

**QUEENSBOROUGH COMMUNITY COLLEGE
CHEMISTRY DEPARTMENT**

CH-115 H2

INTRODUCTION TO NANOSCIENCE

LECTURE: 3 hours per week

CREDITS: 3

TEXTBOOK: Introduction to Nanoscience & Nanotechnology. ISBN: 978-14200-4779-0
By G.L. Hornyak, H.F. Tibbals, J. Dutta and J.J. Moore; CRC Press.
Additional materials will be provided by instructor, including review articles from scientific literature.

COURSE DESCRIPTION:

This course will give students an introduction to nanoscience, which is a rapidly growing field in our society. The synthesis of nanomaterials, the tools used to characterize these materials (Electron Microscopy (SEM/TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM) and UV-Vis spectroscopy), and societal impacts of nanomaterials/technology (such as ethical, legal and environmental implications) will be covered. Students will select a nanomaterial of interest and also do a term paper and presentation.

CURRICULA FOR WHICH THE COURSE IS REQUIRED / RECOMMENDED:

- Scientific World component of the CUNY Common Core.
- A.A degree in Liberal Arts and Science (Free elective in Liberal Studies Concentration).

GENERAL EDUCATIONAL OBJECTIVES:

- Students will communicate effectively through reading, writing, listening and speaking.
- Students will reason quantitatively and mathematically as required in their fields of interest and in everyday life.
- Students will employ concepts and methods of the natural and physical sciences to make informed judgments.

EXPECTED STUDENT LEARNING OUTCOMES:

- Students will identify and explain terms generally used in nanoscience and nanotechnology, give a brief history of nanoscience, give examples of nanomaterials, and be familiar with synthetic routes to prepare nanomaterials.
- Students will evaluate and explain the scientific theory of the relationship between the sizes of nanoparticles and color.
- Students will obtain hands-on experience using the AFM and STM microscopes, where they will analyze nanomaterials, such as gold nanoparticles and carbon nanotubes. They will also obtain microscopic (SEM and TEM) and spectroscopic (UV-Vis and IR) data of such nanomaterials in the literature.
- Students will write a paper on the various theories, sample preparation techniques, and the limitations and benefits of each method of analysis (AFM/STM/TEM/SEM/UV-Vis).
- Students will be able to demonstrate how various nanomaterials can be used to analyze problems and develop solutions in biological, electronic and composite fields.

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EXPECTED STUDENT LEARNING OUTCOMES (CONT.):

- Students will assess the usage of nanomaterials in art-related materials, such as ceramics and stained glass, from a scientific and artistic point of view.
- Students will evaluate the impact of the discovery and technological applications of nanomaterials on issues of ethical responsibilities and articulate their understanding in a written paper.
- Students will understand the scientific principles underlying matters of public concern, such as economic, environmental and health related issues in which nanomaterials and their applications play a role. They will also be knowledgeable in incorporating green nanotechnology in our society.
- Students will write a paper and make an oral presentation on ethical, economic, environmental and health implications associated with specific nanomaterials and their applications.

WRITING INTENSIVE:

The writing intensive approach will facilitate and help enhance students' thinking abilities, encourage critical thinking and activity with the subjects of chemistry, nano-science and in general. A writing intensive approach will improve the students' reading and writing skills.

COURSE ASSESSMENT:

- Assessment of students' opinion of the course: At the beginning and the end of the semester, surveys will be completed anonymously by the students. This assessment serves to evaluate the course. It will not reflect in any way on your grade in the course, but will help to improve course material and instruction.
- Assessment of students' knowledge of the course material: During the semester, several exams will be given. In addition, a cumulative final exam will be given to assess students' understanding of terminology and concepts associated with nanomaterial and nanoscience.
- Assessment of students' communication skills: During the semester, students will complete four papers and one oral presentation.

METHODS BY WHICH STUDENTS LEARNING WILL BE EVALUATED:

The overall grade will be computed from the components below.

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| • Exams: | 35% |
| • Papers (#1: 5%; #2: 10% ; #3: 5% and #4: 10%): | 30% |
| • Presentation | 10% |
| • Final exam: | 25% |

EXAMS:

There will be three one-hour exams. The specific dates of the exams can be seen on page 5.

PAPERS and PRESENTATION:

Each student will be required to submit four papers. All papers should be typed, have 1" margins, and should be between 10-12 pt. font. Late papers **will not** be accepted. Paper #1 (3-4 pages) will summarize the synthesis video where an introduction, a list of the materials used and procedures that were followed should be reported. Paper #2 will provide a

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comparative description of the theory, sample preparation, and limitations and benefits of using different microscopic and spectroscopic techniques in analyzing nanomaterials. This paper is limited to five pages including figures. Paper #3 (2-3 pages) will summarize a guest speaker's seminar presentation. Paper #4 will cover a nanomaterial of your choice. You will discuss the nanomaterial's synthesis, properties, applications, and ethical, economic, environmental and health implications. It should contain a review of the relevant literature published to-date on the material. This paper is due on **Week 14**. Each student is also required to make a Power Point presentation on their topic to the class in **Week 14**. An abstract of your topic is due on **Week 4**.

