Global & Multicultural Perspectives Symbolic Reasoning Written Communication

The Honolulu Community College Foundations Board will review all proposals to ensure that approved courses meet Foundations Hallmarks. If clarification is needed, a Board member will contact you. If the Foundations Board and the General Education Committee approve the proposal, all sections of the course will be designated as satisfying the requirement. The course will be reviewed every five years.

1. Course information. Course Alpha MATH Course Number 140

   If the course is cross listed, please provide the cross listing: Alpha Number

2. Course Title: Trigonometry and Analytic Geometry

3. How many instructors currently teach this course? It makes a difference if there are only one or two instructors teaching this course versus ten instructors teaching this course. This question is asked to get an idea of how many instructors the department needs to communicate with to discuss this foundation course.

4. Syllabus. Submit a master syllabus. If multiple instructors teach the course and use varying texts and/or assignments, please include multiple representative syllabi for comparison. (Three is recommended.)

5. Hallmark Requirements. Provide an explanation of how each of the hallmarks for this proposed Foundation course will be satisfied. Try to completely answer how the course intends to meet each particular hallmark. Referencing assignments, tasks, and evaluations used in the course (as stated on the syllabus /syllabi being submitted) as supporting evidence would be very helpful.

6. Assessment. Provide a brief explanation of how the department will periodically review that this course has been meeting the Foundations Hallmarks including a description of what kinds of evidence will be collected to demonstrate this (Knowledge Survey results, sample of exam responses, writing samples, etc.). Also include a detailed description of how the department plans to have all instructors of this course share information with each other regarding how the hallmarks have been met. Please include a brief explanation of the assessment tools you will use to make this determination (such as Knowledge Surveys, Exams, Projects, Portfolios, etc.) and how you will use the results to make course improvements.

7. Signatures. The signatures of the initiator and the initiator’s Division Chair are required. The completed proposal must be routed to the Chair of the CPC before being delivered to the chair of the Foundations Board. No action on the part of the CPC is required unless the proposal also includes a new course Curriculum Action or a course modification Curriculum Action. The “routing” is a courtesy to the CPC. Signatures indicate approval/acceptance.

Initiated by: Steven Mandraccia Initiation's printed name Date 4/7/2016

Approved by: Michael Ferguson Division Chair's printed name Date 4/12/16

Routed via: Kara Kam-Kalani CPC Chair's printed name Date 4/15/16

Accepted by: Steven Mandraccia Foundation Board Chair's printed name Date 4/11/2016
Official Course Description

MATH 140 - TRIGONOMETRY AND ANALYTIC GEOMETRY

Course Description

- Prerequisite: C or higher in MATH 135 or placement in MATH 140.

This course is a study of angles, trigonometric and circular functions, solution of triangles, graphical representation, identities, inverse trigonometric functions, polar coordinates, conic sections, and graphs of exponential and logarithmic functions.

This course fulfills the Symbolic Reasoning requirement for the Foundation requirement for Honolulu Community College and the University of Hawaii at Manoa. See the Manoa General Education requirements.

Symbolic Reasoning Objectives:

Students will

- Demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in problem solving involving trigonometry and analysis of conic sections.
- Demonstrate through performances on assessment exams, classwork, and homework exercises the concept of proof as a chain of inferences.
- Apply formal rules of algorithms in trigonometry and algebraic representations of conic sections.
- Demonstrate correct and effective use of the symbolic rules of trigonometry, conic functions, and exponential and logarithmic functions on assessment exams, classwork, homework exercises or related projects.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply trigonometric and conical analysis principles to solve real-world problems related to real-world problems.

Course Specific Learning Objectives:

Students will

- Define the trigonometric functions using the unit circle
- Graph trigonometric functions on the rectangular axes
- Solve right and oblique triangles
- Solve verbal and non-verbal problems in plane trigonometry
- Prove trigonometric identities and apply trigonometric formulas
- Solve trigonometric equations
- Represent conic sections algebraically and geometrically
- Convert rectangular and polar coordinates
- Graph trigonometric functions on the polar axes
- Write complex numbers in trigonometric form
- Graph exponential and logarithmic functions
In general, the course will prepare students for

1. the study of calculus by providing them with the skills, knowledge and mathematical maturity necessary for success in that course of study.
2. vocations in which a knowledge of trigonometric and analytic geometry is necessary.

Foundations Hallmarks - Symbolic Reasoning

1. *Students will be exposed to the beauty, power, clarity, and precision of formal systems.*
   How will the course meet this hallmark?

The students are introduced to trigonometric functions in two different, although equivalent, ways. One is based on right triangles and the other is based on arc length on the unit circle. The beauty, power and clarity comes from seeing the interrelationship of these two formal systems. Because the focus is on modeling real-life applications, students come to appreciate and understand the theory of functions first introduced in the pre-requisite Math 135 course. Graphs and figures are stressed to remind students of the geometric meaning behind a calculation and visually promote insight into formal and theorems.

