

University of Victoria Department
of Physics and Astronomy

Physics 550 – A01

**Topics in Condensed Matter:
Microstructural Characterization**

Spring 2024 Syllabus

General Information

Instructor: Arthur Blackburn

Email: ablackbu@uvic.ca

Office: Elliot 108

Office Hours: As arranged within course

Course Webpage: <https://bright.uvic.ca/d2l/home/301867>

CRN: 22691

Lecture Schedule:

Tuesday and Friday, 1 - 2:20 pm
Clearihue, C316

Prerequisites:

This is a graduate level course and requires that the student has an adequate background in aspects of quantum mechanics and electrodynamics related to the course material. Permission to take the course is required from the instructor and department.

Recommended Materials:

- 1) **Microstructural Characterization of Materials**, 2nd Edition
Brandon and Kaplan, Wiley, 2008

This book is currently available as a free-of-charge e-book, within the UVic catalogue. It is recommended to download this while connected to the local University network, following the link below:

[Microstructural Characterization of Materials](#)

- 2) **Introduction to conventional transmission electron microscopy**
De Graaf, Cambridge University Press, 2003

This book is currently available as a free-of-charge e-book, within the UVic catalogue. It is recommended to download this book as soon as possible while connected to the University network, following the link below:

[Introduction to conventional transmission electron microscopy / Marc De Graef.](#)

Required Materials:

You should have access to a computer with either a Matlab or Python programming environment. Installation of other software on your computer such as Fiji / ImageJ will also be helpful for report preparation in this course.

Accommodations:

Accommodations can be made for missed exams/assignments due to illness or other severe affliction, as well as conflicts with classes and religious observances. Accommodations will also be made for issues documented through CAL.

If you miss an exam or assignment, I expect you to contact me as soon as possible. If you anticipate missing a course requirement, you must contact me a reasonable time in advance. If an emergency occurs during a test, please talk to me. I can't help if I don't know about the problem.

Content

- The Concept of Microstructure
 - Material imperfections and crystalline defects
- Crystallography and Crystal Structure
- Basic Theory of Electron and X-Ray Scattering from Materials
- Reciprocal Space Maps
- Transmission Electron Microscope (TEM) and X-Ray Diffraction Instrumentation Arrangements and Capabilities
- Experimental Diffraction Patterns and Energy Spectra Analysis
- Image Contrast Mechanisms
 - Phase Contrast, Diffraction Contrast, Mass-Thickness (Amplitude) Contrast
- Related Techniques
 - Scanning TEM, Electron Energy Loss Spectroscopy, Convergent Beam Electron Diffraction, Electron Holography, and other techniques.

Course Learning Outcomes

Upon successful completion of this course students will have demonstrated:

- Understanding of the application of transmission electron microscopy (TEM) and x-ray diffraction techniques to the study of the structure of materials.

- An understanding of the theory required for analyzing TEM and x-ray images and diffraction data.
- Their ability to collect and process either experimental X-Ray or TEM data to explore the microstructure of material samples.

Assessment and Grading

Assignments: 40%

There will be four assignments throughout the semester, which include a mix of pen-and-paper questions as well as computational questions.

Assignment Policy: You are allowed to collaborate on assignments, so long as your work and your solutions are your own. I take a very strict stance on copying and academic infringement, but I do understand the value in collaborative work. Discussing with a friend is no different from discussing with a professor, except it will likely help your friend learn the material better (teaching someone is the best way to learn material, trust me). However, if you scribe their answers, I will know and there will be consequences!

Lab Sessions: 30%

Hands on lab work forms an essential part of the course, and will consist of group working lab sessions and corresponding individual reports working upon:

1. A TEM based specimen standard investigation
2. XRD and/or TEM based lab based around the students own research, or a sample agreed upon by the instructor.

Final Exam: 30%

The final exam will be comprehensive in that it will require knowledge of all of the material of the course. This will be a one day take-home exam with traditional problems to solve.

If the application of this scheme would result in grades that are judged by the instructor to be inconsistent with the University's grading descriptions, as described at <https://www.uvic.ca/calendar/grad/index.php#/policies> under "Faculty Academic Regulations – Grading", then the instructor will assign percentages consistent with them.

University Regulations on Academic Integrity

These regulations are summarized from <https://www.uvic.ca/students/academics/academic-integrity/index.php>. For full information, including procedures for dealing with academic integrity infringement, see the webpage linked above.

Academic integrity requires commitment to the values of honesty, trust, fairness, respect, and responsibility. Any action that contravenes this standard, including misrepresentation, falsification or deception, undermines the intention and worth of scholarly work and violates the fundamental academic rights of members of our community.

Several types of academic integrity violations are covered in brief below.

Plagiarism

A student commits plagiarism when he or she:

- submits the work of another person as original work
- gives inadequate attribution to an author or creator whose work is incorporated into the student's work, including failing to indicate clearly the inclusion of another individual's work
- paraphrases material from a source without sufficient acknowledgement as described above

Students who are in doubt as to what constitutes plagiarism in a particular instance should consult their course instructor.

Falsifying Material Subject to Academic Evaluation

Falsifying materials subject to academic evaluation includes, but is not limited to:

- fraudulently manipulating laboratory processes, electronic data or research data in order to achieve desired results
- using work prepared by someone else (e.g., commercially prepared essays) and submitting it as one's own
- citing a source from which material was not obtained
- using a quoted reference from a non-original source while implying reference to the original source
- submitting false records, information or data, in writing or orally

Cheating on Assignments, Tests/Quizzes and Examinations

Cheating includes, but is not limited to:

- copying the answers or other work of another person
- sharing information or answers when doing take-home assignments, tests and examinations except where the instructor has authorized collaborative work
- having in an examination or test any materials or equipment other than those authorized by the examiners impersonating a candidate on an examination or test, or being assigned the results of such impersonation
- *assisting others to engage in conduct that is considered cheating*