic understanding of the length scale that defines nano for metal and semiconductor materials.
1.2 The student will demonstrate an understanding of the properties of materials with strong dependence on size.
1.3 The student will demonstrate an understanding of approaches to nanomaterials characterization.
1.4 The student will demonstrate an understanding of approaches to engineering nanomaterials and nanostructures.
1.5 The student will demonstrate an understanding of the challenges on safe nanotechnology.

Outcome 2: The student will gain experience in applying unique properties of nanomaterials to solve problems and challenges in our life.

2.1 The student will demonstrate the ability to develop case studies of nanomaterials with a focus on fundamentals, fabrication, characterization, and applications.
2.2 The student will demonstrate the ability to write final project report to reflect his/her learning on fundamentals through the course.
2.3 The student will demonstrate an ability to present final project and share his/her learning.

Student Outcomes:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(3) An ability to communicate effectively with a range of audiences.

(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topics covered:

The course will emphasize the basic elements of processing and properties of ferrous and non-ferrous metals and alloys, with a focus on process-structure-property correlations and microstructural design at nano-, micro-and meso-length scales.

Correlation between Outcomes of Instruction and Student Outcomes:

Outcomes of Instruction	Student Outcomes						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1.1 The student will demonstrate a basic understanding of the length scale that defines nano for metal and semiconductor materials.	X					X	X
1.2 The student will demonstrate an understanding of the properties of materials with strong dependence on size.	X					X	X
1.3 The student will demonstrate an understanding of approaches to nanomaterials characterization.	X					X	X
1.4 The student will demonstrate an understanding of approaches to engineering nanomaterials and nanostructures.	X					X	X
1.5 The student will demonstrate an understanding of the challenges on safe nanotechnology.	X	X		X	X	X	X
2.1 The student will demonstrate the ability to develop case studies of nanomaterials with a focus on fundamentals, fabrication, characterization, and applications.	X		X	X	X	X	X
2.2 The student will demonstrate the ability to write final project report to reflect his/her learning on fundamentals through the course.	X	X	X		X		
2.3 The student will demonstrate an ability to present final project and share his/her learning.	X	X	X	X	X		X

School of Materials Science and Engineering Student Outcomes:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
(2) An ability to apply engineering design to produce solutions that meet specified needs with consideration for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(3) An ability to communicate effectively with a range of audiences.
(4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
(6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
(7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.