Trigonometry, in particular, is a mathematics subject with numerous practical applications in its own right, so students appreciate the course as more than just a pre-requisite for calculus. Applications from engineering, physics, chemistry, business, biology, environmental studies and other fields show how mathematics becomes a remarkable problem solving tool.

The study of conic sections is also a major part of this course. The students apply formal algebraic techniques to define and alter the equations and see how different parameters affect the shape of the conic section. The immediate visual results, based on precise formal algebraic computations, emphasizes the beauty and power of the relationship of algebra and geometry.

2. *Instructors will help students understand the concept of proof as a chain of inferences.*
   How will the instructors help students understand this concept?

Many theorems and rules are applied in this course. Students learn the standard proof techniques of deductive systems and how many theorems are proved from others. For example, the LAW OF COSINES is proved using the Pythagorean Theorem, with the triangle placed so that one vertex is at the origin. Students logically follow a basic theorem of elementary geometry and see how it can be used to solve triangles.

The student must demonstrate his or her ability to use a chain of algebraically equivalent statements in proving TRIGONOMETRIC IDENTITIES, where the student must reason logically to make two sides of an equation the same. The chain of thinking involves using basic trigonometric definitions and rules of algebra. Students know the final result, but have a choice of working with one side, the other side or both sides, a similar decision making process required to solve real-life challenges.
3. *Instructors will teach students how to apply formal rules of algorithms. How will instructors meet this hallmark?*

In addition to the deductive origins noted above, many theorems and rules are applied in the course. The following are examples:

a) Conversion of angles between degrees and radians requires use of a basic conversion formula or algorithm.
b) Evaluating trigonometric functions requires the use of basic analytic geometry in different quadrants and the Pythagorean Theorem. Students must apply concepts from two earlier math courses, algebra and geometry.
c) Solving triangles requires use of the Pythagorean Theorem.
d) In order to solve trig equations, the algorithms used to solve basic algebraic equations are used.
e) Solving logarithmic and exponential equations requires the application and understanding of finding inverse functions, as well as basic algebra.

4. *Students will be required to use appropriate symbolic techniques in the context of problem solving, and in the presentation and critical evaluation of evidence. What symbolic techniques will be required and in what contexts? How will presentations and evaluation of evidence be incorporated into the course?*

In solving (i.e. finding unknown sides & angles) a triangle, students are presented evidence in symbol form and must evaluate it critically.

For example, if three angles are given (AAA) the sides cannot be uniquely determined.

A better example is when two sides and the angle opposite one of them are given (SSA). There may be 2, 1, or no triangles.

See figures below where A is the given angle, and b the given sides.

![Triangle Diagrams](image)

Specifically, students must evaluate the evidence to determine which possible measures of angle B (right, obtuse, or acute) is compatible with the rest of the given information.

Thus, students must apply knowledge of such basic facts as 1) sine of an angle < 1 and 2) sum of angles of a triangle = 180°.
5. The course will include computational and/or quantitative skills. What reasoning skills will be taught in the course? What computational and/or quantitative skills will be taught in the course? How will you assess this and provide evidence that students are meeting this hallmark?

The students will learn and apply many theorems, rules, and algorithms. The student must decide which of these could and should (to be given a more elegant deductive solution) be used to solve a particular problem.

For example in the proving an identity: \[
\frac{1 + \sec^2 x}{1 + \tan^2 x} = 1 + \cos^2 x
\]

The left hand side could be reduced (eventually) to the right hand side by converting the secant and tangent functions into identities with sine and cosine. But if the Pythagorean Identity \( \sec^2 x = 1 + \tan^2 x \) is used instead, the identity could be proved in two steps.

Solving right triangles involves the use of trigonometric functions, but students must be able to reason and discern the ambiguous and unsolvable cases, where data provided cannot just be automatically substituted into the Law of Sines.

6. Instructors will build a bridge from theory to practice and show students how to transverse this bridge. How will instructors help students make connections between theory and practice?

Trigonometry and geometry have their roots in real world applications. The initial introduction of trigonometric functions may be with abstract definitions and analysis but is interwoven with applications to real life from such diverse disciplines as engineering, astronomy, navigation, sociology, economics and psychology.

For example: Starting with the basic definition of the ELLIPSE, the student is taken through the development of the equation for the ellipse, including the foci, the major and minor axes and the center. The student is then asked to use this in applications ranging from carpentry designs to elliptical planetary paths.

The study of logarithmic and exponential functions is also rich in applications to many fields such as business, science, psychology, and sociology. Models in exponential growth, radioactive decay, pH Scale and Hydrogen Ion Concentration are just a few of the applications included in this course. For example, noting that the Richter Scale is logarithmic allows the student that an 8.0 earthquake is 10,000 times stronger than a 4.0 earthquake, rather than merely twice as strong.
Assessment

Any faculty member assigned to teach Math 140 must become familiar with both the course content and the FS hallmarks. The learning outcomes and FS hallmarks will be assessed by the use of embedded questions on exams. It is the responsibility of the math department liaison to meet with the instructor(s) and ensure that the course learning outcomes and the FS hallmarks are being satisfied. Math 140 faculty will meet, beginning with the spring 2011 semester to correlate the learning outcomes with the appropriate hallmark and to specify which questions to embed and determine whether the FS hallmarks are being addressed via the specific questions chosen. After the initial assessment, the Math 140 faculty will meet each year for a two year period to determine whether the FS hallmarks are being addressed. After the initial assessment, the Math Faculty will meet every three years for a review of the process.

