COURSE SYLLABUS
Math 355.01 – Transformational Geometry
Spring 2017

CRN: 7521
CREDIT HOURS: 3
HOUR/DAY: 8:00 – 8:50 a.m. M W F
MEETING ROOM: Wickersham Hall, Room 219

INSTRUCTOR: Dr. Ron Umble
OFFICE: Wickersham Hall, Room 219
OFFICE PHONE: 871-7318
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OFFICE HOURS: 9:00 - 11:00 a.m. M F
11:00 a.m. – noon R
and by appointment

REQUIRED TEXTS: Dayoub and Lott. *Geometry: Constructions and Transformations. Dale Seymour Publications,* Palo Alto, CA, 1977. ISBN: 0-86651-499-6. (Text available in the University Store.) *Copied by permission of the authors*

Umble, R. and Han Z., *Transformational Plane Geometry,* CRC Press, 2015. ISBN: 978-1-4822-3471-8.

SOFTWARE: Geometer's Sketchpad Student Edition (1 yr. license)
https://www.mheonline.com/program/view/2/16/2647/00000SPAD
On-line price: $9.95 (plus S&H)

REQUIRED TOOLS:

- Mechanical pencil with .05 mm HB lead
- Eraser
- 6" ruler
- Good quality compass with lockable arms
- MIRA
- Protractor
- Overhead transparency pen
- 2 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, in addition, to trisect a general angle.
- Classify an isometry as a reflection, translation, rotation, or glide reflection.
- Express an isometry as a composition of three or fewer reflections.

- By inspection, identify the isometry relating two congruent triangles.
- 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.
- By inspection, identify the similarity relating two similar triangles.
- Use a MIRA to construct the fixed point of a non-isometric similarity.

MAKE UP POLICY: Makeup exams will be administered when exams are missed for the following reasons:

- Documented illness
- Death or serious illness of a family member
- Military service*
- Religious holiday*
- Jury duty*
- Participation in varsity athletic competition*
- Participation in out-of-the-classroom educational activities*

*Advance notification required

EVALUATION:

Component		**Weight**
Problem sets	(7 @ 5 pts)	35 pts
MIRA constructions		10 pts
Hour Exams	(3 @ 15 pts)	45 pts
Final Examination		30 pts
		Total 120 pts

Grading Scale

93% - 100%	A	73% - 76%	C
90% - 92%	A-	87% - 89%	B+
83% - 86%	B	67% - 69%	D+
80% - 82%	B-	63% - 66%	D
77% - 79%	C+	60% - 62%	D-
		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 geometrical properties 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 concrete and visual alternative to Eucild's axiomatic/synthetic approach.

In this course, we shall consider two families of transformations: (1) isometries (transformations that preserve length) -- translations, rotations, reflections or glide reflections -- and (2) similarities (transformations that preserve the ratio of image length to preimage length) -- isometries, stretches, stretch rotations or stretch reflections. Our goal is to understand congruence and similarity of plane figures in terms of these two families of transformations.

Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment, comply with Title IX of the Education Amendments of 1972, 20 U.S.C. §1681, et seq., and act in accordance with guidance from the Office for Civil Rights, the University requires faculty members to report to the University’s Title IX Coordinator incidents of sexual violence shared by students. The only exceptions to the faculty member’s reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report to the person designated in the University Protection of Minors policy incidents of sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred.

Information regarding the reporting of sexual violence, and the resources that are available to victims of sexual violence, is available at http://www.millersville.edu/titleix/title-ix-policies-and-procedures.php.

