

NANOSCIENCE (NANO)

NANO*1000 Introduction to Nanoscience Fall Only (LEC: 3) [0.50]

This course introduces students to the emerging field of nanoscience. Its representation in popular culture and journalism will be contrasted with the present and near future realities in the field. Current industrial and business applications will be discussed. Guest lectures will be given by faculty performing research in the field. The course also aims to help students in their transition to the academic life by emphasizing skills and values such as academic integrity and problem solving and by actively connecting their first-year science core courses to the field of nanoscience.

Prerequisite(s): 4U Chemistry or 4U Physics

Restriction(s): Registration in Nanoscience Major.

Department(s): Department of Chemistry

Location(s): Guelph

NANO*2000 Synthesis and Characterization of Nanomaterials I Fall Only (LEC: 3, LAB: 3) [0.50]

This course explores the structural, mechanical, and electronic properties of matter. Methods to fabricate nanostructured materials such as nanoparticles, nanocomposites, thin films, polymers, and ferrofluids will be discussed. Techniques that have been developed to analyze these materials are also discussed, including scattering, microscopy and spectroscopy.

Prerequisite(s): CHEM*1050, [IPS*1510 or (MATH*1210, PHYS*1010)]

Restriction(s): Registration in Nanoscience Major.

Department(s): Department of Chemistry

Location(s): Guelph

NANO*2100 Synthesis and Characterization of Nanomaterials II Winter Only (LEC: 3, LAB: 3) [0.50]

The structural, mechanical, and electronic properties of matter will be discussed. Topics will include methods to fabricate nanostructured materials such as nanoparticles, nanocomposites, thin films, polymers and ferrofluids, as well as techniques that have been developed to analyze these materials, including scattering, microscopy and spectroscopy

Prerequisite(s): NANO*2000

Department(s): Department of Physics

Location(s): Guelph

NANO*3200 Nanolithographic Techniques Fall Only (LEC: 3, LAB: 3) [0.50]

Lithographic techniques applied at the micrometer and nanometer scale are key to the production of devices for the electronic and related industries. Projection and proximity techniques (XUV, electron, and ion beams) and writing processes (electron beam, ion beam, and scanned probe) will be explored. Emphasis will also be placed on soft lithographic techniques such as stamping and dip-pen nanolithography.

Prerequisite(s): NANO*2100

Department(s): Department of Chemistry

Location(s): Guelph

NANO*3300 Spectroscopy of Nanomaterials Winter Only (LEC: 3, LAB: 3) [0.50]

The interaction of nanostructured matter with light gives rise to some of its most important observable properties. The absorption and fluorescence properties of nanomaterials will be studied. Particular attention will be paid to experiments which require nanoscale path lengths, such as IR spectroscopy of monomolecular thin films. Local spectroscopic probes with nanoscale resolution such as Near-field Scanning Optical Microscopy (NSOM) and Scanning Probe Spectroscopy (SPS) will be explored.

Prerequisite(s): NANO*2100, (CHEM*3860 or PHYS*3230)

Department(s): Department of Chemistry

Location(s): Guelph

NANO*3500 Thin Film Science Fall Only (LEC: 3, LAB: 3) [0.50]

The deposition and growth of thin layers of materials is an important process on the production of many devices. This course will study the various methods by which thin films are grown including physical and chemical vapour deposition, molecular beam epitaxy, atomic layer epitaxy, and self-assembled monolayers. Experimental techniques for analyzing the properties of thin films will also be discussed.

Prerequisite(s): NANO*2100

Department(s): Department of Physics

Location(s): Guelph

NANO*3600 Computational Methods in Materials Science Winter Only (LEC: 3, LAB: 3) [0.50]

Many computational techniques have been brought to bear on the study of nanostructured matter. This course will present several of these techniques and will introduce a number of computational packages that can be used to study matter. Monte Carlo and ab initio methods along with molecular dynamics simulations will be studied, with an emphasis upon the implementation of the software packages and the appropriate interpretation of the results.

Prerequisite(s): (MATH*1160 or MATH*2160), (MATH*2170 or MATH*2270), (CHEM*3860 or PHYS*3230)

Department(s): Department of Physics

Location(s): Guelph

NANO*3800 Molecular and Nanoscale Spectroscopy Winter Only (LEC: 3, LAB: 3) [0.50]

Spectroscopy is the study of the interaction between light and matter and is the principal method to understand matter's structure and function. This course will examine the many spectroscopic techniques employed in the different spectral regions. Applications to probe matter organized as molecules and also as nanostructures such as self-assembled monolayers and quantum dots will be studied.

Prerequisite(s): CHEM*2070 or PHYS*3230

Department(s): Department of Chemistry

Location(s): Guelph

NANO*4100 Biological Nanomaterials Fall Only (LEC: 3) [0.50]

Biological systems provide a rich range of examples of specialized chemical systems that are structured on the nanoscale. Nanofibres, microtubules, viruses, and ribosomes are examples of systems that can be studied from the perspective of nanoscience. Using these systems or developing artificial systems which mimic their functionality are important growth areas in nanoscience and will be explored in this course.

Prerequisite(s): MATH*2270, (CHEM*2820 or PHYS*2240)

Department(s): Department of Physics

Location(s): Guelph

NANO*4200 Topics in Nanomaterials Winter Only (LEC: 3) [0.50]

This course will introduce students to special topics in nanostructured materials. The course will illustrate how to design, create, characterize and utilize new materials in which the presence of a nanoscale structural elements results in new properties of fundamental and technological importance.

Prerequisite(s): NANO*3300, NANO*3500, (CHEM*3860 or PHYS*3230)

Department(s): Department of Chemistry

Location(s): Guelph

NANO*4700 Concepts in Quantum Computing Fall Only (LEC: 3) [0.50]

This course introduces concepts in quantum computation and quantum information. Following an introduction to the basics of linear algebra, quantum mechanics, and computer science, presented from the viewpoint of quantum information theory, topics covered will include quantum computation, quantum algorithms, quantum error correction, quantum cryptography and quantum communication.

Prerequisite(s): MATH*1160, (CHEM*3860 or PHYS*3230)

Restriction(s): NANO*3500

Department(s): Department of Chemistry

Location(s): Guelph

NANO*4910 Nanoscience Research Project I Summer, Fall, and Winter (LAB: 12) [1.00]

Students will work with faculty in their laboratories on research topics of current interest. A final written paper and oral presentation of the work will be given by the students.

Prerequisite(s): 1.50 credits in NANO courses at the 3000 level.

Restriction(s): Instructor consent required.

Department(s): Department of Chemistry

Location(s): Guelph

NANO*4920 Nanoscience Research Project II Summer, Fall, and Winter (LAB: 12) [1.00]

Students will work with faculty in their laboratories on research topics of current interest. A final written paper and oral presentation of the work will be given by the students.

Prerequisite(s): NANO*4910

Restriction(s): Instructor consent required.

Department(s): Department of Chemistry

Location(s): Guelph