Honolulu Community College
University of Hawai'i
General Education
Foundations Course Designation Proposal Form
For Fall 2009 – Summer 2014

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 205

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

Course Title: Calculus I

2. Foundations area requested. Check one.

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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. See the previously submitted Religion 150 application for examples located at http://honolulu.hawaii.edu/intranet/articulation/foundations/REL150.pdf

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: Carol Hiraoka/Steve Mandraccia 4/19/2010

Approved by: Kerry Tanimoto 4/30/2010

Routed via: Marcia Roberts-Deutsch 4/30/2010

Accepted by: Jerry Saviano 4/30/2010
Official Course Description

Math 205 – Calculus I

Course Description
Prerequisite: C or higher in MATH 140 OR placement in Math 205
Basic concepts, techniques and applications of differentiation; introduction to integration.

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.

Students will
- demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in calculus operations and problem solving.
- 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 calculus.
- demonstrate correct and effective use of the symbolic rules of calculus on assessment exams, classwork, homework exercises, or related projects.
- analyze rules and theorems to find the most effective solutions to problems.
- apply calculus principles to solve real-world problems related to physics, biology, economics, and other sciences.

Foundation Hallmarks—Symbolic Reasoning
1. Students will be exposed to the beauty, power, clarity, and precision of formal systems. How will this course meet this hallmark?
   The Fundamental Theorem of Calculus which establishes a connection between differential and integral calculus is an extraordinary example of the beauty, clarity, and precision of mathematics. Differential calculus arose from the tangent problem, whereas integral calculus arose from a seemingly unrelated problem, the area problem. Newton's teacher at Cambridge, Isaac Barrow (1630-1667), discovered that these two problems are actually closely related. In fact, the Fundamental Theorem of Calculus gives the precise inverse relationship between the derivative and the integral.

   As for the power of Calculus, we learn how to solve numerous application problems using the derivative. We learn how derivatives affect the shape of a graph of a function, and in particular, how they help us locate maximum and minimum values of a function. Many practical problems require us to minimize a cost or maximize an area or somehow find the best possible outcome of a situation. In particular, we investigate the optimal shape of a can and we can explain the location of rainbows in the sky.

2. Instructors will help students understand the concept of proof as a chain of inferences. How will instructors help students understand this concept?
   As we study the many theorems in Calculus, including the Mean Value Theorem and the Fundamental Theorem of Calculus, we study the proofs as well. Some are gone
over in detail for students’ understanding. At the beginning, students are required to follow the steps. Later in the course, they are expected to do some short, easier proofs.

For example, one of the homework problems states, “Does there exist a function \( f \) such that \( f(0) = -1, f(2) = 4, \text{ and } f''(x) \leq 2 \text{ for all } x? \)” Students must show (or prove) whether such a function \( f \) exists or not. Basically, the “proof” looks like this:

Suppose such a function \( f \) exists. By the Mean Value Theorem, there is a \( c \) where

\[
0 < c < 2 \text{ with } f''(c) = \frac{f(2) - f(0)}{2 - 0} = \frac{4 - (-1)}{2} = \frac{5}{2}.
\]

But this is impossible since \( f''(x) \leq 2 < \frac{5}{2} \) for all \( x \), so no such function can exist.

3. Instructors will teach students how to apply formal rules or algorithms. How will instructors meet this hallmark?

Calculus includes a number of formal rules and algorithms. Formal rules for evaluating limits, finding derivatives, and evaluating integrals are central to the course. In each of these sections, students will have to learn, select, and correctly apply them, especially in solutions to application problems.

For example, the problems may be “Find the area bounded by the graphs of \( y = x^2, y = x^2 - 2 \).” The student must find the intersections of the two graphs in order to determine the interval. Then the student must decide to use horizontal rectangles to set up the problem and integrate along the y-axis instead of the x-axis. Using the two functions, \( x = y, x = y^2 - 2 \), the student must set up the correct integral for the area and integrate correctly. (See continuation of problem in #4.)

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?

There are many new symbolic notations and techniques that a calculus student must learn. The most common ones are the notation for derivatives and integrals, limits and sigma notations.

In actually using symbolic techniques, continuing the problem in #3, the correct integral setup and solution follows.

\[
A = \int_{-1}^{2} [y - (y^2 - 2)] dy = \left[ \frac{1}{2} y^2 - \frac{1}{3} y^3 + 2y \right]_{-1}^{2} = \left[ \frac{1}{2} \cdot \frac{8}{3} + 4 \right] - \left[ \frac{1}{2} + \frac{1}{3} - 2 \right] = \frac{10}{3} - \left( -\frac{7}{6} \right) = \frac{27}{6} = \frac{9}{2}
\]

The area is \( 9/2 \) square units.

