1. Medical Biophysics 4467B/9567B (6509 Web-Based)
Radiation Biology with Biomedical Applications

Version: Winter 2017

Requisites:
Prerequisite(s): Medical Biophysics 3501F or the former Medical Biophysics 3302E; one of Medical Biophysics 3507G or Physics 2101A/B or 2102A/B, or the former Medical Biophysics 2128A/B and 2129A/B or the former Physics 2128A/B and 2129A/B; or permission of the instructor and Department.

Senate regulation regarding the student's responsibility regarding requisites:
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.

Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Jerry Battista (Course Coordinator)	j2b@uwo.ca	LRCP A4-841	519-685-8300 53613 #	By appointment ONLY
TA – Jason Vickress (2017)	jvickres@uwo.ca	LRCP or Medical Biophysics	519 685 8605	To be set

OWL:

Students with OWL issues should see: https://owl.uwo.ca/portal/site/owldocs

3. Course Syllabus

Course Description

This **Web-based course** consists of lecture slides with dubbed audio, 4 assignments, a mid-term exam of 2 hours, and a final exam of 3 hours. Opportunity for "live" interaction with the Instructor and Teaching Assistant will be provided through monthly scheduled tutorials. This course covers essential material for students in CAMPEP-accredited Medical Physics programs at the graduate or postgraduate levels. It is also required by medical postgraduate residency programs in radiation oncology and diagnostic imaging, including nuclear medicine.

The course describes the effects of ionizing radiation on living organisms, from cells to animals. The lectures begin with a brief physical description of the various types of ionizing radiation, the electromagnetic spectrum, and how radiation interacts with atoms. The early physical events produce ionizations and yield chemical radicals that can damage important biological molecules such as water and DNA, leading to either cellular repair or death. The course emphasizes radiation damage to cells and organs, with practical illustrations of applications to cancer radiotherapy. It also reviews the risk-benefit rationale used in government regulations for the controlled use of radiation in research and medicine.

In order to have a transcript record for this course, participants MUST complete ALL written assignments and write the exams; no auditing is permitted.

Learning Outcomes - At the end of this course, the student should be able:

- To describe the various types of ionizing radiation.
- To define the radiation quantities (units) used in measurement/calculations of "dose".
- To understand and sketch the interactions of radiation particles with atoms in tissue.
- To describe the physical-chemical events which follow an ionizing event, in terms of spatial distribution and time scale.
- To describe the biological impact on living cells and tissue at the DNA, cellular, organ, and whole animal levels.
- To predict the expected radiobiological outcome, when presented with the ambient conditions of irradiation (e.g. energy, dose, dose rate/fractionation, oxygen level, drugs).
- To describe applications of radiation in the research laboratory and to medicine, with emphasis on radiation oncology.
- To apply radiobiological principles and models to fractionated radiation therapy
- To be aware of safety precautions when using radiation and be familiar with the government agencies related to the radiation exposure limits (in Canada) and the radiation protection philosophy (ALARA Principle).

You are strongly advised not to rush through the material.
Use this Schedule as the guideline.

Month	Topics	Old Book Chapters	7th Edition	Slide Pack	Assignm't
January	**Introduction** Learning Objectives Electromagnetic Spectrum Ionizing Radiation **Basic Radiation Physics** - Timing & Scale Major Photon Interactions	**1**	1	1A/B	#1
	Particle Track Structure LET definition, RBE definition Alternative Radiation Beams Radiation Quantities and Units	**7** **24** **1,15**	7 25,17 1	2A/B	
	Radiation Chemistry Water Radiolysis Radical Interactions Oxygen Effect (OER) and Radiosensitizers RadioProtectors (DMF)	**1** **6,23** **25** **9**	1 6 26 9	3A/B	
	TUTORIAL # 1				
February	**DNA Damage and Repair** Types of Radiation Damage Chromosome Aberrations Lethal and Non-Lethal Lesions DSB and Lesion Yields Basics of Carcinogenesis	 **2** **16** **17** **10**	 1 2 5 2,3 10,18	4A/B	
	Cell Survival Curves Experimental Technique Dual Action theory (Linear Quadratic) Statistics of cellular "hits" Mathematical Models	**3**	3,19	5A/B	#2
	TUTORIAL # 2				
	"4 R's" of Radiobiology I Dose Rate Effects Repair of radiation damage Redistribution (cell cycle)	 **5** **5** **4**	 5 5 4	 6 7A 7B	

