

## **Physics 2600 – Introduction to Medical Physics Course Syllabus**

**Instructor:** Dr. Tamie Poepping  
Assistant Professor, Department of Physics and Astronomy  
<http://quark.physics.uwo.ca/~poepping>  
**Phone:** 519-661-2111 x86431, Fax: 519-661-2033  
**Email:** [poepping@uwo.ca](mailto:poepping@uwo.ca)  
**Office Hours:** Tuesdays 4:00-5:00pm, Physics and Astronomy Building, Office 133

### **Course Description**

Physics 210 – Introduction to Medical Physics (3 lecture hours, 0.5 course): An introduction to key physical principles as applied to medical imaging and radiation therapy. Topics covered will include: imaging metrics, ionizing radiation and radiation safety, radioactivity, radiation therapy, computed tomography, nuclear medicine, ultrasound, and magnetic resonance imaging.

### **Course Objectives**

- Develop basic understanding of medical physics concepts,
- Develop problem-solving and critical-thinking skills,
- Learn to integrate and apply various physics concepts to a single problem,
- Develop scientific communication skills.

### **Learning Objectives**

By the end of the course, students will be expected to be able to...

- Describe an imaging system and break it down into its components and physical principles, for each of the imaging modalities covered (x-ray, CT, NM, US, MRI);
- Identify the key factors that affect image quality and address these factors for the different imaging modalities;
- Learn to communicate the physical principles behind medical technology, radiation safety, and relevant applications.

### **Course Outline** (Provisional)

1. Medical physics and imaging principles: intensity, resolution, contrast
2. X-ray physics: photon interactions, attenuation
3. X-ray imaging: x-ray production & detection, mammography, computed tomography
4. Nuclear medicine physics: radioactivity
5. Nuclear medicine imaging: radioisotope production, SPECT, PET
6. Radiation exposure physics: radiobiology, dosimetry, kerma
7. Radiation exposure principles: safety, risk, radiation therapy, radiation protection
8. Ultrasound physics: waves, reflection, transmission, attenuation
9. Ultrasound imaging principles: echoes, resolution, speckle, Doppler
10. Nuclear magnetic resonance physics: magnetic moment, magnetization, relaxation
11. Nuclear magnetic resonance spectroscopy (NMRS) and imaging (MRI) principles: chemical shift, magnetic resonance signal induction and relaxation, pulse sequences, spatial encoding.

### **Course Delivery & Resources**

- *Lectures:* 3 lecture hours per week  
Tues 9:30-10:20 AM and Thurs 9:30-10:20 AM in PAB215  
Fri 9:30-10:20 AM in PAB34
- *Office hours:* Tues 4:00-5:00 PM and by appointment.
- *WebCT Owl:* Course Management System (<http://webct.uwo.ca>). Course material will be posted here along with images and links to useful websites. Syllabus and course material are subject to changes. Check regularly for updates and notices on the *WebCT* Physics 2600 Home Page by logging in at <http://webct.uwo.ca> using your UWO username and password.
- *Required Textbook:* **Medical Imaging Physics**, by W.R. Hendee and E.R. Ritenour, ISBN 0471382264; available in The Book Store at Western ([www.bookstore.uwo.ca](http://www.bookstore.uwo.ca)) for ~\$190.
- *Other resources for reference:*
  - *Physics of Radiology*, A.B. Wolbarst, ISBN 0838557694, UWO Library (TAY stack WN110.W848p) (on reserve)
  - *The Essential Physics of Medical Imaging*, J.T. Bushberg, et al., ISBN 0683301187, UWO Library (TAY stack WN200.E78) (on reserve)
- *Other resources for support (links also on WebCT page):*
  - Assignment Planner: [www.lib.uwo.ca/instruct/calculator/](http://www.lib.uwo.ca/instruct/calculator/)
  - Western Libraries: catalogues, databases, tutorials and tours.
  - Learning Skills Services ([www.sds.uwo.ca/Learning](http://www.sds.uwo.ca/Learning)): study skills and strategies.
  - Learning Styles Questionnaire to help you assess your individual learning preferences (<http://www.engr.ncsu.edu/learningstyles/ilsweb.html>).

