University of Victoria

Department of Physics & Astronomy
University of Victoria
Spring Term 2026

COURSE OUTLINE

PHYS 432 Medical Physics, 1.5 units

Lectures: 2:30 - 3:50 pm on Tue and Fri, in-person

We acknowledge and respect the Lək̓ʷəŋən (Songhees and Esquimalt) Peoples on whose territory the university stands, and the Lək̓ʷəŋən and W̱SÁNEĆ Peoples whose historical relationships with the land continue to this day.

COURSE DESCRIPTION

Physics 432: Medical Physics provides an introduction to the physical principles and technologies underlying modern medical imaging and radiation therapy. The course covers radiation production and interactions, dosimetric quantities and instrumentation, biological effects of ionizing radiation, radiation protection, and the clinical workflow of radiotherapy. Imaging modalities including computed tomography, nuclear medicine, and magnetic resonance imaging are examined alongside radiation treatment planning, brachytherapy, and advanced radiation delivery techniques such as proton therapy and FLASH. The course also introduces Monte Carlo methods and current research topics in medical physics, with an emphasis on quantitative problem solving and applications relevant to clinical practice and research.

PREREQUISITES & COREQUISITES

Complete 1 of the following
Complete 1 of:

- PHYS313 - Atomic, Molecular and Optical Physics (1.5)
- PHYS314 - Nuclear Physics and Radioactivity (1.5)
- PHYS323 - Quantum Mechanics I (1.5)

Complete all of:

- BME335 - Biosensors and Instrumentation (1.5)
- MATH204 - Calculus IV (1.5)

CONTACT INFORMATION

Instructor: Magdalena Bazalova-Carter
Email: bazalova@uvic.ca
Office: Elliott 109
Office Hours: Fridays 1-2pm

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COURSE MATERIALS

There is no one textbook, but some suggestions are listed **http://web.uvic.ca/~bazalova/teaching.html.**

LEARNING OUTCOMES

Upon completion of this course, students should be able to:

- **Explain the physical principles of radiation and its interaction with matter** as they apply to medical imaging and radiation therapy.
- **Describe the design and operation of clinical radiation sources and imaging systems**, including x-ray tubes, linear accelerators, CT, nuclear medicine, and MRI.
- **Apply fundamental dosimetric concepts and measurement techniques** to quantify radiation dose and assess system performance.
- **Explain the biological effects of ionizing radiation and principles of radiation protection** relevant to patient and worker safety.
- **Describe radiation therapy planning and delivery methods**, including external beam therapy, brachytherapy, and emerging techniques such as proton therapy and FLASH.
- **Analyze and communicate medical physics topics using quantitative reasoning**, including current research and engineering applications.

EVALUATION

Assignments	20%
Mid-term exam	20%
Final exam	30%
Quizzes	10%
Paper/project	10%
Oral presentation	10%
In-class bonus	5%

Note:

- *All course material including this course outline, assignments, lecture notes and simple weekly quizzes will be posted on Brightspace.*
- *There will be four assignments.*
- *Midterm will be given immediately after reading break.*
- *Final exam will cover material from the entire course, but will focus on the second half of the course.*
- *Weekly quizzes will be simple 5-7 True/False questions/lecture testing students' understanding of concepts.*
- *Paper should be a 2-page document (with references) on any medical physics related topic not directly covered in class or covered in much more detail than in class or (new this year) on an engineering project related to medical physics. You can discuss your topic selection with any instructor. Some general paper instructions:*
    - *Use scientific/formal language, not colloquial language.*

  - *Always quantify values when possible.*
  - *Give examples.*
  - *Figures are encouraged to help explain concepts.*
- *Project (might be interesting for engineering students) should be a design of a device useful for medical physics. It can be anything from a holder for an ionization chamber to a 3D-printed human.*
- *Oral presentation will be 12 minutes long (10 minute presentation + 2 minutes questions) on the same topic. Figures are preferred over slides with just text.*

COURSE POLICIES

Late/Missed Assignments or Exams

Late assignments will be considered with a half-life of 5 days, i.e. for a 5-day late assignment, only 50% of the mark will be given. Missed assignments will be given a 0 mark.

Academic Integrity

UVic's Policy on Academic Integrity is found at uvic.ca/calendar/future/undergrad/index.php#/home. It is every student's responsibility to be aware of this policy, including policies on cheating, plagiarism, unauthorized use of an editor, multiple submission, and aiding others to cheat. If you have any questions or doubts, please talk to me. For more information, see uvic.ca/learningandteaching/cac.

Use of AI

Please be advised that in this course you are not authorized to use any form of generative AI. In order to successfully complete course activities, generative AI is not required nor welcomed. Students should not make any use of generative AI tools such as ChatGPT, Grammarly, among others that use AI for content generation and editing. As the University of Victoria states on its Academic Integrity Policy "Academic integrity requires commitment to the values of honesty, trust, fairness, respect, and responsibility." Therefore, I expect you to comply with the course syllabus and I encourage you to enhance your academic experience in this course by refraining from use of generative AI.