March	**"4 R's" of Radiobiology II**				
	Repopulation of cells	**21**	5,22	7C	#3
	Re-Oxygenation (OER)	**6, 25**	4,5,6	7D	
	Mid Term Test				
	Radiation Therapy			8	
	Early-Reacting Tissue		23		
	(TCP Calculations)	**18,19,20**	19,21		
	Late-Reacting Tissue		23		
	Normal Tissue Response (NTCP)		19,20		
	Dose Fractionation/Rate		22,23		
	(BED calculations)	**22**			
	Radiation Effects on Humans			9A/B	
	Acute Whole Body Exposures				
	Stochastic *versus*	**10,11**	10,11		
	non-stochastic effects	**8,12,13**	8,12,13		#4
	Carcinogenesis	**10**			
	TUTORIAL # 3				
April	**Radiation Protection**			10	
	Population Radiation Quantities	**15**	17		
	Background radiation levels	**14**	16		
	Risk *versus* Diagnostic Imaging Benefit		15		
	Radiation Regulations	**15**		11/12	
	Dose Limits and ALARA Principle		16 17		
	TUTORIAL # 4				
	Final Exam				

4. Course Materials

Textbook: Radiobiology for the Radiologist, *E. Hall and A. Giaccia (6th edition matches slides)*

5. Evaluation:

Component	% of Final Mark
Assignments (typically 4)	40%
Midterm test weighting	0 or 30% (30% if mid-term exam mark is higher than the final exam mark)
Final exam weighting	30 or 60% (60% if final exam mark is higher than the midterm test mark)

Exam Formats

The midterm and final exams will consist of five sections dealing with radiation physics, radiation chemistry, radiation biology, radiation oncology, and radiation protection. Some questions deal with the definition of concepts and radiation quantities. Others will require calculations with numerical data. There will be a few practice exams provided.

The final exam (3 hr) will be cumulative, covering the entire course.

5. Additional Information/Statements

Statement on Use of Electronic Devices

No electronic devices with storage and communication capability are permitted during any of the exams.

Statement on Academic Offences

"Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following website: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf ."

If written work will be assigned in the course and plagiarism-checking software might be used, the following statement to this effect must be included in the course outline:

"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).”

If computer-marked multiple-choice tests and/or exams will be given, and software might be used to check for unusual coincidences in answer patterns that may indicate cheating, the following statement must be included in the course outline:

“Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.”

Absence from course commitments

A. Absence for medical illness:

Students must familiarize themselves with the Policy on Accommodation for Medical Illness for Undergraduate Students, located at:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf
The policy is also accessible from the Medical Accommodation Policy link at
https://studentservices.uwo.ca/secure/index.cfm

Statement from the Academic Counselling Office, Faculty of Science (for Science and BMSc students)

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 Academic Counselling 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 by the Academic Counselling Office 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 Academic Counselling Office immediately. For further information please see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_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 at:
https://studentservices.uwo.ca/secure/index.cfm

B. Absence for non-medical reasons:

If absent for a non-medical reason please inform the instructor and submit any documentation to the instructor directly.

Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

C. Special Examinations

A Special Examination is any examination other than the regular final examination, and it may be offered only with the permission of the Dean/Academic Counselling Office of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents.

A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean/Academic Counselling Office of the Faculty. The Dean/Academic Counselling Office will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to the Office of the Registrar.

If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean/Academic Counselling Office in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.

When a grade of Special (SPC) or Incomplete (INC) appears on a student's record, the notations will be removed and replaced by a substantive grade as soon as the grade is available.

Support Services

Registrar Services: http://www.registrar.uwo.ca

Academic Counselling (Science and Basic Medical Sciences): http://www.uwo.ca/sci/undergrad/academic_counselling/index.html

USC Student Support Services: http://westernusc.ca/services/

Student Development Services: http://www.sdc.uwo.ca

Student Health Services: http://www.shs.uwo.ca/

Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.