LSC Use Only Proposal No:	UWUCC Use Only Proposal No: 12-26e.
LSC Action-Date: AP-2/7/13	UWUCC Action-Date: AP-5/7/13 Senate Action Date: APP-9/10/13

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) Francisco Alarcon	Email Address falarcon@iup.edu
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
- [x] Course Revision
- [ ] Course Prefix Change
- [ ] Course Number and/or Title Change
- [ ] Course Deletion
- [ ] Catalog Description Change

Current course prefix, number and full title: MATH 121 Calculus I Natural and Social Sciences

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)

- [x] Learning Skills
- [ ] Knowledge Area
- [ ] Global and Multicultural Awareness
- [ ] Writing Across the Curriculum (W Course)
- [x] Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)
  - [ ] Global Citizenship
  - [ ] Information Literacy
  - [ ] Oral Communication
  - [x] 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
- [x] Liberal Studies Requirement Changes
- [ ] Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)		4/20/12
Department Chairperson(s)	Edel Reilly	4/20/12
College Curriculum Committee Chair	Anne Kotala	4/20/12
College Dean		4/20/12
Director of Liberal Studies (as needed)		5/2/13
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	8/28/13

Received AUG 28 2013 Liberal Studies

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Part II: Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

MATH 121 Calculus I for Natural and Social Sciences

4c-0l-4cr

Prerequisites: MATH 105 or MATH 110 or appropriate Placement Test Score or permission of the Mathematics Department Chairperson.
Note: A student may not take MATH 121 after successfully completing a calculus course without the written approval of the Mathematics Department Chairperson.

A review of elementary functions, including logarithmic and exponential functions. Natural and Social Science majors are introduced to the central ideas of calculus, including limit, derivative and integral. Applications to natural and social sciences are emphasized.

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

The student will:

Objective 1:
Identify and utilize patterns in the study of mathematics.
Expected Student Learning Outcomes 1 and 2
Informed and Empowered Learners
Rationale:
Given a set of data, students will be expected to recognize certain mathematical patterns in order to make informed decisions on how that data is related, if at all. The students will be expected to use these relationships to solve a wide variety of problems. Technology will be used to gain deeper insight into the phenomena and make predictions about future behavior.

Objective 2:
Apply functions to solve problems in the natural and social sciences.
Expected Student Learning Outcomes 1 and 2
Informed and Empowered Learners
Rationale:
The study of functions is essential in establishing the mathematical relationship between various sets. Once these relationships are established and formalized, they will enable students to assign mathematical meaning to information related to a variety of real-world situations. Students will 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 will be used to gain deeper insight into phenomena and make predictions about future behavior.

Objective 3:
Interpret functions expressed analytically and graphically.
Expected Student Learning Outcomes 1 and 2
Informed and Empowered Learners
Rationale:
Students will be expected to assess information that is disseminated analytically and/or graphically, and use the tools obtained from their study of functions to gain insight on the relationships exhibited. Technology will be used to gain deeper insight.

Objective 4:
Apply the limit process to functions in the natural and social sciences.
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. 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 5:
Calculate the derivative of a function and interpret its meaning.
Expected Student Learning Outcomes 1 and 2
Informed and Empowered Learners
Rationale:
Students will be able to measure how one quantity changes in response to a change in another quantity. The concept derivative of a function will be used to solve geometric problems, such as curve sketching, and to convert written applied problems into mathematical models. Students will be able to relate the concept of derivative to the concept of slope of the graph of a function.

Objective 6:
Calculate the integral of a function and interpret its meaning.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Students will use antidifferentiation formulas to express indefinite integrals, and apply the substitution method or integration by parts when appropriate. 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 define the concept of area and definite integrals. The Fundamental Theorem of Calculus is used to evaluate definite integrals and represent antiderivatives. Integrals will also be used in a variety of applications to model mathematical, physical and economic situations. In particular, determining totals from rates, computing velocity and position from acceleration, and finding market surplus from supply and demand.

Objective 7:
Study and address issues concerning behavioral consequences of decisions on society and the physical world using mathematics.
Expected Student Learning Outcomes 3:
Responsible Learners
Rationale:
Students will use a variety of calculus techniques, in particular differentiation and integration, to solve applied problems at the discretion of the instructor. These problems include but are not limited to pollution control, population growth, energy consumption, emission control, health insurance premiums, nutrition, earthquake intensity, etc.

III. Detailed Course Outline

A. Functions (4 hours)
1. Real Numbers, Inequalities, and Lines
2. Exponents
3. Functions
4. Functions, Continued

This is intended as a short review of precalculus. All of this material is covered extensively in MATH 105.