### **Important Dates**

Lectures:	Tues <b>Jan 8</b> – Tues <b>Apr 7</b> , excl. Conference Week (Feb 16 – 20)	
Research Topic due:	Fri <b>Feb 13</b> , 2009 by midnight via WebCT	
Midterm:	Tues <b>Feb 10</b> , 2009, 09:30-10:20 am in class	
Research Report due:	Mon <b>Mar 31</b> , 2008 by noon via WebCT	
Tour (voluntary):	Robarts Research Institute (Imaging Labs)	(tentative)
	Fri <b>Apr 3</b> , 09:30-10:20 am (class time)	
Research Presentations:	Tues <b>Mar 31</b> , 2008, 17:00-18:30	(tentative dates & times,
	Thurs <b>Apr 2</b> , 2008, 17:00-18:30	locations TBA)
	Sat <b>Apr 4</b> , 2008, 14:00-16:00	
Final:	Wed <b>Apr 15</b> , 2009, 09:00-12:00, room TBA	(tentative date & time)

### **Evaluation Outline**

Assignments – Problem solving	30%	(Approx. 5-8 distributed throughout term)
Research project	10%	(See details below)
Midterm Examination	30%	(See Important Dates)
Final Examination	30%	(See Important Dates)

**Assignments** are due at the beginning of class on the due date. If you are having difficulty, arrange to see me prior to the assignment due date. If you have a justifiable reason for submitting a late assignment, please let me know on or before the due date or it will not be accepted. You are allowed one late assignment grace without penalty; any further late assignments, will be deducted 15% per day.

**Examinations** will consist of both short-answer concept questions and problem-solving questions. Examinations will be *closed* book with a formula sheet provided. Calculators may be required. Only *non-programmable* pocket calculators will be permitted. Personal communication or entertainment devices (e.g. cell phone, MP3 player) are not permitted.

**Solutions** to the midterm and assignments will be displayed in the viewing cases on first floor of the Physics & Astronomy Building, outside of room PAB115. Note that solutions include additional and complementary information that may be useful and hence worth looking over even if you got full marks on a question.

**Marks** will be posted in the grade book on the *WebCT* site (<http://webct.uwo.ca>).

### ***Research Project:***

The two primary purposes for this project are: (1) to allow additional coverage of material of particular interest to you; and (2) to help you develop research and communication skills.

**Topic:** Following the midterm, you will be asked to form small groups of 2-4 people, depending on class size. Each group will select and research a particular medical physics topic.

**Report:** Each group will prepare a 4-page report as a handout prior to the oral presentations for distribution to your classmates. Reports must be submitted online via WebCT. I will provide black and white copies for class distribution if you send a hard copy or PDF by the deadline.

**Presentation:** The oral presentations are scheduled near the end of the term (i.e. early April) during a time outside of normal lecture hours that is best suitable to everyone. The individual presentations will be 10-15 min in length, with 5 min allowed for questions (i.e. 15-20 min in total length).

**Evaluation:** There will be individual grades for the presentations. The individual grades (for a total of 10% of your final grade) will be obtained in the following way: 50% by instructor(s), 25% by your other classmates (outside your group), and 25% by you and your group (self-assessment). A detailed description of the evaluation criteria will be posted on WebCT.

### **Requisites**

**Pre-requisites:** Physics 1020 or 1024 or 1026 or 1028/1029; (Calculus 1000 or 1100) and (1301 or 1501), or Applied Math 1413.

**Anti-requisite:** Medical Biophysics 4475 (Medical Imaging)

**Note:** It is the **student's responsibility** to ensure that all pre-requisite, co-requisite and anti-requisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. As per the UWO Handbook of Academic and Scholarship Policy, "Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites."

### **Standard University Policies**

Please refer to the UWO Handbook of Academic and Scholarship Policy <http://www.uwo.ca/univsec/handbook/> for further details on the policies in practice here.

*1. Absences & Illness:* The only acceptable excuses for missing an examination are serious personal illness, immediate-family bereavement, or approved religious conflicts.

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: <http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services.

The form can be found here: [https://studentservices.uwo.ca/secure/medical\\_document.pdf](https://studentservices.uwo.ca/secure/medical_document.pdf)

*2. Accommodations for Religious Holidays:* Please see the following link regarding approved religious holidays, <http://www.uwo.ca/equity/docs/mfcalendar.htm>.

*3. Complaints & Suggestions:* If you have a concern related to the course, please come to see me (Prof. Tamie Poepping), the Physics & Astronomy Departmental Chair (Prof. John de Bruyn) or the Departmental Undergraduate Chair (Prof. Jeff Hutter). I also welcome and encourage your feedback at any time.

*4. Plagiarism:* As per the UWO Handbook of Academic and Scholarship Policy, "Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing, such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>)."