Course website:  http://robertkoenig.net/teaching/QM2/internal
for password-protected materials: username quantum password mechanics
lecture times:  11:30-12:20 MWF
location:  MC 4042
Instructor:  Robert Koenig
rkoenig@uwaterloo.ca
office  QNC 3123
office hours:  see 4-5 F/by appointment
Teaching assistant 1:  Sascha Agne, sascha.agne@uwaterloo.ca
Teaching assistant 2:  David Layden, dlayden@uwaterloo.ca

Assignments/Grades:
Assignments (roughly 0.7/week) must be submitted at the beginning of class on the designated due date, or are otherwise considered late, in which case a penalty of 10% per day may be applied. In some instances (such as after solutions have been made available), late assignments will not be accepted. Collaboration on assignments is encouraged but copying is not acceptable.

Students taking this course as a graduate course (AMATH 673) will do extra homework and submit a short project report. Details of the project will be decided in advance in consultation with the instructor.

The course will use the following marking scheme:

<table>
<thead>
<tr>
<th></th>
<th>undergraduate</th>
<th>graduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>homework</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>midterm exam</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>essay</td>
<td>-</td>
<td>10%</td>
</tr>
<tr>
<td>final</td>
<td>50%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Outline of topics: The course will discuss the mathematical structures underlying quantum mechanics (e.g., Hilbert spaces, self-adjoint operators, operator-valued measures, one-parameter-groups). Subsequently, the axiomatic formulation of quantum mechanics and the canonical quantization procedure will be reviewed. The relation between the Schrödinger, Heisenberg and interaction pictures will be discussed, along with some applications. The role of symmetries in quantum mechanics will be examined with a special focus on rotational invariance. Basic perturbative methods will be treated. Time permitting, some additional topics include many-particle physics and entanglement theory/Bell inequalities, as well as decoherence.\(^1\)

\(^1\)See reverse side for important information on University policies.
The following information must be included in every course outline, as mandated by the University Senate.

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 Student Petitions and Grievances, Section 4, [http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm)

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 Student Discipline, [http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm)

**Avoiding Academic Offenses:** Most students are unaware of the line between acceptable and unacceptable academic behaviour, especially when discussing assignments with classmates and using the work of other students. For information on commonly misunderstood academic offenses and how to avoid them, students should refer to the Faculty of Mathematics Cheating and Student Academic Discipline Policy, [http://www.math.uwaterloo.ca/navigation/Current/cheating policy.shtml](http://www.math.uwaterloo.ca/navigation/Current/cheating policy.shtml)

**Appeals:** A student may appeal the finding and/or penalty in a decision made under Policy 70 Student Petitions and Grievances (other than regarding a petition) or Policy 71 Student Discipline if a ground for an appeal can be established. Read Policy 72 Student Appeals, [http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

**Note for students with disabilities:** The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.