PMATH 763: Lie Groups and Lie Algebras  
WINTER 2015

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- Office Hours: Mon 1:30pm – 2:30pm; Fri 12:01pm – 1:30pm.  
- Course Lectures: Mon/Wed 12:01pm – 1:20pm in TBA.  

Course description: This course is an introduction to Lie groups and Lie algebras, including their representation theory, with a focus on matrix groups. An emphasis will be placed on the concrete examples of the classical Lie groups. If time permits, we will briefly discuss exceptional groups, spin groups, and Jordan algebras at the end of the course.

Prerequisites: The course prerequisites are real analysis, linear algebra, and group theory. Familiarity with complex analysis and manifold theory is helpful but not required. Previous exposure to the representation theory of finite groups will give students added appreciation for the results of this course. Most importantly, however, students must have mathematical maturity. We will cover a very large amount of material at a fast pace.

Brief (tentative) description of topics: Matrix Lie groups; Lie algebras and the exponential mapping; big “Ad” and little “ad”; the Lie correspondence; homomorphisms of Lie groups and Lie algebras; the Campbell-Baker-Hausdorff formula; bilinear forms and the classical Lie groups; representation theory: explicit examples of SU(2) and SU(3); roots, weights, the Weyl group; if time permits: Clifford algebras and spin groups; the exceptional Lie groups; Jordan algebras.

Textbook

- Lie Groups, Lie Algebras, and Representations: An Elementary Introduction,  
  by Brian C. Hall; Springer, 2003.

The text will be available in the bookstore. I plan to cover all the material in Chapters 1–6, as well as some additional material from this textbook and from other sources.

Here are some useful additional references. The first one (as well as the required text) will be on reserve at the Davis library.

- Representation Theory: A First Course; by William Fulton and Joe Harris; Springer, 1991.  
- Spinors and Calibrations; by F. Reese Harvey; Academic Press, 1990.

Marking scheme

Your course mark will be determined as follows:

- Assignments: 54% (six assignments, one about every two weeks, worth 9% each)  
- FINAL EXAM: 46% (2.5 hours; date and time of the final exam TBA)

Please note that while you are encouraged to work together with your classmates on the assignment problems, but you must write up and turn in your own solutions to the problems.
Academic offenses

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. Please see http://www.uwaterloo.ca/academicintegrity/ for more information.

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. When in doubt please be certain to contact the departments administrative assistant who will provide further assistance.

 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. 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. For typical penalties check Guidelines for the Assessment of Penalties, http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.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

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

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.