Math 4303 **FUNDAMENTALS OF MATH** Fall 2014
Dr. Duval **Final Projects**

Groups of three (or two) students each will work on one of the final projects listed below. You must work with other students than the ones you worked with for the student presentation.

Each group will prepare a complete written solution (approximately five pages) and a 15-minute presentation. The paper does not need to be typeset if the handwriting is legible. The projects will be presented during the final exam period on **Thursday, December 11, 1:00 – 3:45**. The accompanying papers are due before the start of the presentations. In all cases, you should prove in some detail the steps of any results you present (include the details in your written report; summarize them appropriately during your presentation). If you look up any sources, you must cite them appropriately; plagiarism will not be tolerated.

The student group will be graded as a group. All group members must contribute to both the written solution and the presentation in equal parts. If members of a group feel that one member is not contributing in a meaningful way, they can ask me to remove the particular student from their group.

The group will be graded foremost on the mathematical correctness and mathematical clarity of their solution. Other criteria include the quality and completeness of the written report, the quality of the group presentation, making effective use of the allotted time, and staying within the time frame of 15 minutes for the oral presentation.

Projects (The numbers refer to end-of-chapter projects.)

1. Duodecimal system — State and prove theorems for numbers in base 12 corresponding to the theorems in Section 2.1.3.

2. Countability of algebraic numbers (2.2).

3. Algebraic numbers closed under addition and multiplication (see handout with summary of proof).

4. Stereographic projection (2.8).

5. nth differences and polynomial functions (3.5; see also Section 3.3.2).

6. Limit definitions for the number e (3.6).

7. How likely are real solutions for quadratic equations with integer coefficients? (4.2a). [Requires probability theory.]

8. Cardano-Tartaglia method for solving cubic equations; include the "casus irreducibilis" (2.5).

9. Ferrari's method to solve quartic equations (4.5).

10. Newton's method (4.6). Include a discussion of the application of Newton's method to the polynomial $f(x) = x^2 + 1$. [Requires use of appropriate software, *e.g.*, *Excel* or *Mathematica*.]