Course Information

Lecturer:
Miranda Schmidt  MACN 330 (ext. 53985)  mschmidt@uoguelph.ca

Lectures:
Monday, Wednesday, Friday 11:30 am – 12:20 pm MACN 434

Office Hours:
TBA and by appointment, please email.

Laboratory Technician:
Jay Leitch  SCIE 2107 (ext. 56262)  leitchj@uoguelph.ca

Laboratory:
Thursday 8:30 – 11:20 am SCIE 2109/2110

Office Hours:
TBA and by appointment, please email.

Course Website:
Lecture notes, problem sets, and supplementary materials will be available on CourseLink.

Course Calendar Description
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

Major Concepts
Crystal Lattices: (real-space and reciprocal space)
– basis for understanding (X-ray) diffraction methods;
– basis for the energy band theory for condensed matters – establishing some familiarity with vector algebra.

Determination Crystal Structures by Diffraction Methods:
– generation of X-rays;
– waves interaction with crystal lattices (pictured in reciprocal space);
– application examples in X-ray powder diffraction.

Spectroscopic Methods in Atomic Structural Characterization:
– necessary concepts of quantum mechanics and energy band theory (for UV-vis; Fluorescence labs; STM/STS, SPM; and an introduction to X-ray absorption spectroscopy);
– introduction to concepts of electrodynamics for describing EM boundary conditions (for surface plasma enhanced UV-vis absorption).
**Learning Resources**

2. Solid State Physics, by Ashcroft and Mermin, 1976
3. Absorption and Scattering of Light by Small Particles, by Bohren and Huffman, 1983

**Schedule**

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<tr>
<th>Week</th>
<th>Topics</th>
<th>Assessments</th>
<th>Laboratory</th>
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<tr>
<td>Week 1: Jan 8-12</td>
<td>Introduction to the course, Bravais and crystal lattices</td>
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<td>Check in</td>
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<td>Week 2: Jan 15-19</td>
<td>Lattices – Basis and reciprocal lattice</td>
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<td>Lab – Jan 18</td>
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<td>Week 3: Jan 22-26</td>
<td>Brillouin zone, lattice planes, Miller indices</td>
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<td>Lab – Jan 25</td>
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<tr>
<td>Week 4: Jan 29 – Feb 2</td>
<td>X-rays, single crystal diffraction</td>
<td>Assignment 1 Due</td>
<td>Lab – Feb 1</td>
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<td>Week 5: Feb 8-12</td>
<td>Powder diffraction, intro to quantum mechanics</td>
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<td>NO LAB</td>
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<tr>
<td>Week 6: Feb 12-16</td>
<td>Bohr H atom, uncertainty principle</td>
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<td>Lab – Feb 15</td>
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<tr>
<td>READING WEEK: Feb 19-23</td>
<td>NO CLASS</td>
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<td>NO LAB</td>
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<tr>
<td>Week 7: Feb 26- Mar 2</td>
<td>Schrödinger equation, state functions</td>
<td>Assignment 2 Due</td>
<td>Lab – Mar 1</td>
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<td>Week 8: Mar 5-9</td>
<td>Tunneling, expectation values</td>
<td>Midterm</td>
<td>NO LAB</td>
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<tr>
<td>Week 9: Mar 12-16</td>
<td>Energy band theory, density of states</td>
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<td>Lab – Mar 15</td>
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<td>Week 10: Mar 19-23</td>
<td>STM/STS, semiconductors of nanoparticles</td>
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<td>NO LAB</td>
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<td>Week 11: Mar 26-30</td>
<td>Two atom system, 1D/2D lattice band structure</td>
<td>Assignment 3 Due</td>
<td>Lab – Mar 29</td>
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<td>NO CLASS March 30th</td>
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<tr>
<td>Week 12: Apr 2-6</td>
<td>Graphene, field-effect transistor</td>
<td>Assignment 4 Due</td>
<td>Cleanup</td>
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Assignments:
There will be four (4) homework assignments:

Homework 1: Friday, February 2
Homework 2: Monday, February 26
Homework 3: Wednesday, March 28
Homework 4: Friday, April 6

Laboratory:
For details please refer to the laboratory manual on CourseLink.

Midterm examination:
Monday, March 5. The midterm is worth 20% of the total course grade.

Final examination:
Friday, April 12, 2:30 – 4:30 pm, location TBA. The final exam is cumulative and is worth 30% of the total course grade.

Late Assignments:
The penalty for late assignments is a 10% deduction per day.

Other Information and Policies

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

Course Policy regarding use of electronic devices and recording of lectures:
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.

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.
**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.

**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: [https://wellness.uoguelph.ca/accessibility/](https://wellness.uoguelph.ca/accessibility/)

**Course Evaluation Information:**
Information about the date and time of the course evaluation will be made available during the semester.

**Drop date:**
The last date to drop one-semester courses, without academic penalty, is *March 9, 2018*. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar.