

## Student Learning Outcomes for MATH 43

*Precalculus III: Advanced Topics*

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### Team Members:

**Team Leader:**

[Iaroslav Kryliouk](#) (8865) in MATH

**Other members:**

1. [Roberta Bloom](#) (x8591) MATH
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**Additional team members/notes about team:**

Charlie Klein, Iaroslav Kryliouk, Bert Lo

**Additional Notes:**

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### Outcomes:

**Outcome 1 Phase I: Statement**

Analyze, investigate, and evaluate linear systems, vectors, and matrices related to two or three dimensional geometric objects.

**Outcome 1 Phase II: Assessment Strategy Used:**

Assessment Quarter: Winter 2011

Assessors: Roberta Bloom

Assessment Tools: *No tools assigned.*

**Outcome 1 Phase III: Reflect & Enhance**

**Number of people involved in Phase III:** 1

**Changes:**

There are no changes. This is a new course for 2010-2011. There have not been assessments for Math 43 in prior academic years.

**Methods:**

One assessment for Winter 2011 is based on questions from the final exam. Multiple choice questions 5, 7, 10, 12, 15, 16, 17 related to this SLO. Several free response

questions in the final exam also related to this SLO. Another assessment used this quarter was an in class worksheet exploring the concept of projectile motion, requiring students to use their knowledge of vectors and parametric equations in solving an application. Students had various sets of data in their worksheets, so students could work together to understand the material, but each student had to do their own individual calculations, as they had different initial conditions for their particular worksheet. Students were able to check answers with the instructor as they proceeded, which provided the instructor with insight on a step by step basis as to what the students did or did not understand. Students with errors had their errors pointed out and were given direction as to what to think about to do it correctly, but were not "fed" the correct answers. The goal was the learning process, but the constant interaction with students rather than the emphasis on the final written work provided the instructor with a more qualitative means to assess students understanding from a different point of view than when viewing answers without insight into why the students were making certain types of errors.

### **Findings and Conclusions:**

Final Exam: The proportions of students getting multiple choice questions relating to this SLO correct were, 20/33, 5/33, 27/33, 26/33, 32/33, 16/33, 11/33, respectively for questions 5, 7, 10, 12, 15, 16, 17. The questions relating to basic mechanical operations, such as matrix multiplication, and questions relating to lines had better results. Question with worse results tended to be conceptual rather than mechanical, such as questions relating vector products to properties of vectors such as orthogonal and parallel, or a question asking what a 0 determinant tells us about a system of equations. In the free response section of the exam, there a similar dichotomy was seen - problems relating to finding the equation of a line in 3 dimensional space, or to solving a system of linear equations using Gauss Jordan elimination had overall good results, while questions relating to vector projections or planes in 3 dimensional space were missed by more students. The students in this class entered the class "out of sequence". Instead of coming directly from trigonometry as the sequence was supposed to work, most students came into this class having had trigonometry several quarters ago, as part of our old sequence of classes, or having had trigonometry over a year ago at another school. Many students did not remember their trigonometry, and tended to have a great deal of difficulty overall with any topics that required trigonometry. This is seen in their ability to multiply matrices and perform Gauss Jordan elimination, but greater difficulty with questions involving planes and vectors in space. The course began by studying how to solve linear systems mechanically and manipulate matrices; the vectors and surfaces in 3 dimensions with which they had difficulty came later in the quarter. In the future I save the more mechanical skills for later and concentrate on concepts early on. Then when learning the mechanical skills, they can be related to the geometry in 3 dimensional space more effectively and with more repetition, so that students may understand the conceptual areas better. Projectile Motion Worksheet Activity: Based on the instructor's more qualitative assessment in this type of situation, students were relatively able to complete each step individually, but had difficulty synthesising the entire application. They could resolve vectors but did not understand the equations for projectile motion. After they grasped the equations, they could not distinguish between finding a position at time  $t$ , or solving for a time at which the object reached a certain position. When asked to eliminate the parameter, they did not understand what they were being asked to do. Once they remembered that, they were able to do the mechanical work to eliminate the parameter. In the end, students were able to perform all aspects of the task and most understood the concepts, but did need support and explanation along

the way.

### **Enhancement (Planned Actions)**

#### **Part I:**

In the future students most will come into this course "in sequence", and their trigonometry knowledge will be more current. This should improve students' ability to handle much of the information in this course. This in fact is a primary reasons why the sequence was revised. Only one section of this course was offered in Winter 2011. As more sections of this course are given on an ongoing basis, the assessments should provide more information into what enhancements are needed in the future. In addition instructors teaching this course should use applications throughout the course and use them to relate concepts in different topics in the course when possible.

#### **Part II:**

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### **Outcome 2 Phase I: Statement**

Graph and analyze regions/curves represented by inequalities or trigonometric, polar, and parametric equations, including conic sections.

