

UNIVERSITY of GUELPH
College of Engineering & Physical Sciences
DEPARTMENT OF CHEMISTRY
Winter 2020

NANO*3300, Spectroscopy of Nanomaterials [0.5]

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

Instructor: Jeff Roberts, SSC 2503, e-mail: jrober22@uoguelph.ca
Office hours: TBA
Lab instructor: Dr. Jay Leitch, SSC 2107, e-mail: leitchj@uoguelph.ca
Lectures: Tues. and Thur. 1:00PM – 2:20PM in MACN 201
Laboratory: Weds. 2:30PM – 5:20PM, SSC 2109 & 2110
Final Exam: Weds. 11:30AM - 1:30PM (2020/04/15) Room TBA

Bibliography

There is no required textbook for NANO-3300. Readings will be identified for each topic and theme discussed in class. These reading materials and Class Notes will be available on D2L CourseLink site.

Context for Course

This course focuses on the instrumentation and techniques used in the spectroscopic analysis of nanomaterials. For each spectroscopic tool, the scientific bases of the method are presented, as well as aspects that are specific to length-scales on the order of Angstroms to nanometers. Applications will be presented to provide a context for the techniques used. The course will begin with an introduction to the propagation of light in condensed-phase materials and the electronic structure of solids. Specific instrumentation topics to be discussed are shown in the table below.

Please note that since the focus of this course is on techniques suitable for the characterization of nanometric materials, some of the macroscopic aspects of the techniques will be left for the students to explore. Subject to the time available, NANO-3300 may not cover the complete list of topics and themes presented below.

Content of Lecture Series

Theme	Content
1 – two lectures	Introduction to the propagation of light through condensed matter, optical constants, the electronic structure of metals and semiconductors, plasmons and surface plasmonic oscillations
2 – one lecture	Reflection absorption spectroscopy, Fresnel equations, external reflection and internal reflection
3 – one lecture	Electronic Structure of Solids
4 – two lectures	Surface Plasmon Resonance (SPR) and application of SPR to study biological surface and Wave guiding.
5 – one lecture	Infrared reflection absorption spectroscopy (IRRAS) and attenuated total internal reflection absorption spectroscopy (ATR); surface selection rules

6 – one lecture	IRRAS and ATR-IR studies of thin organic films on metal and semiconductor surfaces; determination of molecular orientation and conformation
7 – one lecture	Plasmonic surfaces, surface enhancement phenomenon
8 – one lecture	IR and Raman Spectroscopy, Selection rules, Symmetry and Group Theory
9 – one lecture	Surface-enhanced IR absorption Spectroscopy (SEIRAS)
10 – one lecture	IRRAS, SNIFTIRS and PM-IRRAS spectroscopy
11 – two lecture	Surface enhanced Raman Spectroscopy (SERS)
12 – one lecture	Fabrication of nano-patterned surfaces for SERS and their applications
13 – two lectures	Ultraviolet/Visible Spectroscopy, and the application to metal and semiconductor nanoparticles
14 – one lecture	Quantum Dots
15 – one lecture	X-ray photoelectron, Auger and Electron Dispersive spectroscopies (XPS, Auger, EDS)
16 – one lecture	STM imaging and Spatially-resolved tunneling spectroscopy using STM

Evaluations

- 1) Mechanisms Mid-term exam, final exam, 3 assignments and laboratory work
2) Weighting 15% for the assignments
 30% for laboratory work
 25% mid-term examination (held in-class, date – Thurs. Feb. 13)
 30% final examination (April 15, 11:30-13:30)

Note : In order to pass NANO3300, the student must receive passing grades on both the laboratory and the lecture. Students who do not pass both components will receive a maximum grade of 48% for the course.

A Note Concerning Assignments

An important aspect of the course is a series of assignments that assess the students' understanding of the material.

The due date and time for each assignment will be clearly identified. Unless an extension is arranged prior to the due date, a penalty of 10% per day will be imposed for late assignments, up to a maximum of three days. Assignments will not be accepted more than three days past the due date. These assignments have to be completed individually by each student and either submitted by CourseLink Dropbox or handed-in to the course Instructor by the end of class on the due-date.

The solutions to these problems will be posted to the course web site as soon as possible afterwards.

University regulations:

E-mail Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Drop Date

The last date to drop one-semester courses, without academic penalty, is Friday, April 3rd. For Regulations and Procedures, see the Undergraduate Calendar.

Copies of out-of-class assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students

need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.