LSC Use Only Proposal No:	UWUCC Use Only Proposal No: 11-105a
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Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

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Proposing Department/Unit Mathematics	Phone 724-357-2608

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

New Course | Course Prefix Change | Course Deletion

✓ Course Revision | Course Number and/or Title Change | Catalog Description Change

Current course prefix, number and full title: Math 125 - Calculus I for Physics, Chemistry, and Mathematics

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

☑ Learning Skills ☐ Knowledge Area ☐ Global and Multicultural Awareness ☐ Writing Across the Curriculum (W Course)

☐ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

☐ Global Citizenship ☐ Information Literacy ☐ Oral Communication

☐ Quantitative Reasoning ☐ Scientific Literacy ☐ Technological Literacy

3. Other Designations, as appropriate

☐ Honors College Course ☐ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

☐ Catalog Description Change ☐ Program Revision ☐ Program Title Change ☐ New Track

☐ New Degree Program ☐ New Minor Program ☑ Liberal Studies Requirement Changes ☐ Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	Frederick E. Cole	2/13/12
Department Chairperson(s)	[signature]	2/13/12
College Curriculum Committee Chair	Anne Kondo	2/16/12
College Dean	Deanne Snavely	2/16/12
Director of Liberal Studies (as needed)	David H. Pistole	4/9/12
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S. Sechrist	4/10/12

Received APR 9 2012 Liberal Studies

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Part II. Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

MATH 125 Calculus I/Physics, Chemistry, Mathematics

3 class hours
0 lab hours
3 credits
3c-0l-3cr

Prerequisite: MATH 110 or equivalent placement (Algebra, geometry and trigonometry.)

The first of a three semester sequence for math and science majors covering the theory of calculus and its application in problem solving. Topics include: functions, limits, continuity, derivatives, applications of derivative, integrals and applications of the integral. (Trigonometric, exponential and logarithmic functions are included throughout the course.)

II. Course Outcomes and Assessment: Expected Undergraduate Student Learning Outcomes - EUSLO

Objective 1:
The student will be able to describe functions verbally, numerically, graphically, and algebraically and use them to model problems in the physical world.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Given a set of data, students will be expected model phenomena using the various functional representations. Solving problems such as these will enable students to see the relationship among the representations and assign mathematical meaning to information related to a variety of real-world situations. Students may model phenomena such as the size of a population, demand for a product, speed of a falling object, as well as many others. This will give students the opportunity to interpret, analyze, and use numerical data and graphs, and develop simple mathematical models to solve problems. Technology may be used to gain deeper insight into the phenomena and make predictions about future behavior.

Objective 2:
The student will be able to calculate limits by graphical, numerical, and analytic methods and determine when they fail to exist.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to make observations about and calculate limits using data tables, graphs, and limit laws. To provide students with an analytic understanding of the nature of limits, the technical definition will be introduced. Limits will also be used to make conclusions about the accuracy of mathematical models and assist in refining them. Technology can be used to verify observations and exhibit the correspondence between geometric and analytic information.

Objective 3:
The student will understand continuity geometrically and analytically through the use of limits, and classify points of discontinuity.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Problems concerning continuity are used to develop deductive reasoning and critical thinking skills. Understanding and using the concept of continuity will require that students translate an intuitive or graphical idea to one expressed analytically in terms of limits. The importance of continuity throughout the sciences is explained, as it is essential in proving many important theorems in mathematics. As an illustration, the Intermediate Value Theorem is introduced along with several of its applications. Students can immediately identify the importance of continuity across various disciplines. Technology can be used to assign geometric meaning to analytic results concerning continuity. Understanding these technical results from an intuitive perspective will increase the students' confidence and ability in using mathematics.

Objective 4 :
The student will calculate and interpret derivatives as limits, slopes of tangent lines, and rates of change.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Students will be exploring the various interpretations of the derivative, measuring how one quantity changes in response to a change in another quantity. Through this exploration, the relationship between slopes of lines, rates of change, and limits is reinforced. The concept of the derivative will be used to solve geometric problems, such as curve sketching, and to convert written applied problems into mathematical models. Students will gain a deeper understanding of mathematics, as the relationship between limits, continuity, and differentiability is exhibited. Integrating these key concepts will increase confidence and ability in understanding mathematics.

