TRENT/UOIT MATERIALS SCIENCE GRADUATE PROGRAM
DEPARTMENT OF PHYSICS AND ASTRONOMY
TRENT UNIVERSITY

MTSC 6140: TECHNIQUES IN MATERIALS CHARACTERIZATION
2019 FA
Peterborough

Instructor: Dr. Aaron Slepkov	**Trent Email:** aaronslepkov@trentu.ca	**Telephone:** 705-748-1011 x6216
Campus: Peterborough	**Office Location:** SC211	**Office Hours:** Wed: 13:00-14:00 OR Email any time!

Course Description:

Materials science is a multi-disciplinary area of science, with broad goals of understanding and predicting of the properties of matter. Such understanding allows the design of materials with functional properties. Underpinning material characterization is the development of experimental and predictive tools applicable to size scales ranging from the molecular to the macroscopic levels. Much of the field of "materials science" lies at the intersection of physics and chemistry, and includes many sub-fields such as nanotechnology, electronic materials, surface science, biomaterials, and materials characterization. The role of characterization techniques in Materials Science is to bridge the gap between the Materials Synthesis and Processing and the Materials' Performance. Therefore the role of characterization techniques is to obtain information on the best structures responsible for optimum performances, and on the techniques that produce these structures. This course aims to expose budding materials scientists to a broad set of core and emerging materials characterization techniques, with the goal of establishing both a scientific vocabulary and application scope that will link graduate students to a broader materials characterization community.

Course Objectives:

- Introduce students to a range of commonly used materials characterization techniques
- Provide students sufficient understanding of various techniques to allow their assessment of which techniques are most appropriate for key characterization needs
- Develop sufficient understanding of various techniques to allow for rudimentary interpretation of results/data borne of such techniques
- Provide an understanding of the physical/chemical underpinnings of various classes of characterization techniques
- Introduce students to new and emerging materials characterization techniques, and situate such techniques in the context of existing methods
- Establish an in-depth exploration of how one characterization technique is used or is useful within the context of the student's anticipated graduate thesis research.

Course Materials and Text:

- Pre-recorded online course lectures
- Supplemental readings available through blackboard
- Journal article accessible via (each student's home institution's) library

Course Schedule: [This is only a tentative schedule. It will likely changed somewhat]

Week #	Topics	Instructor	Notes
1 Sept. 9-14	***Introduction to course** ***Thermal Analysis**	**Dr. Slepkov, Trent U** **Dr. Easton (On Tech U)**	**Assignment #1**
2-3 Sept. 16-20 Sept. 23-27	***Vibrational spectroscopy an imaging** ***Infrared and Raman techniques; introduction and equipment**	**Dr. Vreugdenhil, Trent U** **Dr. Slepkov, Trent U**	**Assignment #1 due** **Assignment #2**
4-5 Sept. 30- Oct. 4 Oct. 7-11	**Diffraction Techniques:** *** XRD** *** Electron and neutron diffraction**	**Dr. Germann (Max Planck)** **Dr. Clancy (McMaster)**	**Assignment #2 due** **Assignment #3**
6 Oct. 14-18	**Electron Microscopy: SEM & TEM**	**Dr. Subramanian, Trent U**	**Assignment #3 due** **Assignment#4**
Reading week at Trent—No lectures in MTSC 6140			
7-8 Oct. 28- Nov. 8	**Surface Chem. Anal.:** **SIMS** **XPS**	**Dr. Gaspari (On Tech U)** **Dr. Tagliaferro (Politechnico di Torino)**	**Assignment #4 due** **Assignment #5**
9 Nov. 11-15	**NMR**	**Dr. Burns (U of T)**	**Assignment #5 due** **Assignment #6**
10 Nov. 18-22	**Assignment #6 due** **--Working on course paper--**		
11 Nov 25-29	**Course paper due on Tuesday, November 26 by email at 3 PM (EST)**		
12 Dec 2-6			

Course Format:

This course is offered mainly online, with students accessing course content through Blackboard/YouTube. The course is 11-weeks long, and comprises 7 topic modules. A problem set that covers material from each module will be assigned at the beginning of the module, and is due on the first Friday of the proceeding module at 3 PM (by email). In addition, students will be required to submit a reflective report on each of the released lectures. The lecture summary report can be submitted any time during the first 14 days that the lecture has been released. It is

recommended that students cover the content of the lecture modules in weeks 1-9, then spending two weeks writing/researching a research paper, which will be reviewed and edited for a final submission in week 11. ~~A final exam, proctored at each institution, will be given in the second week of December~~.

Course Evaluation:

Problem sets (submitted by email to instructor): 45%
Lecture summary reports: 25% (Due within 14 days of the release of each lecture)
Term Paper: 30%
~~Final Examination (proctored at each institution in December 2018): 20%~~

Lecture Summary Reports:

Students are to submit a 1.5-page (max) report on their experience with each of the recorded lectures. This report can be submitted any time within the first 14 days that a lecture recording has been released. The report is meant to be both an exercise in reflective writing and as an honest consultation regarding the quality, appropriateness, and usefulness of the lecture material to their education in experimental characterization techniques. The report shall be structured as follows:

1. Provide a summary of the topics covered by the lecture
2. Comment on your prior knowledge of the topic, and assess the lecture's scope and delivery as it pertains to increasing your knowledge base in the topic.
3. Identify and briefly describe at least one application of the technique that was not mentioned in the lecture.
4. Summarize the aspect of the lecture you found most interesting or most useful to you.
5. Summarize the aspect of the lecture you found least interesting or least useful to you.

Late Policy:

Late post-lecture reports and assignments will not be accepted. Without strong justification **and prior arrangement** with the instructor, late/absent assignments/reports will receive a score of zero. Late project reports will be docked $10\%_{pp}$ for each late day.

Trent University Policies

Academic Integrity:

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

Access to Instruction:

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that he/she may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.