

**ENGPHYS 2QM3**  
**Introduction to Quantum Mechanics**  
Undergraduate Studies  
Winter 2024  
Course Outline

**CALENDAR/COURSE DESCRIPTION**

Basic foundations of quantum mechanics; wave-particle duality, uncertainty principle, Hydrogen atom, Schrodinger Equation, barriers and tunnelling, probability, spin, quantum statistics, selected applications.

**PRE-REQUISITES AND ANTI-REQUISITES**

Prerequisite(s): Registration in Level II or above of an Engineering program

Antirequisite(s): PHYSICS 2C03

**INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION**

**Dr. Rafael Kleiman**

[kleiman@mcmaster.ca](mailto:kleiman@mcmaster.ca)

**Office Hours:**

Use email to discuss a topic and/or book a meeting

**TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION**

**Lauren Watson**

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**Kieran D'Sena**

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**COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION**

1. Avenue to Learn is the official course website for course communication, submission of work and grading, <http://avenue.mcmaster.ca/>
2. Lectures and tutorials will be in person. Quizzes will take place during the tutorials. Students should bring their laptops to the tutorials for the quizzes.

**COURSE INTENDED LEARNING OUTCOMES**

By the end of this course, students should have a working knowledge of the fundamental concepts of quantum mechanics and their connection to ordinary phenomena and experimental observations. The topics include:

- Planck's constant, Correspondence Principle
- De Broglie wavelength and the Wave-particle duality
- Quantized energy and momentum of particles
- Uncertainty principle and Zero-point motion
- Central postulates of Quantum Mechanics
- Probability wavefunction and probabilistic outcomes
- Schrödinger Equation
- Solution of Schrödinger Equation for one dimensional systems
- Hydrogen atom, atomic structure, Periodic Table
- Identical particles
- Quantum statistics

### **MATERIALS AND FEES**

#### **Required Texts:**

"Quantum Physics: A Fundamental Approach to Modern Physics", by John Townsend, published by University Science Books, 2009.

ISBN 10: 1891389629

ISBN 13: 978-1-891389-62-7

eISBN: 978-1-938787-51-5

#### **Recommended Additional Texts/Resources:**

"Modern Physics for Scientists and Engineers", by Stephen Thornton & Andrew Rex, published by Thomson - Brooks/Cole, 4<sup>th</sup> Edition, 2013.

"Quantum Mechanics: The Theoretical Minimum", Leonard Susskind and Art Friedman (Perseus Books 2014) and <http://theoreticalminimum.com/courses>

"The Feynman Lectures on Physics, New Millennium Edition", Richard Feynman and Robert Leighton (Basic Books 2011) and <http://www.feynmanlectures.caltech.edu/>

### **COURSE FORMAT AND EXPECTATIONS**

The course is scheduled as follows:

• C01: lecture	Tuesday	12:30 – 1:20 pm	DSB AB102
• C01: lecture	Wednesday	12:30 – 1:20 pm	DSB AB102
• C01: lecture	Friday	12:30 – 1:20 pm	DSB AB102
• T01: tutorial	Tuesday	5:30 – 6:20 pm	JHE 326H

Maps are posted on Avenue with directions to DSB AB102, which *cannot* be accessed through the DSB entrance.

The class format is in person. Student attendance and participation at the lectures/tutorials is expected. This is difficult material to learn entirely on your own.

### **COURSE SCHEDULE**

This lecture schedule is based upon current university and public health guidelines and may be subject to changes during the term. Any changes to the schedule or course delivery will be communicated on the course announcements section on Avenue to Learn. Please check the announcements prior to attending class.

A detailed course schedule of topics and related readings is posted on Avenue. This schedule may be modified from time to time based on student input and extenuating circumstances. Students are expected to read the material from the textbook prior to coming to class, to make best use of class time.

Assignments will be due, and quizzes will be held every 2 weeks, as indicated in the schedule below. The quizzes will be held on Tuesdays at the regular tutorial time. The Assignments will be issued on Avenue approximately 1 week prior to the due date, with submissions via the Avenue dropbox. No grades will be provided for late submissions – please plan accordingly.

**ASSESSMENT**

Component	Sub-component	Date	Weight
Quizzes (6)			25% (5% each) for the best 5 of 6 quizzes
	Quiz 1	Tuesday January 16 <sup>th</sup> 5:30-6:20 pm	
	Quiz 2	Tuesday January 30 <sup>th</sup> 5:30-6:20 pm	
	Quiz 3	Tuesday February 13 <sup>th</sup> 5:30-6:20 pm	
	Quiz 4	Tuesday March 5 <sup>th</sup> 5:30-6:20 pm	
	Quiz 5	Tuesday March 19 <sup>th</sup> 5:30-6:20 pm	
	Quiz 6	Tuesday April 2 <sup>nd</sup> 5:30-6:20 pm	
Assignments (5)			50% (10% each)
	Assignment 1	Due Monday January 29 <sup>th</sup> 11:59 pm	
	Assignment 2	Due Monday, February 12 <sup>th</sup> 11:59 pm	
	Assignment 3	Due Monday March 4 <sup>th</sup> 11:59 pm	
	Assignment 4	Due Monday March 18 <sup>th</sup> 11:59 pm	
	Assignment 5	Due Monday April 1 <sup>st</sup> 11:59 pm	
Final Exam		Time, date, and location set by the Registrar	25%
Total			100%

**MSAF policy:**

- An MSAF for a missed quiz will automatically allocate the missed grade to the total quiz grade component.
- An MSAF for a missed assignment will automatically lead to a 1-week extension for that assignment, but it still needs to be submitted.

**ACCREDITATION LEARNING OUTCOMES**

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
01.1 - Competence in Mathematics	1.1
01.2 - Competence in Natural Sciences	1.2
01.3 - Competence in Engineering Fundamentals	1.3
01.4 - Competence in Specialized Engineering Knowledge	1.4
02.1 - Demonstrates an ability to identify reasonable assumptions (including identification of uncertainties and imprecise information) that could or should be made before a solution path is proposed.	2.1

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

### **EQUITY, DIVERSITY, AND INCLUSION**

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Engineering Physics is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the [Equity and Inclusion Office](#).

### **PHYSICAL AND MENTAL HEALTH**

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#).

### **GENERATIVE AI: UNRESTRICTED USE**

Students may use generative AI throughout this course in whatever way enhances their learning; no special documentation or citation is required.

### **ACADEMIC INTEGRITY**

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](#), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

### **AUTHENTICITY / PLAGIARISM DETECTION**

**Some courses may** use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic**

**integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

#### **COURSES WITH AN ON-LINE ELEMENT**

McMaster is committed to an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

**Some courses may** use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

#### **CONDUCT EXPECTATIONS**

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

#### **ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES**

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905-525-9140 ext. 28652 or [sas@mcmaster.ca](mailto:sas@mcmaster.ca) to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

#### **COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES**

No credit will be given for work submitted after the stated deadlines.

#### **SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK**

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**

- Use the [McMaster Student Absence Form](#) (MSAF) on-line self-reporting tool. No further documentation is required.

- Students may submit requests for relief using the MSAF once per term.
- An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
- The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
- The MSAF cannot be used for academic work that has already been completed/attempted.
- An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
- The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**

- Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
- If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

#### **ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)**

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [\*\*RISO\*\*](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

#### **COPYRIGHT AND RECORDING**

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

#### **EXTREME CIRCUMSTANCES**

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.