



UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** MDPH 639 **Term:** Winter 2019

Instructor: Dr. Esmaeel Ghasroddashti | 1-403-388-6878 | 1A 135 JACC | esmaeel.ghasroddashti@ahs.ca | Office
Hours: Flexible with appointment

(a) Course Description

The course aims to explain Cell Kinetics, Cell Survival Curves, Radiation Pathology, Fractionation, Radiation Safety, Shielding Calculations.

Lecture Sections: T 1300-1430 and TH 1030-1200

Course Website: d2l.ucalgary.ca

Department of Physics & Astronomy:

Office: Science B 605

Phone: 403 220-5385 Email: phasoffice@ucalgary.ca

2. **Prerequisites:** MDPH 625.

3. **Grading:** The University policy on grading and related matters is described in sections [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Attendance/Participation	5%
Quizzes (weekly)	10%
Assignments	15%
Project	15%
Exam I (Midterm: Over Radiobiology Part)	40%
Exam II Final Examination-Over Radiation Safety Part	15%

Notes:

- Projects are to be both handed in (electronically or hard copy) and given as a presentation.
- Assignments are composed of two major ones (on selected questions from the CCPM exam question bank), and a few small ones on class discussions.
- This course has a non-registrar scheduled final exam.

Late Projects and Assignments:

- Project and assignments are due on time as announced. Late assignments/projects will be accepted only in well-documented emergencies (e.g. a doctor's note should be provided in case of illness); otherwise they may be accepted with a penalty applied.

Final Grades:

- The final grade will be calculated using the above percentages and then converted to a letter grade using the chart below.

Percentage to letter grade conversion scale:

>= 95 %	A +	>= 80 %	B +	>= 65 %	C +	>= 50 %	D
>= 90 %	A	>= 75 %	B	>= 60 %	C	< 50 %	F
>= 85 %	A -	>= 70 %	B -	>= 55 %	C -		

- 4. Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize himself/herself with these regulations. See also [Section E.6](#) of the University Calendar
- 5. Scheduled out-of-class activities:** There are no scheduled activities outside of class time.
- 6. Course Materials:** Textbook: Radiobiology for the Radiologist, 7th edition, Eric J. Hall and Amato J. Giaccia
- 7. Examination Policy:** Exams will be closed book. No aids allowed. Students should also read the Calendar, [Section G](#), on Examinations.
- 8. Course fees:** None
- 9. Writing across the curriculum:** In this course, the quality of the student's writing will be a factor in the evaluation of the works. See also [Section E.2](#) of the University Calendar.
- 10. Human studies statement:** Students in this course are not expected to participate as subjects or researchers. See also [Section E.5](#) of the University Calendar.
- 11. Reappraisal of Grades:**

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

 - 1. Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **15 days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall immediately submit the Reappraisal of Graded Term work form to the department in which the course is offered. The department will arrange for a reassessment of the work if, and only if, the student has sufficient academic grounds. See sections [I.1](#) and [I.2](#) of the University Calendar
 - 2. Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

12. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room

370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).

(b) SU Wellness Center: The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see www.ucalgary.ca/wellnesscentre or call [403-210-9355](tel:403-210-9355).

(c) Sexual Violence: The University of Calgary is committed to fostering a safe, productive learning environment. The Sexual Violence Policy (<https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf>) is a fundamental element in creating and sustaining a safer campus environment for all community members. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need. The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (svsa@ucalgary.ca) or phone at [403-220-2208](tel:403-220-2208).

(d) Misconduct: Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. **These are only examples.**

(e) Assembly Points: In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).

(f) Academic Accommodation Policy: Students needing an accommodation because of a disability or medical condition should contact Student Accessibility Services in accordance with the procedure for accommodations for students with disabilities available at [procedure-for-accommodations-for-students-with-disabilities.pdf](#).

Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Associate Head, Graduate, of the Department of Physics & Astronomy, Dr. Jo-Anne Brown by email jocat@ucalgary.ca or phone 403-220-8014. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See [Section E.4](#) of the University Calendar.