COURSE SCHEDULE
Math 355.01 -- Transformational Geometry
Spring 2017

Date		Lecture Topic	Exercises (D/L)	(U)
Jan	23M	Introduction: The MIRA; Transformations of the plane	1.1-1.10	35:1-4,6
		Problem Set #1: 35:4; 40:1,7,10,17		
	25W	Isometries and similarities defined	1.11-1.15	40:1,3,4,5
	27F	Properties of isometries	1.16-1.20	41:6,8,9,11
	30M	Translations **(class meets in the Math Lab)**	2.1-2.8	41:12,13,15; 51:1,3
Feb	1W	Properties of translations	2.9-2.10	42:17; 51:2,4,6
		PROBLEM SET #1 DUE		
	3F	Rotations **(class meets in the Math Lab)**	2.11-2.18	58:1-6
		Problem Set #2: 58:6;10,17; 67:6,8		
	6M	Halfturns	2.20-2.23	58:7-9,12
	8W	Reflections **(class meets in the Math Lab)**	1.21-1.24 2.24-2.31	58:13-16,18 65:1-3,12
	10F	Using a MIRA to trisect a general angle	1.53-1.55	66:4,5,7,9,10,13
	13M	The Three Points Theorem	1.25-1.33	69:14-17,20
	15W	Rotations as compositions of two reflections **(class meets in the Math Lab)** **PROBLEM SET #2 DUE**	2.32-2.36	70:21-23; 80:1,3,4
	17F	Translations as compositions of two reflections **(class meets in the Math Lab)**	2.37-2.38	80:2,5,6; 85:1-7
	20M	**PROBLEM SESSION / FLEX DAY**		
	22W	**HOUR TEST 1**		
	24F	The Angle Addition Theorem, part 1 **(class meets in the Math Lab)** *Problem Set #3: 69:18,19; 86:8,9,20*	2.39 2.42-2.44	87:10-17; 93:1-4
	27M	The Angle Addition Theorem, parts 2, 3, and 4	2.19,2.45-2.49	93:5,7-14
Mar	1W	Glide reflections	1.34-1.40	102:1,2,5,12,13
	3F	Properties of glide reflections	2.40,2.41	103:3,4,6,8,10
	6M	The Fundamental Theorem of Transformational Geometry	1.42,1.43	105:11,14; 112:1

	8W	Congruence **PROBLEM SET #3 DUE** *Problem Set #4: 94:16,17; 104:7,9,15*		112:2
Date		**Lecture Topic**	**Exercises (D/L)**	**(U)**
Mar	10F	Classification of isometries	2.50-2.54	118:1-9
	11-19	**SPRING BREAK**		
	20M	Orientation and the Isometry Recognition Problem	1.44-1.52	123:1-4
	22W	Introduction to conjugation		131:1-5
		PROBLEM SET #4 DUE		
	24F	Geometry of conjugation		131:6,8-10
	27M	**PROBLEM SESSION / FLEX DAY**		
	29W	**HOUR TEST 2**		
	31F	Groups of isometries		136:1-5
		Problem Set #5: 119:10; 124:5; 131:7; 144:8,9		
Apr	3M	Symmetry type		144:1-7
	5W	Rosettes and Da Vinci's Theorem		145:10,11; 148:1-4
	7F	Frieze patterns		153:1,2,5
	10M	Wallpaper patterns **PROBLEM SET #5 DUE** *Problem Set #6: 145:12; 153:3,4; 167:3,4*		153:6,7; 166:1,6
	12W	Crystallographic Restriction		167: 2,7
	14F	Edge tessellations		167: 5
	17M	Similarities	2.55-2.59	171:1-5
	19W	Classification of dilatations **PROBLEM SET #6 DUE**	2.60-2.63	175:1-3
	21F	Classification of similarities		181:1-3,5
	24M	**PROBLEM SESSION/ FLEX DAY**		
	26W	**HOUR TEST 3**		
	28F	The Similarity Recognition Problem		182:4,6

MIRA CONSTRUCTIONS DUE

May	1M	The fixed point of a non-isometric similarity	183:7
	3W	Conjugation and similarity symmetry type	189:1,2,4-8
	5F	**PROBLEM SESSION / FLEX DAY**	
	8W	**FINAL EXAMINATION (8:00 – 10:00 a.m.)**	