COURSE SYLLABUS
Math 355.01 -- TRANSFORMATIONAL GEOMETRY
Spring 2006

CRN: 7522
CREDIT HOURS: 3
HOUR/DAY: 7:30 – 8:45 a.m.  T
8:00 – 9:15 a.m.  R
MEETING ROOM: Osburn Hall, Room 120

INSTRUCTOR: Ron Umble
OFFICE: Chester House, Room 200
OFFICE PHONE: 872-3708
DEPT. PHONE: 872-3531
FAX: 871-2320
E-MAIL: ron.umble@millersville.edu
URL: http://marauder.millersville.edu/~rumble/
OFFICE HOURS: 11:00 a.m. – noon M T R F
3:00 – 4:00 p.m.            R
and by appointment


FORMAT: Lecture and laboratory
REQUIRED TOOLS:
- 3-ring binder
- Mechanical pencil with .05 mm HB lead
- Eraser
- 6” ruler
- Good quality compass with lockable arms
- MIRA
- Protractor
- Overhead projector pen
- 2 overhead projector transparencies

OBJECTIVES: Upon completion of this course, the student will be able to:
- Use a MIRA and Geometer’s Sketchpad to perform the standard straight-edge & compass constructions and trisect a general angle.
- Classify a non-identity isometry as a reflection, rotation, translation, or glide reflection.
- Factor a non-identity isometry as a composition of three or fewer reflections.
- Identify the symmetries of a plane figure and determine its symmetry group (rosette, frieze and wallpaper groups).
- Classify a similarity as an isometry, stretch, stretch rotation, or stretch reflection.

MAKE UP POLICY: Makeup exams will be administered when an exam is missed for one of the following university authorized reasons:
- Illness documented by the campus infirmary
- Death of a family member
- Religious holiday
- Participation in out-of-the-classroom educational activities
- Participation in varsity athletic competition.
Advance notification is required in the later three cases.
<table>
<thead>
<tr>
<th>EVALUATION:</th>
<th>Component</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Problem sets</td>
<td>(3 @ 5%)</td>
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<tr>
<td></td>
<td>Lab reports</td>
<td>(5 @ 3%)</td>
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<td></td>
<td>MIRA constructions</td>
<td></td>
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<tr>
<td></td>
<td>Hour Exams</td>
<td>(2 @ 20%)</td>
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<tr>
<td></td>
<td>Final Examination</td>
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**Grading Scale**

- 93% - 100% A
- 90% - 92% A-
- 87% - 89% B+
- 83% - 86% B
- 80% - 82% B-
- 77% - 79% C+
- Below 60% F

**INTRODUCTION**

Euclidean plane geometry is the study of size and shape of objects in the plane. It is one of the oldest branches of mathematics. Indeed, by 300 BC Euclid had deductively derived the theorems of plane geometry from his five postulates. More than 2000 years later in 1628, Rene' Descartes introduced coordinates and revolutionized the discipline by using analytical tools to attack geometrical problems. To quote Descartes, "Any problem in geometry can easily be reduced to such terms that a knowledge of the lengths of certain lines is sufficient for its construction."

About 250 years later, in 1872, Felix Klein capitalized on Descartes' analytical approach and inaugurated his so called *Erlangen Program*, which views plane geometry as the study of those properties of plane figures that remain unchanged under some set of transformations. Klein's startling observation that plane geometry can be completely understood from this point of view is the guiding principle of this course and provides an alternative to Euclid's axiomatic/synthetic approach. In this course, we shall consider two such families of transformations: (1) the plane isometries (distance-preserving transformations), which include the translations, rotations, reflections and glide reflections and (2) the plane similarities, which include the isometries, stretches, stretch rotations and stretch reflections. Our goal is to understand congruence and similarity of plane figures in terms of transformations in these two families.
# COURSE SCHEDULE
## Math 355.01 -- Transformational Geometry
### Spring 2006