(g) Safewalk: Campus Security will escort individuals day or night (See the [Campus Safewalk](#) website). Call [403220-5333](tel:403220-5333) for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

(h) Freedom of Information and Privacy: This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.

(i) Student Union Information: [VP Academic](#), Phone: [403-220-3911](tel:403-220-3911) Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: [403-220-3913](tel:403-220-3913) Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: suvpaca@ucalgary.ca.

(j) Internet and Electronic Device Information: Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.

(k) Surveys: At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference please participate in these surveys.

13. OTHER COURSE RELATED INFORMATION:

(a) Course Learning Outcomes

The goal of the course is to provide the students with a clear understanding of the interaction of ionizing radiation with living cells.

(b) Course Learning Incomes

This course requires a basic background in the nature of ionizing radiation, as well as a general understanding of cancer formation.

(c) Syllabus

A. Topics Recommendations of AAPM REPORT NO. 197 for Radiobiology

1. Review of Interaction of Radiation with Matter
 - (a) Types of radiation
 - (b) Mechanisms of radiation absorption
 - (c) Ionization density
2. Radiation Injury to DNA
 - (a) Radiation chemistry of water
 - (b) Structure of DNA and radiation-induced lesions
3. Repair of DNA Damage
 - (a) Excision repair
 - (b) Repair of double –strand breaks
4. Radiation-Induced Chromosome Damage and Repair
 - (a) Chromosome biology and aberrations
 - (b) Linear-quadratic model
5. Survival Curve Theory
 - (a) Target theory
 - (b) Survival curve models
 - i. Single-hit multitarget
 - ii. Linear-quadratic
 - (c) Cellular sensitivity
 - i. Single-hit multitarget
 - ii. Mechanisms of cell killing
6. Cell Death: Concepts of Cell Death (Apoptosis and Reproductive Cell Death)
7. Cellular Recovery Processes
 - (a) Types of radiation damage
 - (b) Potentially lethal and sublethal damage
 - (c) Fractionation effort
 - (d) Dose rate effects
8. Cell Cycle
 - (a) Cell kinetics and cycle phases
 - (b) Radiosensitivity and cell cycle position
 - (c) Radiation effects on cell cycle
9. Modifiers of Radiation Response – Sensitizers and Protectors
 - (a) Oxygen effect and other radiosensitizers

- (b) Radioprotection
- 10. RBE, OER, and LET
 - (a) Linear energy transfer (LET)
 - (b) Relative biological effectiveness (RBE)
 - (c) Oxygen enhancement ratio (OER)
- 11. Cell Kinetics
 - (a) The cell cycle and quantitation of its constituent parts
 - (b) The growth fraction and cell loss from tumors
 - (c) Autoradiography and flow cytometry
 - (d) The growth kinetics of human tumors
- 12. Radiation Injury to Tissues
 - (a) Tissue and organ anatomy
 - (b) Expression and measurement of damage
- 13. Radiation Pathology – Acute and Late Effects
 - (a) Acute and late responding normal tissues
 - (b) Pathogenesis of acute and late effects
 - (c) Different kinds of late responses
 - (d) Residual damage/Radiation Syndromes/Clinical TBI (total body irradiation)
- 14. Histopathology
 - (a) General morphology of radiation injury
 - (b) Morphology of cell death
 - (c) Morphologic changes in irradiated tumors
- 15. Tumor Radiobiology
 - (a) Basic tumor structure and physiology
 - (b) Importance of hypoxic cells in tumors and importance of reoxygenation
- 16. Time, Dose, and Fractionation
 - (a) The 4 R's of radiobiology
 - (b) Volume effects
 - (c) The basis of fractionation
 - (d) Dose-response relationships for early and late responding normal tissues
 - (e) Hyperfractionation and accelerated treatments
 - (f) α/β Model
- 17. Radiation Genetics: Radiation Effects of Fertility and Mutagenesis
 - (a) Target cells for infertility
 - (b) Doses to result in temporary and permanent sterility
 - (c) "Reverse-fractionation effect"
 - (d) Mechanisms of mutation induction
 - (e) Relative risk vs. absolute risk
 - (f) Time course and latency period/Risks of cancer induction in different sites
- 18. Molecular Mechanisms
 - (a) Molecular cloning techniques
 - (b) Gene analyses
 - (c) Oncogenes and tumor suppressor genes
- 19. Drug Radiation Interactions