5. The course will not focus solely on computational skills. What reasoning skills will be taught in the course?
Students will learn how to solve problems using inductive and deductive reasoning skills. For example, when using Riemann Sums to approximate the area under a curve, the student must use inductive reasoning to set up the formula for the area of the ith rectangle. Then the student must use deductive reasoning together with appropriate theorems, formulas, and techniques in evaluating the limit of the Riemann Sum, to find the actual area in question.

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?

The concept of derivatives and integrals are first discussed on an abstract level. General principles and theorems are introduced. Then they are discussed on a practical level in solutions to real world problems.

For example, “if a cyclist is traveling at 40 ft/s and decelerates at a constant speed of 4 ft/s², how many feet does she travel before coming to a complete stop?”

Solution: \( v'(t) = a(t) = -4 \). The initial velocity is 40 ft/s, so \( v(t) = -4t + 40 \). The bicycle stops when \( v(t) = 0 \Leftrightarrow t = 10 \). Since \( s(t) = -2t^2 + 40t \), the distance covered is \( s(10) = -2(10)^2 + 40(10) = -200 + 400 = 200 \). So she travels 200 ft before stopping.

Assessment

Any faculty member assigned to teach Math 205 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 205 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 205 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.
Course Objectives: This 4 credit course covers the basic concepts, techniques and applications of differentiation with an introduction to integration.

Prerequisite: An entering student must have a “C” or higher in MATH 140 or placement in MATH 205.
This course fulfills the Symbolic Reasoning requirement for the Foundation requirement for Honolulu Community College and all campuses belonging to the Multi-Campus Foundations Agreement.

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 the use of differentiation to find minimum and maximum values, the use of differentiation and properties thereof to sketch the curve of the function, and the use integration to find areas and volumes.
- Demonstrate through performances on assessment exams, classwork, and homework exercises the concept of proof as a chain of inferences starting with basic definitions and working up to easily applied rules and algorithms.
- Apply formal rules of algorithms in differentiating and integrating basic algebraic and trigonometric expressions.
- Demonstrate correct and effective use of the symbolic rules of calculus on assessment exams, classwork, homework exercises or related projects.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply basic principles, such as implicit differentiation or the fundamental Theorem of Calculus, to solve problems related to real-world situations.

Course Specific Learning Objectives:

The student will be able to:
- Define and use the concepts of limit and continuity
- Differentiate functions, including products, quotients, and compositions of functions
- Use differentiation to find the maximum and minimum values of a function
- Use differentiation to approximate the value of a function
- Solve applied problems using differentiation, including maximization or minimization problems and related rates problems
- Use differential calculus to sketch curves
- Integrate functions by approximation and by the use of anti-derivatives
• Learn and use the Fundamental Theorem of Calculus
• Use integral calculus to determine area under and between curves
• Use integral calculus to determine volume of rectangular solids

In general, the course is designed for students who plan to major in a program requiring the use of calculus. The successful student will learn major mathematical techniques and the use of these techniques in applied situations.

Textbook: This course will cover Chapters 1 through 6(.3), of Calculus (Single Variable), Sixth Edition, by James Stewart. A student solutions manual may be helpful, but is not required.

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

Attendance: Regular attendance is expected. Students will be responsible for all material covered in class. The printed distributed schedule is tentative and any variation will be announced in class. Attendance will be recorded for administrative purposes.

Homework will be collected and is generally due no later than one week after coverage of the material in class. Refer to the assignment sheet for the problems to turn-in. Practice problems (odd numbered) are NOT to be turned in and have answers in the textbook. Be sure to show your work neatly. Staple or clip multiple pages. Write your name and date.

Chapter Exams: There will be five exams, 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. A missed exam may be made up only under certain conditions and only within one week of the scheduled test date. You must notify the instructor as soon as possible of your absence and make arrangements for the makeup. Otherwise, a zero will be recorded for your test grade.

Final exam: The final exam is cumulative, and will be scheduled per the College’s final exam schedule.

Grading Policy:  

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Tests</td>
<td>500</td>
</tr>
<tr>
<td>Homework</td>
<td>100</td>
</tr>
<tr>
<td>Final Exam</td>
<td>200</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>800</strong></td>
</tr>
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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 Monday, March 22, 2010.

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 while class is in session.

If you are a qualified student with a disability and wish to receive the appropriate accommodations, please contact student ACCESS at 844-2392, by email at access@hcc.hawaii.edu, or by simply stopping by at the office located in 7-319. Do this right away.