

MATH 667

Algebra of Symmetries

Class Policies

Dr. Mike O'Leary

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Fall 2010

Class: Tu 5:00-7:40

Room: Towson High School, Room 111

Section: 101

Office Hours: By appointment

Prerequisites: Admission to the Master of Science in Mathematics Education Program or approval of the department

Catalog Description: Complex integers, permutation groups, properties of abstract groups of plane transformations and matrix representations of transformations. Culminates in developing the 17 groups of symmetries of the Euclidean plane

Instructional Material The primary text is

- Bernard L. Johnson & Fred Richman, *Numbers and Symmetry*, CRC Press, 1997. ISBN: 9780849303012

Other related references include:

- M.A. Armstrong, *Groups and Symmetry*, Springer-Verlag 1988.
- W. Farmer, *Groups and Symmetry, A Guide to Discovering Mathematics*, Mathematical World, Vol. 5, (American Mathematical Society, 1996).
- M.J. Greenberg, *Euclidean and Non-Euclidean Geometries, Development and History*, Third Ed., W.H. Freeman and Company, 1993.
- J. Kappraff, *Connections, The Geometric Bridge between Art and Science*, McGraw Hill, 1991.
- T.Q. Sibley, *The Geometric Viewpoint, A Survey of Geometries*, Addison Wesley Longman 1998.

Course Topics: The following is the planned list of course topics (with the corresponding section in our primary text); we may add or subtract material depending on the balance of available time in class.

1. New Numbers (Chapter 1). Rings; examples of number systems other than integers, rationals, or real numbers. Discussion of Gaussian integers $\mathbf{Z}[i]$, circular numbers \mathbf{Z}_n , and $\mathbf{Z}[\sqrt{2}]$.
2. The Division Algorithm (Chapter 2). The division algorithm for integers. Norms on rings. Fields; the Gaussian numbers and $\mathbf{Q}[\sqrt{2}]$. Polynomials.
3. Symmetries (Chapter 6). Symmetries of plane figures. Groups; permutation groups, dihedral groups. Permutations and their cycle structure. Cyclic groups. Even and odd permutations; the sign of a permutation; the alternating groups.
4. Matrices (Chapter 7). Matrices, 2×2 matrices. The ring $M_2(R)$; units in $M_2(R)$. The general linear group $GL(2, R)$. Complex numbers and quaternions.

5. Groups (Chapter 8). Groups, subgroups. Lagrange's Theorem. Isomorphism. The group of units of a finite field. External direct product of groups. The Euclidean groups $E(1)$, $E(2)$ and $E(3)$.
6. Wallpaper patterns (Chapter 9). One dimensional patterns; classification of patterns by their symmetry group. Plane lattices. Frieze patterns. Space groups and the 17 plane groups.

Attendance: Attendance is expected; you should only miss a class for a compelling reason. If you do miss a class, you are responsible for any material that you miss, including any homework assignments given in that class. Unexcused absences can result in a lower grade.

Students should not attend classes or other university events from the onset of flu-like symptoms until at least 24 hours after the fever subsides without the use of fever reducing medications. Such absences will be considered excused absences; however, students are responsible for the material covered during the period of their absence.

Grading: Problem sets will be assigned each week; they will be collected 1-2 weeks later. There will be no midterm examinations, but there will be a final exam. The final grade shall be determined by a weighted average of the homework grade and the final exam grade; the final exam is worth 30% and the homework assignments will be worth 70%.

Guidelines for Homework:

1. Late work will not be accepted without a compelling reason.
2. Assignments are required to be neat, clean, and paper-clipped or stapled.
3. Assignments must include the authors name, and a brief description of the assignment.
4. Students are allowed to discuss homework problems with their classmates, however all work that is turned in must be the students own work.

Any assignment that does not meet these criteria may receive a deduction in score, or more generally will simply be rejected.

Final Exam: The Final Exam is scheduled for Tuesday, December 14, from 5:00 - 7:00 pm; please note the time. The final exam will not be rescheduled. Attendance is expected; a make-up exam will not be given without an extremely compelling reason. The final exam shall be comprehensive.

Academic Integrity The nature of higher mathematics requires that students adhere to accepted standards of academic integrity. Violations of academic integrity include cheating, plagiarism, falsification and fabrication, complicity in academic dishonesty, personal misrepresentation and proxy, bribes, favors and threats. Cheating is a serious offense that will have grave consequences for your academic life.

Students who violate these standards will either fail the course outright or, at the instructors discretion, may merely receive a zero on any assignment for which the student receives inappropriate assistance. Particularly serious violations of these standards will be referred to the administration for possible additional action.

Withdraw: The last day to withdraw from the course with a grade of W is November 8.

Help: If you have difficulty completing a homework assignment, do not hesitate to ask for help, either from your friends, or from me. You are welcome to stop by my office, for whatever reason, and at whatever time, even if there are no office hours scheduled then. If you wish, you may also simply

send an e-mail message.

Web Page: My web page at <http://www.towson.edu/moleary> has copies of all of the old exams that I have given while at Towson.