Course Outlines for Radiation Biophysics (Phys 480)

Course description

Here is the UW official calendar description:

The effect of radiation of various kinds on cells and tissues; mechanisms of damage, repair theories, genetic effects, dose-response relationships; cancer radiotherapy (x-rays, electrons, neutrons, protons, negative Pi mesons); other types of cancer therapies used in conjunction with radiotherapy (e.g. hyperthermia); late effects of radiation; carcinogenesis; risk vs. benefit; applications. [Prereq: One of PHYS 111, 115, 121 and one of PHYS 112, 122, 125 and level at least 4A in Applied Health Sciences, Engineering, Mathematics or Science].

Here is an enhanced version:

This course is an introduction to radiation biophysics and is intended to stimulate and educate students about the use of ionizing radiation in biology and medicine. The course has been designed to follow the basic curriculum of a Medical Biophysics training program, including three major parts. Part I represents introductory radiation physics and radiation chemistry, including the types of radiation, fundamental interactions of radiation with matter, photochemistry and radiation chemistry. Part II is focused on radiation biology, including photochemistry and radiation chemistry of DNA, mechanisms of radiation-induced DNA damage; repair pathways of radiation damage to DNA, mechanisms of cell killing, and cell survival curves. Part III is devoted to radiation oncology, including radiobiology in radiation therapy, phototherapy, photodynamic therapy and photothermal therapy, the oxygen effects in radiotherapy and photodynamic therapy, other types of cancer therapies used in combination with radiotherapy, and radiation protection.

The course will be delivered by lectures with chalkboard, PowerPoint, and group discussions (special topic seminars).

Lectures begin: September 10, 2012 (last lecture Dec 4, 2012)
When: Tuesdays and Thursdays, 08:30-09:50 am
Where: MC  4042

Course learning objectives

Students will gain insight to the importance of radiation biophysics in biology and medicine and issues associated with radiation therapy and protection. The course is intended to stimulate students who will be pursuing graduate studies and possibly future careers in radiology, nuclear medicine, radiation oncology, biophysics, and medical physicists. The students may also learn some material suitable for the written examination for residents in diagnostic radiology and nuclear medicine and in radiation oncology.
Contact information

**Instructor:** Qing-Bin Lu  **Office:** Phys 376  **Ext:** 33503  **Email:** qblu@uwaterloo.ca

Office hours: 2:30-3:30 pm Tuesday, or by appointment.

Resources

Course Text (recommended):


Other Useful Texts:

*Radiation Biophysics* by Yurii B. Kudryashov, (Nova, 2008)


*Biomolecular Action of Ionizing Radiation* by S Lehnert (Taylor & Francis Ltd. 2007)

Biological effects of radiation by J.E. Coggle (Taylor & Francis Ltd, 1983)


*Student assessment*

**Assignments:**

*Independent* work. Use (8.5 x11” paper), single-sided, stapled together with a cover sheet. The due date for submission of assignments is one week.

**Mid-term & Final Exam:**

Closed book midterm test and final exam, based on materials covered in class and problems related to assignments.

Date and Place: (check the appropriate UW websites).

Aids allowed: pocket calculator

**Marking Scheme:**

Assignments 20 marks; Midterm 20 marks; Group discussion 10 marks; Term paper (Essay) 10 marks, and final term 40 marks.

Course topics (week-by-week, approximately only)
Part 1: Radiation Physics and Chemistry (Week 1-4)

Week 1  Introduction; Types of Radiation: Nature and Properties; Radiation sources
Week 2  Radioactivity; Radiation terms and units; Interaction Processes of Radiation with matter (Absorption)
Week 3  Interaction Processes of Radiation with matter (Ionization); Deposition of Radiation Energy
Week 4  Photochemistry and Radiation Chemistry

Part II: Radiation Biology: Biological effects of radiation (Week 5-8)

Week 5  Photochemistry of DNA; Radiation Chemistry of DNA
Week 6  Mechanisms of DNA Damage; Midterm (Oct 18th)
Week 7  Repair of Radiation Damage to DNA
Week 8  Mechanisms of cell killing; Cell survival curves

Part III: Radiation Oncology (Radiotherapy of Cancer, Combination therapy & Radiation protection) (Week 9-12)

Week 9  Radiobiology in radiation therapy
Week 10  Time, dose and fractionation in radiotherapy
Week 11  Phototherapy, Photodynamic therapy (PDT) and photothermal therapy
Week 12  The oxygen effects in Radiotherapy & PDT; Combination therapy; Radiation protection

Expectation of Academic Integrity

“To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo should be based on honesty, trust, fairness, respect and responsibility.”

Avoidance of Academic Offenses. Students are expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offense, or who need help in learning how to avoid offenses (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, TA, academic advisor, or the Undergraduate Associate Dean. For information on categories of offenses and types of penalties, students should refer to Policy #71, Student Academic Discipline, http://wwwadm.uwaterloocainfosecPolicies/policy71.htm. Students who believe that they have been wrongly or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance, http://wwwadm.uwaterloocainfosecPolicies/policy70htm.”

Student Grievances

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