Objective 5:
The student will be able to calculate derivatives of algebraic and transcendental functions using the sum, power, product, quotient, and chain rules.
Expected Student Learning Outcome 2:
Empowered Learners
Rationale:
In addition to the topics described in Objective 4, assignments will be designed so that students will learn the various differentiation formulas and identify the types of functions to which they apply.

Objective 6:
The student will use derivatives to sketch curves.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Methods utilized for curve sketching will be used to identify important characteristics of mathematical models generated by applied problems, such as finding extreme values to

solve optimization problems.

Objective 7:
The student will express definite integrals as the area under a curve and the limit of Riemann sums.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
The problem of rigorously defining area under general curves is presented. As an area-based concept dating back to the nineteenth century, the definite integral is motivated geometrically and historically. Students will use the basic idea of calculating the area of rectangles to obtain approximations for the area under continuous functions over appropriate regions. Analytic methods are then introduced through the use of limits to formally define the concept of area and definite integrals. Technology may be used to calculate the error between the approximations and actual value, and show how this error becomes smaller as the approximations get better. Demonstrations such as these enable the student to link theory with practice and application.

Objective 8:
The student will calculate definite and indefinite integrals using the Fundamental Theorem of Calculus and apply the appropriate integration formulas and techniques.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
An historical perspective of the subject will be presented as the connection between differential and integral calculus is established. The Fundamental Theorem of Calculus (FTC) is shown to have developed calculus into a systematic mathematical method. Assignments will require the application of the FTC to evaluate definite integrals and represent antiderivatives. Students will also be expected to use antidifferentiation formulas to express indefinite integrals, and apply the substitution method when appropriate. Integrals will also be used in a variety of applications to model mathematical, physical and economic situations. In particular, calculating the average value of a function, determining the distance traveled by a particle along a line, and calculating accumulated changes.

Objective 9:
The student will convert written applied problems from the physical, natural and social sciences into mathematical models and solve these using methods of differential calculus.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Applied problems will be converted into mathematical models and solved using differential calculus. This includes the concepts of optimization and related rates, in which the student is required to express a written problem mathematically. To do so, the student must have a thorough understanding of the problem, define functions to model the phenomena, and apply the methods of differential calculus to find extreme values. These techniques are shown to have applications in business and economics, physics, biology, and/or other areas at the instructor's discretion.

Objective 10:
The student will use technology appropriately as an aid to problem solving.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Technology is useful for reinforcement and clarification of many topics in Calculus. For examples refer to Objectives 1, 2, 3 and 7. One of the Mathematics Departments overall objectives is to improve students' skills in utilizing technological tools for quantitative analysis.

Objective 11:
The student will communicate mathematical ideas and solutions through well-written sentences.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
This skill is developed as objectives 1 through 10 are accomplished. One of the Mathematics Departments overall objectives is to improve students' skills in communicating outcomes of quantitative analysis.

III. Detailed Course Outline

A. Review and Overview
   1. Functions and Models (0.5 class)
   2. Overview of Calculus (0.5 class)
B. Limits and Derivatives
   1. The Tangent and Velocity Problems (1 class)
   2. The Limit of a Function (1 class)
   3. Calculating Limits Using the Limit Laws (1.5 classes)
   4. Continuity (1 class)
   5. Limits Involving Infinity (1 class)
   6. Tangents, Velocities, and Rates of Change (1 class)
   7. Derivatives (0.5 class)
   8. The Derivative as a Function (1 class)
   9. What Does f' Say about f? (1 class)
C. Differentiation Rules
   1. Derivatives of Polynomials and Exponential Functions (1 class)
   2. The Product and Quotient Rules (1 class)
   3. Rates of Change in the Natural Sciences (1 class)
   4. Derivatives of Trigonometric Functions (1 class)
   5. The Chain Rule (1.5 classes)
   6. Implicit Differentiation (1.5 classes)
   7. Derivatives of Logarithmic Functions (1 class)
   8. Approximations, Differentials and Newton's Method (1 class)
D. Applications of Differentiation
   1. Related Rates (2 classes)
   2. Maximum and Minimum Values (1 class)
   3. Derivatives and the Shapes of Curves (1.5 classes)
   4. Graphing with Calculus and Calculators (1.5 classes)

