

Physics 2400 [Subatomic Physics] Winter 2022

This course is designed to be offered fully online. There are no scheduled classes. Students will need to have access to a networked PC or Mac computer. Please see the [minimum computer requirements](#).

Professor	Svetlana Barkanova	
Email Address	sbarkanova@grenfell.mun.ca	
Office Location	n/a	
Office Hours	Feel free to email anytime.	
Office Phone	n/a	
Class Meeting Time/Place	n/a	
Grading	Home Assignments (4): 40% Tests (4): 40% Presentation (1): 20% Final Exam: n/a	
Text	Required: "Modern Physics", 3 rd or 4 th edition, Kenneth Krane, Wiley; Suggested: "An Introduction to Physics of Nuclei and Particles", by Richard Dunlap, 1 st ed.	

Outline: Topics include classification and properties of subatomic particles, nuclear properties and models, radioactive dating, fission and fusion, reactors and accelerators. We will also discuss applications in areas such as energy production, ecology, dosimetry, medical physics and nuclear astrophysics.

Skills: Problem-solving and analytical skills, time management, literature search, writing and presentation skills

All members of the Memorial University of Newfoundland community, including students, faculty, and staff, shall treat others with respect and fairness, be responsible and honest, and uphold the highest standards of academic integrity. By submitting work for this course, the students state that all work is entirely their own and does not violate [Memorial University's Academic Integrity policy](#).

If you have a disability or other condition that requires special arrangement or consideration, please feel free to discuss this with staff in the Learning Centre (Student Services), phone 637-6268, e-mail studentservices@grenfell.mun.ca - in a confidential setting. More information on the University's policy is available at <http://www.grenfell.mun.ca/student-services/disability-services>.

Structure:

The course is sub-divided into four blocks, each with its own assessment mode:

Module 1 – Particle Physics, with HA#1 and Test#1 on Module 1 material. See Chapter 14 in Krane.

Module 2 – Nuclear Structure and Nuclear Decays, with HA#2 and Test#2 on Module 2 material. See Chapter 12 in Krane.

Module 3 – Nuclear Reactions and Applications, with HA#3 and Test#3 on Module 3 material. See Chapter 13 in Krane.

Module 4 – Physics and Society, with 10-min live or pre-recorded student presentations. HA#4 and Test#4 on Module 4 material.

Submit home assignments as PDF files on D2L. Tests are 90-min each, online, multiple-choice, open-book.

Schedule:

Week #	Dates	Information
Week 1	January 10 - 16	1.0 Introduction and Basic Concepts 1.1 The Four Basic Forces 1.2 Classifying Particles 1.3 Conservation Laws 1.4 Particle Interactions and Decays 1.5 Energy and Momentum in Particle Decays 1.6 Energy and Momentum in Particle Reactions
Week 2	January 17 - 23	1.7 The Quark Structure of Mesons and Baryons 1.8 The Standard Model 1.9 Neutrino Physics 1.10 Cosmic Rays 1.11 Physics Beyond Standard Model
Week 3	January 24 – 30	HA #1 (Module 1); Test #1 (Module 1)
Week 4	Jan. 31 - February 6	2.1 Nuclear Constituents 2.2 Nuclear Sizes and Shapes 2.3 Nuclear Masses and Binding Energies 2.4 The Nuclear Force 2.5 Quantum States in Nuclei
Week 5	February 7 - 13	2.6 Radioactive Decay 2.7 Alpha Decay 2.8 Beta Decay

		2.9 Gamma Decay and Nuclear Excited States 2.10 Natural Radioactivity 2.11 Radioactive Dating
Week 6	February 14 - 20	HA #2 (Module 2); Test #2 (Module 2)
Week 7	February 21 – 27	Winter Break - No Classes
Week 8	Feb. 28 - March 6	3.1 Types of Nuclear Reactions 3.2 Radioisotope Production in Nuclear Reactions 3.3 Low-Energy Reaction Kinematics 3.4 Fission 3.5 Fusion
Week 9	March 7 - 13	3.6 Nucleosynthesis 3.7 Stellar Evolution and Nuclei Formation 3.8 Nuclear Energy 3.9 Nuclear Weapons 3.10 Biological Effects of Radiation 3.11 Radon Measurement and Mitigation
Week 10	March 14 - 20	HA #3 (Module 3); Test #3 (Module 3)
Week 11	March 21 - 27 [Student Presentations]	4.1 Radioactive Dating: Famous Examples 4.2 Uranium Mining in Canada 4.3 PPE: Nuclear vs Chemical vs Biological 4.4 Radiation Safety in Workplace 4.5 Dosimetry 4.6 Nuclear Medicine: Imaging 4.7 Nuclear Medicine: Therapy 4.8 Food Irradiation 4.9 Accidents and Risk Communication
Week 12	March 28 - April 3 [Student Presentations]	4.10 International Nuclear Treaties 4.11 Multi-Messenger Astrophysics 4.12 “Big Science”: CERN and KEK 4.13 “Big Science”: TRUIMF and Los Alamos 4.14 “Big Science”: Ice Cube and SNOLab 4.15 Our History and Our Heroes 4.16 Women in Nuclear and Particle Physics 4.17 TBA 4.18 TBA 4.19 TBA 4.20 TBA
Week 13	April 4 – 10	HA #4 (Module 4); Test #4 (Module 4)