ATTENDANCE/ABSENCE POLICY:

Attendance will be taken at every class. The Student Handbook states that a student will be considered excessively absent from a course and will receive a WU grade if the student has been absent for 15% or more of the total number of contact hours for the course. A WU is computed as an F in the student's GPA.

This course meets once per week. Therefore, students will receive a grade of WU if they have 4 or more excused/unexcused absences.

Students who have valid excuses for missed classes should speak with their instructor and present documentation explaining the reason for the absence.

ACADEMIC INTEGRITY:

Academic honesty is taken extremely seriously and is expected of all students. All assignments must be the original work of the student (and partners or group, if applicable). All questions or concerns regarding ethical conduct should be brought to the course instructor. "It is the official policy of the College that all acts or attempted acts that are violations of academic integrity be reported to the Office of Student Affairs (OSA). At the faculty member's discretion and with the concurrence of the student or students involved, some cases, though reported to the OSA, may be resolved within the confines of the course and department. The instructor has the authority to adjust the offender's grades as deemed appropriate, including assigning an F to the assignment or exercise or, in more serious cases, an F to the student for the entire course" (Adopted from the QCC Academic Integrity Policy, 2/14/2005).

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES:

As stated in the current college catalog, any student who needs specific accommodations based upon the impact of a disability should register with the office of Services for Students with Disabilities (SSD) to be eligible for accommodations which are determined on an individual basis. The SSD office is located in the Science Building, room S132 (718-631-6257). Students should also contact their instructor privately to discuss their specific needs.

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Week	Topics/Activities	Hrs
2 nd Sept.	Introduction to the course (Ch 1), Survey questions.	3
9 th Sept.	Elements and Periodic Table (Handout); Compounds and Types of Bonding (Ch 10).	3
16 th Sept.	Review for Exam #1 Visit to QCC Library. Please meet at S-412. You will decide a nanomaterial for your final paper.	1 2
23 rd Sept.	No Class	
30 th Sept.	Abstract of term paper/presentation due. Exam #1: Elements, Compounds and Types of Bonding and Intro to Nanoscience. Synthesis of Nanomaterials: Carbon Nanotubes and Semiconductor Nanowires (Ch 9)	1 2
7 th Oct.	Synthesis of Nanomaterials: Organic Nanomaterials and Assembly of Bio-Inspired Nanomaterials (Ch 12, 13). Synthesis of Nanomaterials: Inorganic Nanoparticles (Ch 1, 4).	3
14 th Oct.	Video: Synthesis of Nanoparticles (cadmium sulfide quantum dots and gold nanoparticles). In Class Writing (LS): Summary report on the synthesis of nanoparticles video.	2 1
21 st Oct.	Paper #1 due: Typed summary report on the synthesis of nanoparticles video. (3 pages) Mechanical Properties of Nanomaterials and Composites: size effects, nanoparticles, nanotubes and reinforced composites (Ch 24). Review for Exam #2 Characterization of Nanomaterials: UV-Vis absorption and Mid-Infrared Spectroscopy and (Ch 3 and handout).	1 1 1
28 th Oct.	Paper 4 Draft #1 due: Synthesis, properties and applications of nanomaterial of your choice. (3-4 pages) Exam #2: Synthesis and Mechanical Properties of Nanomaterials. Characterization of Nanomaterials: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) (Ch 3).	1 2
4 th Nov.	Characterization of Nanomaterials: Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM) (Ch 3). In Class Activity: Characterization of Nanomaterials by AFM and STM In Class Group Writing (LS): Comparison of theory, sample preparation, and limitations and benefits of different microscopic and spectroscopic techniques (SEM/TEM/AFM/STM etc).	1 1 1
11 th Nov.	Paper #2 due: Typed comparison of microscopic and spectroscopic techniques (2 pages) Green Nanotechnology: nanomaterials for water treatment and renewable energy, role of nanotechnology in chemical substitution and environmental concerns of nanotechnology (Ch 28).	3

18 th Nov.	Paper #4 Draft #2 due: Ethical, economic, environmental and health implications of nanomaterials of your choice. (3-4 pages) Exam #3: Characterization of Nanomaterials and Green Nanotechnology. Group Activity and In class writing (LS): Societal Impact of Nanomaterials/Technology: Ethical and Legal implications, Public Perception and Future of Nanotechnology	1 2
25 th Nov.	Nanomaterials in Industry: Guest speaker seminar. In class discussion and writing (LS)	2 1
2 nd Dec.	Paper #3 due: Summary paper on seminar due. (2 pages) Societal Impact of Nanomaterials/Technology: Ethical and Legal implications, Public Perception and Future of Nanotechnology (Ch 2).	3
9 th Dec.	FINAL Paper #4 due: Nanomaterials of choice. Discuss synthesis, properties, applications, and ethical, economic, environmental and health implications. (8-10 pages) Student Presentation: Power Point presentation based on Paper #4. (5 min. each , between 8-12 slides).	3
16 th Dec.	Final Exam (Cumulative)	2