COURSE CALENDAR AND OUTLINE

UVic Important Dates: uvic.ca/calendar/dates/
Last day to add courses: January 21, 2026
Last day to drop a course without penalty of failure: January 31, 2026
Final Exam Period: April 7 – April 22, 2026

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Date	Lec.	Assign		Topic
Jan 06	1		Intro to radiotherapy	Radiotherapy workflow
Jan 09	2		Tour of BC Cancer	2410 Lee Avenue, at 4pm
Jan 13	3		Radioactivity	Atomic mass, nuclear decay, radioactivity, half-life, attenuation coefficients, uses in medical physics
Jan 16	4		X-ray and γ interactions	Photoelectric effect, Compton effect, pair production, interaction coefficients
Jan 20	5		Charged particle interactions	Electron and proton stopping power, bremsstrahlung production, LET, uses of charged particles
Jan 23	6	**A1 due**	Dosimetric quantities	Exposure and dose, charged particle equilibrium
Jan 27	7		Radiation generators, x-ray tubes	Theory, design, and operation
Jan 30	8		Linear accelerators and isotope devices	Design and operation, sources of RF, mechanical features, output spectra
Feb 03	9		Dosimetry instrumentation	Ionization chambers, TLD, diodes, film, chemical dosimetry, calorimetry, Bragg-Gray cavity theory
Feb 06	10		Biological effects of ionizing radiation	Stochastic and non-stochastic effects, equivalent dose
Feb 10	11	**A2 due**	Radiation protection and safety	Dose limits, exposure from natural and man-made sources, shielding
Feb 13	12		Problem solving	Prepare for midterm
Feb 24	13		Midterm	
Feb 27	14		Radiation treatment planning	Dose calculations and distributions
Mar 03	15		Computed tomography I	System configuration and evolution, x-ray source, scintillation detectors
Mar 06	16		Computed tomography II	Scintillation detectors, image reconstruction
Mar 10	17	**A3 due**	Nuclear medicine	Isotope production, radionuclide imaging using gamma camera, SPECT, PET: isotopes, detectors, sampling, random and true coincidences
Mar 13	18		Magnetic resonance imaging	NMR phenomenon, biological tissue discrimination, mapping of MR signals in 3-dimensions
Mar 17	19		Alternative radiation delivery methods	Proton therapy, gamma knife, CyberKnife, FLASH
Mar 20	20		Brachytherapy	Radioactive seeds. Methods of delivery. Application to prostate and cervical cancers
Mar 24	21		Monte Carlo methods	Introduction to Monte Carlo simulations
Mar 27	22	**A4 due**	Current Research Topics	Graduate students
Mar 31	23	**Paper due**	Student presentation	Undergraduate students

CHANGES DUE TO UNFORESEEN CIRCUMSTANCES

The above schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances. In the event of significant changes, a revised outline will be posted/circulated.

UVIC GRADING SYSTEM – UNDERGRADUATE

As per the Academic Calendar:

Grade	Grade Point Value	Grade Scale	Description
A+	9	90 – 100%	**Exceptional, outstanding** and **excellent** performance. Normally achieved by a minority of students. These grades indicate a student who is self-initiating, exceeds expectation and has an insightful grasp of the subject matter.
A	8	85 – 89%	
A-	7	80 – 84%	
B+	6	77 – 79%	**Very good, good** and **solid** performance. Normally achieved by the largest number of students. These grades indicate a good grasp of the subject matter or excellent grasp in one area balanced with satisfactory grasp in the other area.
B	5	73 – 76%	
B-	4	70 – 72%	
C+	3	65 – 69%	**Satisfactory**, or **minimally satisfactory**. These grades indicate a satisfactory performance and knowledge of the subject matter.
C	2	60 – 64%	
D	1	50 – 59%	**Marginal** Performance. A student receiving this grade demonstrated a superficial grasp of the subject matter.
F	0	0 – 49%	**Unsatisfactory** performance. Wrote final examination and completed course requirements; no supplemental.
N	0	0 – 49%	Did not write examination or complete course requirements by the end of term or session; no supplemental.

COURSE FEEDBACK

I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous **Course Evaluation Survey (CES)** regarding your learning experience. The survey is important for providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. The survey is accessed online and can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time, but please be thinking about this important activity during the course.