B. Derivatives and Their Uses (11 hours)
1. Limits and Continuity
2. Slopes, Rates of Change, and Derivatives
3. Some Differentiation Formulas
4. Product and Quotient Rules
5. Higher-Order Derivatives
6. Chain Rule and Generalized Power Rule
7. Nondifferentiable Functions

C. Further Applications of Derivatives (11 hours)
1. Graphing Using the First Derivative
2. Graphing Using the First and Second Derivatives
3. Optimization
4. Further Applications of Optimization
5. Optimizing Harvest Size
6. Implicit Differentiation and Related Rates

D. Exponential and Logarithmic Functions (5 hours)
1. Exponential Functions
2. Logarithmic Functions
3. Differentiation of Logarithmic and Exponential Functions

Reminder: Items 1 and 2 are a review from MATH 105.

E. Integration and Its Applications (11 hours)
   1. Antiderivatives and Indefinite Integrals
   2. Integration Using Logarithmic and Exponential Functions
   3. Definite Integrals and Area
   4. Further Applications of Definite Integrals
   5. Integration by Substitution

F. Additional Topics in Integration (8 hours)
   1. Integration by Parts
   2. Integration Using Tables
   3. Improper Integrals
   4. Numerical Integration

This syllabus covers 50 hours, leaving 6 hours for testing and/or review.

There are also 2 hours for a final exam or concluding activity.

IV. Evaluation Methods

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

50% Tests. Tests will include problems on basic competency and critical thinking.
20% Final Examination. The final examination will be comprehensive and cover both basic competency and critical thinking.
30% Homework, Quizzes, and Projects. These will cover textbook assignments and applications.

V. Grading Scale

Grades will be assigned as follows:

A: 90%-100%
B: 80%-89%
C: 70%-79%
D: 60-69%
F: 0%-59%

VI. Undergraduate Course 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

Lial, Margaret L., Raymond N. Greenwell, and Nathan P. Ritchey, *Calculus with Applications* (10th edition). Boston: Addison Wesley, 2011.

Switkes, Jennifer, *A Quotient Rule Integration by Parts Formula,* College Mathematics Journal, Vol 36, No. 1, pp. 58-60, 2005.

Austin, B., Barry, D., and Berman, D., *The Lengthening Shadow: The Story of Related Rates,* Mathematics Magazine, Vol. 73, No. 1, pp. 3-12, 2000.

Cooney, M., *Celebrating Women in Mathematics,* The National Council of Teachers of Mathematics, 1996.

VIII. Special Resource Requirements

Some instructors may require students to purchase a graphing calculator.

IX. Bibliography

Committee on the Mathematical Sciences in the Year 2000. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education,* Washington, DC : National Academy Press, 1989.

Hughes-Hallet, Deborah, et al. *Applied Calculus*, New York: John Wiley & Sons, Inc., 1999.

Larson, Ron. *Calculus.* 9th ed., Brooks\Cole, 2009.

Ostebee, Arnold, and Paul Zorn. *Calculus from Graphical, Numerical, and Symbolic Points of View*, Stamford, CT: Harcourt, 1997.

Stewart, James. *Calculus.* 7th ed., Brooks\Cole, 2011

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. Objective 7 from the old syllabus of record was removed, as it was determined to be vague and not measurable. The idea behind this objective is already covered by Objectives 1 – 6.

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 Record

I. Catalog Description

MATH 121 Calculus I for Natural and Social Sciences

4 class hours
0 lab hours
4 credits
(4c-0l-4sh)

Prerequisites: MATH 105 or MATH 110 or appropriate Placement Test Score or permission of the Mathematics Department Chairperson.
Note: A student may not take MATH 115 after successfully completing a calculus course without the written approval of the Mathematics Department Chairperson.

A review of elementary functions, including logarithmic and exponential functions. Natural and Social Science majors are introduced to the central ideas of calculus, including limit, derivative and integral. Applications to natural and social sciences are emphasized.

II. Course Objectives

1. Students will understand and take advantage of pattern recognition in the study of mathematics.
2. Students will make a careful study of functions and their application to the natural and social sciences.
3. Students will understand how to interpret functions expressed analytically and graphically.
4. Students will understand the limit process and how it pertains to functions in the natural and social sciences.
5. Students will be able to calculate the derivative of a function and interpret its meaning.
6. Students will be able to calculate the integral of a function and interpret its meaning.

7. Students will leave the course with a solid set of skills and a conceptual framework to equip the students for future study.

III. Course Outline

A. Functions (4 hours)
1. Real Numbers, Inequalities, and Lines
2. Exponents
3. Functions
4. Functions, Continued

This is intended as a short review of precalculus. All of this material is covered extensively in MATH 105.

B. Derivatives and Their Uses (11 hours)
1. Limits and Continuity
2. Slopes, Rates of Change, and Derivatives
3. Some Differentiation Formulas
4. Product and Quotient Rules
5. Higher-Order Derivatives
6. Chain Rule and Generalized Power Rule
7. Nondifferentiable Functions

C. Further Applications of Derivatives (11 hours)
1. Graphing Using the First Derivative
2. Graphing Using the First and Second Derivatives
3. Optimization
4. Further Applications of Optimization
5. Optimizing Harvest Size
6. Implicit Differentiation and Related Rates

D. Exponential and Logarithmic Functions (6 hours)
1. Exponential Functions
2. Logarithmic Functions
3. Differentiation of Logarithmic and Exponential Functions

Reminder: Items 1 and 2 are a review from MATH 105.