5. Indeterminate Forms and l'Hospital's Rule (1 class)
6. Optimization Problems (2 classes)
7. Antiderivatives (1 class)

E. Integrals
1. Areas and Distances (1 class)
2. The Definite Integral (1 class)
3. Evaluating Definite Integrals (1 class)
4. The Fundamental Theorem of Calculus (1.5 classes)
5. The Substitution Rule (1.5 classes)

F. Applications of Integration
1. More about Areas (1 class)
2. Volumes (1 class)

Additional class time for review periods and examinations (5 classes)

Total classes: 42

IV. Evaluation Methods

The final grade for the course will be determined as follows:

Homework	15%
Quizzes	10%
3 exams	55%
Comprehensive Final	20%

V. Example Grading Scale

90% - 100%	A
80% - 89%	B
70%-79%	C
60% - 69%	D
Below 60%	F

VI. Undergraduate Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions.
[Note: It is recommended that an attendance policy be developed by individual faculty and included in student syllabi. (See undergraduate catalog for Undergraduate Course Attendance Policy.)]

VII. Required Textbooks, Supplemental Books and Readings

Textbook
Stewart, J., *Essential Calculus, Early Transcendentals*, Thompson Brooks/Cole, 2007.
Coverage: Chapters 1-5.

Supplemental Readings
Instructors are encouraged to select and assign a set of readings from the following or to utilize an appropriate supplemental article.

Dudley, U., *Readings for Calculus*, MAA Notes Volume 31, The Mathematical Association of America, 1993.

VIII. Special Resource Requirements

Students should have access to a calculator with graphical and symbolic capabilities.

IX. Bibliography

Anton, H., Bivens, I., and Davis, S., *Calculus: Early Transcendentals, Single and Multivariable*, 8th Edition, John Wiley & Sons, 2005.

Briggs, W. and Cochran, L. *Calculus: Early Transcendentals*, 1st Edition, Addison-Wesley, 2010.

Varberg, D., Purcell, E., and Rigdon, S., *Calculus*, 9th Edition, Prentice-Hall, 2006.

2. Summary of the proposed revisions

1. Objectives – the course objectives were revised from the original syllabus of record and aligned with the Expected Undergraduate Student Learning Outcomes (EUSLO) and Common Learning Objectives found in the criteria for a mathematics course.

2. Common Learning Objectives for a mathematics course are met in the content portion of the course (not necessarily a specific revision but it should be noted that the objectives for the new curriculum have been met). These objectives are:

   - understand deductive reasoning and apply it in the problem-solving process.
   - apply appropriate techniques to solve a variety of problems.
   - interpret, understand, and apply mathematical formulas appropriate to the course.
   - interpret, analyze, and use numerical data and graphs.
   - develop simple mathematical models to solve problems.

3. Updated the required textbook to reflect the textbook currently being used in the course.

4. Added a suggested source for supplemental readings. This is a new suggestion to instructors as the current syllabus does not require any supplemental readings.

3. Justification/Rationale for the revision

The course is a currently approved Liberal Studies mathematics course and is being revised to meet the new curriculum criteria for this category.

4. Old syllabus of ecord

I. Catalog Description

MATH 125 Calculus I/Physics, Chemistry, Mathematics

3 class hours
0 lab hours
3 credit hours
3c-0l-3cr

Prerequisite: MATH 110 or equivalent placement (Algebra, geometry and trigonometry.)

The first of a three semester sequence for math and science majors covering the theory of calculus and its application in problem solving. Topics include: functions, limits, continuity, derivatives, applications of derivative, integrals and applications of the integral. (Trigonometric, exponential and logarithmic functions are included throughout the course.)