### **Outcome 2 Phase II: Assessment Strategy Used:**

Assessment Quarter: Winter 2011

Assessors: Roberta Bloom

Assessment Tools: • worksheets

### **Outcome 2 Phase III: Reflect & Enhance**

**Number of people involved in Phase III: 1**

#### **Changes:**

There are no changes. This is a new course for 2011-2012. There have not been assessments for Math 43 in prior academic years.

#### **Methods:**

#### **Findings and Conclusions:**

On the multiple choice questions the proportions of students answering correctly were 25/33, 23/33, 27/33, 12/33, 21/33, 24/33, 21/33, 20/33, 22/33 respectively for questions 3, 4, 6, 8, 9, 13, 14, 18, 22. In the free response section, students were overall able to identify polar graphs, able do identify conic sections in rectangular coordinates but had difficulties with details to get orientation or relative shape correct. They tended to have more difficulty with an application problem for a parabola and in eliminating the parameter for an ellipse. Again, some students were hampered in their ability to understand the concepts in these topics by their weak or rusty skills in trigonometry. The students in this class entered the class "out of sequence". Instead of coming directly from trigonometry as the sequence was supposed to work, most students came into this class having had trigonometry several quarters ago, as part of our old sequence of classes, or having had trigonometry over a year ago at another school. Many students did not remember their trigonometry, and

tended to have a great deal of difficulty overall with any topics that required trigonometry. This greatly affected their ability to understand and master polar and parametric graphing. The fact that students did succeed at the rate that they did reflects a great amount of work done to try to work with them to improve their skills. However some skills such as using trigonometric identities to eliminate the parameter in parametric equations for circles, ellipses, and hyperbolas continued to be a problem for students who had a weak grasp of trigonometric identities, a prerequisite for this class. Many students who ultimately were able to understand polar graphs did so after much work and many previously failed assessments.

### **Enhancement (Planned Actions)**

#### **Part I:**

In the future students most will come into this course "in sequence", and their trigonometry knowledge will be more current. This should improve students' ability to handle much of the information in this course, particularly in the areas of polar and parametric graphing. This in fact is a primary reasons why the sequence was revised. Only one section of this course was offered in Winter 2011. As more sections of this course are given on an ongoing basis, the assessments should provide more information into what enhancements are needed in the future.

#### **Part II:**

In the future students most will come into this course "in sequence", and their trigonometry knowledge will be more current. This should improve students' ability to handle much of the information in this course, particularly in the areas of polar and parametric graphing. This in fact is a primary reasons why the sequence was revised. Only one section of this course was offered in Winter 2011. As more sections of this course are given on an ongoing basis, the assessments should provide more information into what enhancements are needed in the future.

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### **Outcome 3 Phase I: Statement**

Analyze, develop, and evaluate formulas for sequences and series; Justify those formulas by mathematical induction.

### **Outcome 3 Phase II: Assessment Strategy Used:**

Assessment Quarter: Winter 2011

Assessors: Roberta Bloom

Assessment Tools: • quizzes

### **Outcome 3 Phase III: Reflect & Enhance**

**Number of people involved in Phase III: 1**

#### **Changes:**

There are no changes. This is a new course for 2011-2012. There have not been assessments for Math 43 in prior academic years.

#### **Methods:**

On the final exam there were 2 multiple choice questions relating to geometric series and a

free response question relating to arithmetic series. There were also two questions relating to the binomial theorem, which is also included in the topics relating to sequences and series.

**Findings and Conclusions:**

There results for the multiple choice problems were 17/33 and 11/33 correct. The question with only 11/33 correct did not involve straightforward use of a formula but also required that the series be re-expressed in the proper form to use the formula, whereas the previous question required only recognizing what formula to use and applying it without having to be sure the series was expressed in a manner consistent with the formula. The students understood which formula to use, but were less successful in applying it if it was not a straightforward application. On the free response question for the arithmetic series, 18/33 students did it correctly or made only minor errors, which 15/33 had significant errors or missed the concept entirely. Students were generally very successful in answering questions concerning the binomial theorem, which is also included in the topics relating to sequences and series. This is quite important as binomial expansion is needed in the next course, math 1A when using the limit definition of a derivative. We covered sequences and series early in the quarter, except for the binomial theorem at the end. Students had been generally proficient in using skills related to this topic earlier in the quarter, but after covering sequences and series, we moved on to topics involving trigonometry, for which many students were not well prepared coming into this class (see comments in SLO 1 and SLO 2). Had the topic for sequences and series been covered later in the quarter they would have done better in this on the final exam. If I teach this course in the future, I would

**Enhancement (Planned Actions)****Part I:**

If I teach this course in the future, I would cover sequences and series at the end of the quarter. This would give students more time to grapple with the harder topics (SLO 1 and 2) and would reduce the chance that they forget this material when focusing on the harder material. However the material was covered in the order presented in the textbook. Many instructors do not want to cover material out of order as some chapters rely on skills covered in previous chapters. Therefore it should not be expected that all instructors teaching this class would make this enhancement. Again, as with SLO 1 and 2, as more sections of this course are given on an ongoing basis, the assessments should provide more information into what enhancements are needed in the future.

**Part II:**

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