B. Additional Radiobiology Topics

- 1. Effect of radiation on Fetus & Embryo
- 2. Exotic Radiation Modalities

C. Radiation Safety Topic

1. Introduction to radiation safety, dose limits, background radiation, interactions
2. Regulations and licensing
3. Instrumentation, radiation safety program, brachytherapy sources
4. Shielding and room design
5. Radiation safety lab (survey, stuck source emergency, brachytherapy)
6. Review, internal exposure, non-ionizing radiation

Lec	Day	Date	Time	Place	Notes	Topic	Notes
1	Mon	7-Jan	2:00-3:00 PM	MPR	Makeup Class	Introduction + Chapter 1	
2	Tue	8-Jan	1:00-2:30 PM	MPR		Chapter 2	Quiz 1
3	Wed	9-Jan	9:00-10:30 AM	MPR	Makeup Class	Chapter 3	
	Thu	10-Jan			EG Away		
	Tue	15-Jan					
	Thu	17-Jan					
4	Tue	22-Jan	1:00-2:30 PM	MPR		Chapter 4	Quiz 2
5	Thu	24-Jan	10:30-12:00	HSC G834		Chapter 5	
6	Tue	29-Jan	1:00-2:30 PM	MPR		Chapter 6	Quiz 3
7	Thu	31-Jan	10:30-12:00	CC105		Chapter 7	
8	Tue	5-Feb	1:00-2:30 PM	MPR		Chapter 8, 9	Quiz 4
9	Thu	7-Feb	10:30-12:00	HSC G750		Chapter 10	
10	Tue	12-Feb	1:00-2:30 PM	MPR		Chapter 12,13	Quiz 5
11	Thu	14-Feb	10:30-12:00	CC109		Chapter 19	
	Tue	19-Feb			Midterm Break		
	Thu	21-Feb					
12	Tue	26-Feb	1:00-2:30 PM	MPR		Chapter 20	Quiz 6
13	Thu	28-Feb	10:30-12:00	CC105		Presentations	Projects Due
14	Tue	5-Mar	1:00-2:30 PM	MPR		Chapter 22	
15	Thu	7-Mar	11:00-1:00	CC121		Chapter 23	Quiz 7
16	Tue	12-Mar	1:00-2:30 PM	MPR		Chapter 25	Assig-1 Due
17	Thu	14-Mar	10:30-12:00	CC109		Chapter 27	Quiz 8
18	Tue	19-Mar	1:00-2:30 PM	MPR		Chapter 28	
19	Thu	21-Mar	10:30-12:00	CC105		Prepare for Exam I	No Classes
20	Tue	26-Mar	1:00-2:30 PM	MPR		Exam I on Radiobiology	
21	Thu	28-Mar	10:30-12:00	HSC G750		Radiation Safety-1	
22	Tue	2-Apr	1:00-2:30 PM	MPR		Radiation Safety-2	Quiz 9
23	Thu	4-Apr	10:30-11:45	CCB20		Radiation Safety-3	Assig-2 Due

24	Tue	9-Apr	1:00-2:30 PM	MPR		Radiation Safety-4/5	
25	Thu	11-Apr	10:30-12:00	CC109		Radiation Safety-6: RS LAB	Quiz 10
	Tue	16-Apr					
	Thu	18-Apr	10:30-12:00	CC105		Exam II on Radiation Safety	
	Tue	23-Apr					
	Thu	25-Apr					

Exam Period April 15-27 Two weeks
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U of C academic
calendar

<https://www.ucalgary.ca/pubs/calendar/grad/current/academic-schedule.html>