Syllabus

See attachment for sample syllabus.
MATH 140
TRIGONOMETRY AND ANALYTIC GEOMETRY

COURSE DESCRIPTION: This course is a study of angles, trigonometric and circular functions, solution of triangles, graphical representation, identities, inverse trigonometric functions, polar coordinates, conic sections, and graphs of exponential and logarithmic functions. (3 credits)

PREREQUISITES: An entering student must have a “C” or higher in MATH 135 or placement in MATH 140.
This course fulfills the Symbolic Reasoning requirement for the Foundation requirement for Honolulu Community College and the University of Hawaii at Manoa. See the Manoa General Education requirements.

Symbolic Reasoning Objectives:

Students will
- Demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in problem solving involving trigonometry and analysis of conic sections.
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- Demonstrate correct and effective use of the symbolic rules of trigonometry, conic functions, and exponential and logarithmic functions on assessment exams, classwork, homework exercises or related projects.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply trigonometric and conical analysis principles to solve real-world problems related to real-world problems.

Course Specific Learning Objectives:

Students will
- Define the trigonometric functions using the unit circle
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- Solve right and oblique triangles
- Solve verbal and non-verbal problems in plane trigonometry
- Prove trigonometric identities and apply trigonometric formulas
- Solve trigonometric equations
- Represent conic sections algebraically and geometrically
- Convert rectangular and polar coordinates
- Graph trigonometric functions on the polar axes
- Write complex numbers in trigonometric form
- Graph exponential and logarithmic functions
Textbook: This course will cover Chapters 4, 5, 6, 7, and 9 of *Mathematics for Calculus*, 4th ed., by Stewart, Redlin, and Watson.

Supplies: Scientific calculator (log, ln, sin, cos, and tan functions).
Ruler, Protractor

Quizzes: You should expect a 5 to 10 minute quiz at the end of each class session. Quizzes are open book and open notes and will generally be based on your homework problems. A missed quiz will score zero points and cannot be made up. The lowest two quiz scores will be thrown out before the overall average is computed.

Tests: There will be four tests, which are in-class, closed book, and closed notes. The exact date of the test and coverage will be announced at least two sessions ahead of time. You will be allowed the entire period for each test. The exact date for each of the exams will be announced in class at least two sessions ahead of time.

Final exam: The final exam is cumulative, and will be scheduled per the College’s final exam schedule. The final will be closed book and in-class. *For the final only*, you may use one side of a 5” by 8” note card for reference notes.

Attendance & Homework: *You are expected to attend each class and do the assigned homework.* Homework will NOT be collected. However, attendance will be recorded for administrative purposes.

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<tr>
<th>Grading</th>
<th>4 Tests each 100 points = 400</th>
<th>A 90+ % or (630+ pts)</th>
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<tbody>
<tr>
<td></td>
<td>Quizzes 200 points = 100</td>
<td>B 80+ % or (560+ pts)</td>
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<td></td>
<td>Final Exam 200 points = 200</td>
<td>C 70+ % or (490+ pts)</td>
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<td></td>
<td>TOTAL = 700</td>
<td>D 55+ % or (385+ pts)</td>
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<td>F Below 55%</td>
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Grades A-F: Only letter grades “A”-“F” will be given in this class. “N” grades will not be given in this class. The last day to withdraw with no grade penalty is October 31, 2005.

Cell-Phones: In consideration for the entire class, during the class session, your cell-phone should be turned off or put in silent mode. Do not accept non-emergency calls during class.

Test #1: Chapter 4 Exponential & Logarithmic Functions & Chapter 6 Trig Functions of Angles
  4.1 Exponential Functions
  4.2 Logarithmic Functions
  4.3 Laws of Logarithms
  4.4 Exponential and Logarithmic Equations
  6.1 Angle Measure
  6.2 Trigonometry of Right Triangles
  6.3 Trigonometric Functions of Angles
  6.4 Law of Sines
  6.5 Law of Cosines

Test #2: Chapter 5 Trigonometric Functions of Real Numbers
  5.1 The Unit Circle
  5.2 Trigonometric Functions of Real Numbers
5.3 Trigonometric Graphs
5.4 More Trig Graphs

Test #3: Chapter 7 Analytic Trigonometry
    7.1 Trigonometric Identities
    7.2 Addition and Subtraction Formulas
    7.3 Double Angle, Half Angle, Product Sum
    7.4 Inverse Trig Functions
    7.5 Trigonometric Equations
    7.6 Trigonometric Form of Complex Numbers

Test #4: Chapter 9 Topics in Analytic Geometry
    9.1 Parabolas
    9.2 Ellipses
    9.3 Hyperbolas
    9.4 Shifted Conics
    9.5 Rotation of Axes
    9.6 Polar Coordinates