Course Change Request

New Course Proposal

Date Submitted: 03/06/20 4:16 pm

Viewing: CHEM 680 : Fundamentals of Nanoscience and Nanomaterials

Last edit: 03/06/20 4:16 pm

Changes proposed by: msikowit

In Workflow

1. **CHEM Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Approval Path

1. 03/07/20 8:48 am Gerald Weatherspoon (grobert1): Approved for CHEM Chair

Are you completing this form on someone else's behalf?

Yes

Requestor:

Name	Extension	Email
Hao Jing	3-5221	hjing2@gmu.edu

Effective Term: Fall 2020

Subject Code: CHEM - Chemistry **Course Number:** 680

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Fundamentals of Nanoscience and Nanomaterials

Banner Title: Nanoscience and Nanomaterials

Will section titles vary by semester? No

Credits:

3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable: May only be taken once for credit (NR)
GRADUATE ONLY

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):
A grade of C or better in CHEM 331 and 332, MATH 113 and 114

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

This course will i) start with physical chemistry and surface science to elucidate the fundamental concepts and unique properties of solid materials emerging at the nanoscale; ii) introduce both “top-down” and “bottom-up” approaches to the fabrication of nanostructures and nanomaterials; iii) discuss advanced tools for characterizing the physical and chemical properties of nanomaterials; iv) review recent developments of nanomaterials for applications in catalysis, electronics, optoelectronics, energy, and nanomedicine; and v) discuss the environmental, health and safety (EHS) issues of nanomaterials for understanding the societal impact of nanotechnology.

Justification:

Nanomaterials is a growing field of chemistry with many applications. This course was popular when offered as a special topics section.

Does this course cover material which crosses into another department? No

Learning Outcomes:

1. Develop a systematic and coherent picture of the nanoscience and nanotechnology and become familiar with the current techniques used in the field of nanomaterials;
2. Describe the fundamentals and methods developed for synthesizing a range of nanostructures with strictly controlled size, shape, bulk and surface structure and composition, and properties in the field of nanoscience;
3. Understand the applications of nanoscience and apply the key concepts of chemistry and physics to the field of nanotechnology;
4. Discuss safety and technological issues associated with nanoscience and nanotechnology.

Attach Syllabus

CHEM 680 Syllabus.pdf

Additional Attachments

Staffing:

Hao Jing

Relationship to Existing Programs:

Will be used for elective CHEM credit by CHEM MS and PhD students.

Relationship to Existing Courses:

Materials does not overlap existing CHEM courses. It will complement growing focuses on materials chemistry.

Additional Comments:

Reviewer Comments

Key: 16804

CHEM 680: Fundamentals of Nanoscience and Nanomaterials — 2019 Spring

Department of Chemistry & Biochemistry, College of Science, George Mason University

Locations: IN 317

Mondays: 4:30 pm - 7:10 pm

Office Hours: 10:00 am – 11:00 am (Fridays) or appointment by emails

Planetary Hall, Room 311, George Mason University, Fairfax Campus

Prerequisites: A grade of C or better in CHEM 331 and 332, MATH 113 and 114 or instructor approval

Course Overview: This course covers the fundamentals of nanomaterials and nanostructures, as well as their unique properties for a broad spectrum of applications in science and technology. It emphasizes the interplay of engineering, chemistry, surface science, and physics to elucidate the multi-disciplinary nature of nanoscale science and engineering. The selected topics are appropriate for students in materials science and engineering, chemistry, physics, chemical engineering, mechanical engineering, environmental engineering, biomedical engineering, and electrical engineering.

Course Description: This course will *i*) start with physical chemistry and surface science to elucidate the fundamental concepts and unique properties of solid materials emerging at the nanoscale; *ii*) introduce both "top-down" and "bottom-up" approaches to the fabrication of nanostructures and nanomaterials; *iii*) discuss advanced tools for characterizing the physical and chemical properties of nanomaterials; *iv*) review recent developments of nanomaterials for applications in catalysis, electronics, optoelectronics, energy, and nanomedicine; and *v*) discuss the environmental, health and safety (EHS) issues of nanomaterials for understanding the societal impact of nanotechnology.