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Exercises (D/L)</th>
<th>(U)</th>
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</thead>
</table>
| Jan 17T| Introduction: The MIRA and Geometer's Sketchpad  
Transformations of the plane | 1.1-1.12        | 5:1-5     |
|        | **Lab #1: Water Supply I: Four Towns** |                 |           |
| 19R    | Isometries and reflections  
The equations of a reflection          | 1.13-1.20       | 9:1-6,8-14,17 |
|        | **Problem Set #1: (U) 5:6; 10:7; 12:16; 16:1b,6,7; 21:3,5; 25:9; 31:5**  |                 |           |
| 24T    | Translations and glide reflections  
LAB #1 REPORT DUE                  | 2.1-2.8         | 16:1a,2-5,9 |
|        | 21:1,2,4,6                       |                 |           |
| 26R    | Translations, halfturns and their compositions  
LAB #1 REPORT DUE                  | 2.9-2.10        | 24:1-8,10,11 |
|        | LAB #2: Water Supply II: Three Towns                                       | 2.13-2.18       | 31:1-4,6-8 |
| 31T    | Rotations  
The Three Points Theorem                                       | 2.11-2.12       | 36:1-4    |
|        | PROBLEM SET #1 DUE                                                          | 2.32-2.33       |           |
|        | 2.39-2.44                      |                 |           |
| Feb 2R | Translations as reflections in two parallel lines  
Reflections in three parallel lines  
PROBLEM SET #1 DUE                  | 2.20-2.23       | 46:1-5    |
|        | PROBLEM set #2: 37:5; 51:6,7,8,9; 62:3; 68:8,9,10; 76:6                   |                 |           |
| 7T     | Rotations as reflections in two intersecting lines  
Reflections of three concurrent lines  
LAB #2 REPORT DUE                  | 2.46-2.50       | 50:1-5    |
|        | Lab #3: Triangle Altitudes                                                  |                 |           |
| 9R     | The Fundamental Theorem  
Congruent plane figures                                                        | 1.21-1.24       | 51:10-14  |
|        | 2.51-2.54                     |                 | 58:1,2    |
| 14T    | **PROBLEM SESSION AND REVIEW**                                             |                 |           |
| 16R    | **HOUR TEST I**                                                             |                 |           |
| 21T    | Classification of isometries with fixed points  
The Angle Addition Theorem, part I  
LAB #3 REPORT DUE                  | 1.25-1.33       | 62:1,2    |
|        | **Lab #4: Triangle Angle Sum**                                              | 2.19             |           |
| 23R    | Simplifying compositions of four reflections                                | 1.34-1.40       | 67:1-3    |
| 28T    | Parity                                                                       | 1.42-1.43       | 67:4-6    |
Mar 2R Geometry of conjugation 1.44-1.51 76:1-5

7T Angle addition Theorem, parts II and III 1.52-1.55 Properties of glide reflections 76:7-8
  LAB #4 REPORT DUE

7T Lab #5: The Airport Problem

9R Classification of isometries 83:1,3(a-d),4,5
  Conjugating glide reflections
  PROBLEM SET #2 DUE

Problem set #3: 76:9; 79:4; 83:3e,6; 91:2; 95:5; 100:3,4; 110:5,7

11 – 19 SPRING BREAK

21T Groups of isometries 87:1-3
  LAB #5 REPORT DUE 91:1,3-7

23R The rosette groups 95:1-4
  Leonardo’s Theorem

28T The frieze groups 2.55-2.59 100:1,2,56

30R The wallpaper groups 108:1-4,6
  PROBLEM SET #3 DUE

April 4T PROBLEM SESSION AND REVIEW

6R HOUR TEST II

11T SNOW MAKEUP DAY

13R Similarities and stretches 2.60-2.63 118:1,2

18T Dilations and dilatations 118:3,4

20R Similar plane figures 118:5,6

25T The fixed point of a non-isometric similarity 121:1-4
  MIRA CONSTRUCTIONS DUE

27R Classification of plane similarities 125:2-5

May 2T PROBLEM SESSION AND GENERAL REVIEW

8M FINAL EXAMINATION (2:45 – 4:45 p.m.)