E. Integration and Its Applications (11 hours)

F. Antiderivatives and Indefinite Integrals

G. Integration Using Logarithmic and Exponential Functions

H. Definite Integrals and Area

I. Further Applications of Definite Integrals

J. Integration by Substitution

K. Additional Topics in Integration (9 hours)
   1. Integration by Parts
   2. Integration Using Tables
   3. Improper Integrals
   4. Numerical Integration

The remaining eight hours are for four review classes and four tests.

IV. Method of Instruction

This course is taught in a traditional classroom setting involving lecture, student participation in class, homework assignments, and written in class evaluations. Instructors are free to assign optional projects that may or may not involve graphing technology.

V. Evaluation Methods

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

50% Tests. Tests will include problems on basic competency and critical thinking.
20% Final Examination. The final examination will be comprehensive and cover both basic competency and critical thinking.
30% Homework, Quizzes, and Projects. These will cover textbook assignments and applications.

Grades will be assigned as follows:

A: 90%-100%
B: 80%-89%
C: 70%-79%
D: 60-69%
F: 0%-59%

VI. Required Textbook

Berresford, Geoffrey C. and Andrew M. Rockett. Applied Calculus (2nd edition). Boston: Houghton Mifflin Publishing Company, 2000.

VII. Special Resource Requirements

Some instructors may require students to purchase a graphing calculator.

VIII. Bibliography

Committee on the Mathematical Sciences in the Year 2000. Everybody Counts: A Report to the Nation on the Future of Mathematics Education. Washington, DC : National Academy Press, 1989.

Hughes-Hallet, Deborah, et al. Applied Calculus. New York: John Wiley & Sons, Inc., 1999.

Ostebee, Arnold, and Paul Zorn. Calculus from Graphical, Numerical, and Symbolic Points of View. Stamford, CT: Harcourt, 1997.

IX. Student Enrollment

This course is offered every semester and the average enrollment is 210 students.

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

Major assignments for this course include daily homework sets, chapter tests, and final exam. Although the homework, tests, and final exam cover the same content from the same chapters, instructors for each section determine their homework policies, test structures and grading criterion an individual basis.

6. Answers to Liberal Studies Questions

A. This course will be taught by multiple instructors. The Service Course Curriculum Committee selects the text that all instructors will use for MATH 121 and develops the objectives for this course. Each instructor is expected to cover the same textbook sections and have the same course objectives.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to the development of the mathematics involved by women and minorities. These discussions, for instance, can be based on content from the supplemental readings. Also, instructors will be sensitive to gender and ethnic balancing with respect to language in problem construction on homework, quizzes, and tests. The construction of contextual problems will be used to facilitate learning by making the material culturally relevant.

C. In this course we would like to exercise the exception to the use of a work of fiction or non-fiction. In this calculus course we are concentrating on developing the foundation of calculus; we will work on quantitative skills.

D. This course is an introductory course, but for a specific audience: natural and social science students. This course can be used for credit towards a minor in mathematics; however, it does not fulfill the liberal studies requirement for mathematics majors. In this course, particular attention is given to applications that arise in business, nature, finance, health and safety professions. 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.

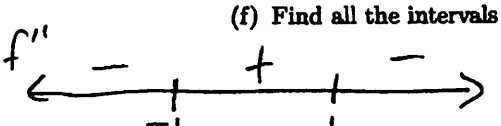
(e) Find all the places where the second derivative is 0 or does not exist. f'' exists everywhere.

(2 pts) $-12(x^2-1) = 0$

$-12(x-1)(x+1) = 0$

$x = 1$ or $x = -1$

(f) Find all the intervals of concavity for f.



intervals & signs (1 pt)

$f''(-2) < 0$

$f''(0) > 0$

$f''(2) < 0$

So, f is concave up on $(-1, 1)$ and concave down on the intervals $(-\infty, -1)$ and $(1, \infty)$. (1 pt – conclusions)

(g) Find all relative max points and all relative min points (include both x and y points for each).

(1 pt) $f(-\sqrt{3})$ is a relative max because changes from increasing to decreasing.

(1 pt) $f(0)$ is a local min because $f''(0) > 0$. (see part f)

(1 pt) $f(\sqrt{3})$ is a local max because $f''(\sqrt{3}) < 0$. (see part f).

(1 pt) So, f has relative max's at $(-\sqrt{3}, 9)$ and $(\sqrt{3}, 9)$. f has a relative min at $(0, 0)$.

(h) Find any inflection points of f.

f has inflection points at $x = -1$ & $x = 1$ b/c changes concavity.

(1 pt) Inflection points of f are $(-1, 5)$ and $(1, 5)$.