II. Course Outcomes

Upon completion of this course, students will be able to

1. Use graphical, numerical, analytical, and verbal representations of functions.
2. Calculate limits by graphical, numerical, and analytic methods.
3. Use the concept of derivative to express both rate of change and slope of tangent lines.
4. Express continuity and the derivative of a function in terms of limits.
5. Calculate derivatives of algebraic and transcendental functions using sum, product, quotient and chain rules.
6. Use derivatives to sketch graphs and solve applied problems.
7. Calculate definite and indefinite integrals using the fundamental theorem of calculus.
8. Express definite integrals as Riemann sums.
9. Express area and volume in terms of definite integrals.
10. Use technology appropriately as an aid to problem solving.
11. Convert written applied problems into mathematical models and solve these using methods of differential calculus.
12. Understand mathematics as part of the language of science and as a study in itself.

III. Detailed Course Outline

G. Review and Overview
    1. Functions and Models (0.5 class)
    2. Overview of Calculus (0.5 class)
H. Limits and Derivatives
    1. The Tangent and Velocity Problems (1 class)
    2. The Limit of a Function (1 class)
    3. Calculating Limits Using the Limit Laws (1.5 classes)
    4. Continuity (1 class)
    5. Limits Involving Infinity (1 class)
    6. Tangents, Velocities, and Rates of Change (1 class)

7. Derivatives	(0.5 class)
8. The Derivative as a Function	(1 class)
9. What Does f' Say about f?	(1 class)
I. Differentiation Rules	
1. Derivatives of Polynomials and Exponential Functions	(1 class)
2. The Product and Quotient Rules	(1 class)
3. Rates of Change in the Natural Sciences	(1 class)
4. Derivatives of Trigonometric Functions	(1 class)
5. The Chain Rule	(1.5 classes)
6. Implicit Differentiation	(1.5 classes)
7. Derivatives of Logarithmic Functions	(1 class)
8. Approximations, Differentials and Newton's Method	(1 class)
J. Applications of Differentiation	
1. Related Rates	(2 classes)
2. Maximum and Minimum Values	(1 class)
3. Derivatives and the Shapes of Curves	(1.5 classes)
4. Graphing with Calculus and Calculators	(1.5 classes)
5. Indeterminate Forms and l'Hospital's Rule	(1 class)
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K. Integrals	
1. Areas and Distances	(1 class)
2. The Definite Integral	(1 class)
3. Evaluating Definite Integrals	(1 class)
4. The Fundamental Theorem of Calculus	(1.5 classes)
5. The Substitution Rule	(1.5 classes)
L. Applications of Integration	
1. More about Areas	(1 class)
2. Volumes	(1 class)
Additional class time for review periods and examinations	(5 classes)
Total classes:	42

IV. Evaluation Methods

The final grade for the course will be determined as follows:

Homework	15%
Quizzes	10%
Projects	5%
3 exams	51%
Comprehensive Final	19%

The projects cover curve fitting and exponential rates of change, graph sketching with calculus, and applications where rates of change are integrated to yield quantities

V. Example Grading Scale

90% - 100%	A
80% - 89%	B

70%-79%	C
60% - 69%	D
Below 60%	F

VI. Undergraduate Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions.
[Note: It is recommended that an attendance policy be developed by individual faculty and included in student syllabi. (See undergraduate catalog for Undergraduate Course Attendance Policy.)]

VII. Required Textbooks, Supplemental Books and Readings

Stewart, J., *Calculus: Concepts and Contexts*, Third Edition, Brooks/Cole, 2004.

Coverage: Chapters 2, 3, 4, sections 5.1 through 5.5, and 6.1. Sections 4.7 and 4.8 will be incorporated into other sections.

VIII. Special Resource Requirements

Students should have access to a calculator with graphical and symbolic capabilities.

IX. Bibliography

Anton, H., Bivens, I., and Davis, S., *Calculus: Early Transcendentals, Single and Multivariable*, 8th Edition, John Wiley & Sons, 2005.