Instructor: Professor Hao Jing, Department of Chemistry & Biochemistry, College of Science

Planetary Hall Room 311, hjing2@gmu.edu

Teaching Method: In-class lectures

Teaching Modules:

Module I: Physical and Chemical Concepts in Nanoscience; Midterm Exam #1 is based on Module I

Module II: Characterization of Nanomaterials

Module III: Fabrication and Synthesis of Nanomaterials; Midterm Exam #2 is based on Module II & III

Module IV: Case Studies of Advanced Nanomaterials; Term papers and presentations

Requirements:		
	Midterm exam #1	25%
	Midterm exam #2	25%
	Homework (2)	25%
	Term paper and presentation	25% (20% and 5%)

Textbooks:

1. Introduction to Nanoscience & Nanotechnology, *Gabor L. Hornyak, Harry F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press, Taylor & Francis Group (2009) (Required)*
2. Introductory Nanoscience: Physical and Chemical Concepts*, Masaru Kuno, Garland Science; the first edition (August 19, 2011) (Optional)*
3. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, Guozhong Cao and Ying Wang, World Scientific, the 2nd edition (2011) (Optional)*
Recent reports and review articles will also be given during the lecture.

Learning Outcomes:

Upon successful completion of this course, you should be able to:

1. Develop a systematic and coherent picture of the nanoscience and nanotechnology and become familiar with the current techniques used in the field of nanomaterials;

2. Describe the fundamentals and methods developed for synthesizing a range of nanostructures with strictly controlled size, shape, bulk and surface structure and composition, and properties in the field of nanoscience;

3. Understand the applications of nanoscience and apply the key concepts of chemistry and physics to the field of nanotechnology;

4. Discuss safety and technological issues associated with nanoscience and nanotechnology.

Tentative class schedule:

Jan. 21	MLK day	NO CLASS
Jan. 28	Lecture 1	Introduction and course overview Quantum mechanics review
Feb. 4	Lecture 2	Structure and properties of nanomaterials
Feb. 11	Lecture 3	Energy at the nanoscale (surface energy of nanomaterials) and fundamentals of length scales
Feb. 18	**1st mid-term**	**4:30 pm – 6:30 pm**
Feb. 25	Lecture 4	Characterization (structural and chemical) of nanomaterials **Homework 1 due**
Mar. 4	Lecture 5	Student presentation (~10 min) on the assigned references on characterization techniques
Mar. 11	Spring Break	NO CLASS
Mar. 18	Lecture 6	Fabrication methods and types of nanostructures (zero-, one- and two-dimensional)
Mar. 25	**2nd mid-term**	**4:30 pm – 6:30 pm**
Apr. 1	Lecture 7	Case studies---Recent development of nanomaterials for emerging applications (plasmonic, carbon, magnetic and luminescent nanoparticles) **Homework 2 due**
Apr. 8	Presentation	Each presentation 20 min + 5 min Q & A
Apr. 15	Presentation	Each presentation 20 min + 5 min Q & A
Apr. 22	Term paper due at 5:00 pm by email	NO CLASS

Notes: Module I include lectures 1-3; Module II and III consist of lecture 4-6; lecture 7 has topics for Module IV.

Term paper and presentation: Students are encouraged to select a topic from case studies for a term paper and presentation that should *i*) describe a phenomenon and its fundamental science on the nanoscale; *ii*) envision a potential application in nanotechnology; and *iii*) identify a critical, unresolved scientific or technological issue. Recommended subjects include *i*) plasmonic nanostructures; *ii*) quantum dots; *iii*) magnetic nanoparticles; and *iv*) carbon-based nanomaterials. The term paper should be 5-6 pages (Times New Roman, 12 pt, single-space), including text and figures and excluding references. The duration of oral presentation for each

person should be ~20 minute, plus 5-min Q & A session, and all students should send their copies of ppt files to the Dr. Hao Jing (hjing2@gmu.edu) at least 2 days prior to the presentation date.

Grading scale:

The final grade in this course will be based on a percentage of points earned relative to total possible points. Although as a rule of thumb the following scale will apply, it is subject to minor change during the semester: 100-94% (A); 93-90% (A-); 89-87% (B+); 86-84% (B); 83-80% (B-); 79-77% (C+); 76-70% (C); <69% (D or F).

Academic Integrity

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. Please see the Office for Academic Integrity for a full description of the code and the honor committee process, http://oai.gmu.edu/.

Disabilities Statement

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474, http://ods.gmu.edu. All academic accommodations must be arranged through the ODS.

Mason Diversity Statement

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

Title IX information

Title IX of the Education Amendments of 1972 prohibits discrimination on the basis of gender under any education program or activity receiving federal funding. Sexual assault and sexual harassment are forms of sex discrimination prohibited by Title IX.

If you experience gender-based discrimination and disclose this to the instructor, know that the instructor is required by law to report this to the Title IX coordinator for the University. If you have further questions about this policy, or wish to obtain further information what Title IX covers, please talk to Dr. Hao Jing and/or visit https://diversity.gmu.edu/title-ix/what-title-ix