APPENDICES

DEPARTMENT OF PHYSICS AND ASTRONOMY INFORMATION

- **Department Website:** uvic.ca/science/physics/index.php
- **Department General Office:** physgen@uvic.ca
- **Department Undergraduate Advisor:** phast_advising@uvic.ca

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UNIVERSITY STATEMENTS & POLICIES

- Academic Calendar: Information for All Students
- Creating a respectful, inclusive, and productive learning environment
- Accommodation of Religious Observance
- Accommodation and Access for Students with Disabilities
- Student Conduct
- Non-academic Student Misconduct
- Accessibility
- Diversity / EDI
- Equity Statement
- Sexualized Violence Prevention and Response
- Discrimination and Harassment Policy

STUDENT RESOURCES

POSITIVITY AND SAFETY

The University of Victoria is committed to promoting, providing, and protecting a positive and safe learning and working environment for all its members.

Student Groups & Resources

ACADEMIC RESOURCES

UVic Library - *UVic Library offers many services and resources for undergraduate and graduate students*.

uvic.ca/students/academics/library-services

Learning Resources - *UVic Learn Anywhere is the primary learning resource for students that offers many learning workshops and resources to help students with academics and learning strategies.*

onlineacademiccommunity.uvic.ca/uviclearn/

Centre for Academic Communication - *Offers online and in-person one-on-one tutorials, workshops, and more.*

uvic.ca/learningandteaching/cac

Physics Aid Service – *Addresses problems with conceptual understanding, difficulties encountered with homework assignments, preparation for mid-term and final exams, and occasionally even preparation for external exams such as the MCAT. Instruction may be one-to-one or in small groups, with emphasis placed on engaged interaction between the students and the instructor.*

https://www.uvic.ca/science/physics/current/undergraduate/pas/index.php

MENTAL HEALTH & WELLNESS

A note to remind you to take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, getting enough sleep, and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone.

Student Wellness Centre - *Our team of practitioners offers a variety of services to support students' mental, physical, and spiritual health.*

uvic.ca/student-wellness

Counselling Services - *Counselling Services can help you make the most of your university experience. They offer free professional, confidential, inclusive support to currently registered UVic students.*

uvic.ca/student-wellness

Health Services - *University Health Services (UHS) provides a full-service primary health clinic for students and coordinates healthy student and campus initiatives.*

uvic.ca/student-wellness

ACCESSIBILITY

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a documented disability or health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL) as soon as possible.

Centre for Accessible Learning - *The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.*

uvic.ca/accessible-learning

ADVISING

For academic advising-related questions, students in the Department of Physics & Astronomy are also encouraged to meet with the Undergraduate Advisor (phast_advising@uvic.ca) as well as an academic advisor in the Academic Advising Centre early in their studies to help map out a plan to declare a major and complete university program requirements.

Academic Advising Centre - *Academic advice and support is currently available by phone, email and virtual or in-person appointments*. uvic.ca/services/advising

Ombudsperson - *The ombuds office is an independent, impartial, and confidential resource for undergraduate and graduate students and other members of the University of Victoria community. The ombudsperson helps resolve student problems or disputes fairly.* uvicombudsperson.ca

ACADEMIC CONCESSION

You can request an academic concession if your course requirements are affected by unexpected and unavoidable circumstances, or conflicting responsibilities. Concession requests can be for an in-course extension, deferral, withdrawal under extenuating circumstances, or an aegrotat. Please speak to an advisor at the Academic Advising Centre if you have questions on how requesting a concession will affect your academic program.

Undergraduate Academic Concessions - uvic.ca/students/academics/academic-concessions-accommodations

EQUITY AND HUMAN RIGHTS AT UVIC

EQHR is a resource for students, staff, and faculty who have experienced sexualized violence, discrimination, and/or harassment and are looking for informal and/or formal resolution options as well as advice, coaching, and/or education. We are available for confidential consultations so that you can ask questions and learn your options.

EQHR – By email at eqhr01@uvic.ca or in-person (Sedgewick C115). uvic.ca/equity

Sexualized Violence Resource Office – *If you have been directly or indirectly impacted by sexualized violence, reach out to the SVRO for information, advice, and resolution options (restorative and disciplinary) as well as support options and referrals. The SVRO is both survivor-centred and trauma-informed in their approach. You can reach us by phone at 250-721-8021 or by email at eqhr01@uvic.ca to book either an in-person (Sedgewick C119) or online appointment.* uvic.ca/sexualizedviolence

RESOURCES FOR INTERNATIONAL STUDENTS

International Centre for Students - *The primary office supporting international students on campus at the university-wide level*. uvic.ca/international-experiences

UVic Global Community Initiative - *Provides various supportive programming, including a Mentorship Program and Conversation Partner Program*. uvic.ca/international-experiences/get-involved/uvic-global-community

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RESOURCES FOR INDIGENOUS STUDENTS

Indigenous Student Support - *UVic offers holistic services to Indigenous students throughout their academic journey.* uvic.ca/students/info-for/indigenous-students

Elders in Residence - *The Office of Indigenous Academic and Community Engagement (IACE) has the privilege of assembling a group of Elders from local communities to guide students, staff, faculty, and administration in Indigenous ways of knowing and being.* uvic.ca/iace/