Thomas, G., Wier, M., Hoss, J., and Giordano, F., *Thomas' Calculus Early Transcendental*, 11th Edition, Addison-Wesley, 2005.

Varberg, D., Purcell, E., and Rigdon, S., *Calculus*, 9th Edition, Prentice-Hall, 2006.

5. Assignment instructions for one major course assignment and a grading rubric for that assignment

The majority of graded content for this course is chapter tests and final exams. Although the tests and exams cover the same content from the same chapters, instructors for each section determine their test structures, frequency, and grading criteria on an individual basis. Grading rubrics are typically based on mastery with partial credit given for progress on fundamentals.

The projects cover curve fitting and exponential rates of change, graph sketching with calculus, and applications where rates of change are integrated to yield quantities.

Possible projects include case studies where students work on small "contractor teams" to address a problem related to course content. Consider the following application: (reference: http://www.math.lsa.umich.edu/~glarose/courseinfo/calc/projhtml/cal1_p2s98.html)

> An industrial manufacturer needs to review the safety precautions for a number of free standing vertical cylindrical fuel tanks. These are filled and discharged through the valve at the base of tank. As the tanks are large (20' high with radii of 8'), there is a clear incentive to be sure that should they develop a leak the fuel release would be adequately contained, and we are therefore building a wall around each tank that will catch the fuel in this case. Simultaneously, we would like to avoid spending too much on a very large wall if a small one will suffice, and we are therefore contacting you to obtain an estimate for the amount of fuel that might be released.
>
> The greatest risk of unintended discharge is when the tank is being filled or emptied through the valve (the diameter of which is approximately 9"), as through unintended contact or mechanical failure the valve could fail and allow unimpeded discharge through the pipe to which the valve is connected. In this case, it is known that the rate at which the height of the fuel in the tank will change is proportional to the ratio of the squares of the diameters of the valve and the tank and the square root of the height of the liquid in the tank, with constant of proportionality $k=(2g)^{1/2}$ (where g is the acceleration due to gravity).
>
> Owing to our strong accident-containment procedures, any spill in these circumstances should be stopped within 5 minutes of its initiation but we want the containment to hold a leak that could run for 10 minutes. We need to know under these conditions how much fuel will need to be contained if the leak starts with a full tank and proceeds for either 5 or 10 minutes.
>
> In order to push the industrial site into production as soon as possible, we need your 3 page report as soon as possible.

The grading rubric would assess 70% on accuracy and completion of solution, 20% on format and appearance of report, 5% on references and documentation, and 5% on uniform group participation.

6. Answers to Liberal Studies Questions

A. This will be a multiple-section course. Because this is the first course in a sequence, it is essential that there is basic equivalency among the sections because students could schedule a different instructor for later courses in the sequence. There will be a common syllabus that should be covered by each of the instructors. Calculus instructors typically meet at the end of each year to discuss the textbook for the following year. Throughout the semester instructors typically meet to compare their pace in the course, check what students are finding difficult, and compare tests. The calculus sequence is governed by the Mathematics Department Mathematics/Applied Mathematics Curriculum Committee.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to the development of the Calculus by women and minorities. Also, instructors will be sensitive to gender and ethnic balancing with respect to language in problem construction on homework, quizzes, and tests.

C. In this first Calculus course we are concentrating on developing the foundation of calculus; we will work on quantitative skills. Instructors are encouraged to require a reading that exposes students to the historical development of calculus concepts.

D. This course is an introductory course, but for a specific audience: mathematics and science students. It does not differ from what is provided to beginning mathematics majors. Calculus is a core discipline in both mathematics and science, and students in these majors benefit from a shared core course. Mathematics majors benefit by understanding the science applications inherent in the course. Calculus was developed to solve certain problems, some inherent to science, and some inherent to mathematics itself. Science students get an appreciation for mathematics as the language of science. The scientific method is the process by which scientists, collectively and over time, endeavor to construct an accurate, reliable, consistent and non-arbitrary representation of the world. Mathematics is a tool to write, analyze, and convey these representations.