

CURRICULUM PROPOSAL COVER SHEET  
University-Wide Undergraduate Curriculum Committee

LSC Use Only  
Number LS 51  
Action A  
Date 2-2-89

UWUCC Use Only  
Number \_\_\_\_\_  
Action \_\_\_\_\_  
Date \_\_\_\_\_

I. TITLE/AUTHOR OF CHANGE

COURSE/PROGRAM TITLE MA 123 - Calculus I for Physics/Chemistry

DEPARTMENT Mathematics

CONTACT PERSON John Broughton

II. THIS COURSE IS BEING PROPOSED FOR:

- Course Approval Only  
 Course Approval and Liberal Studies Approval  
 Liberal Studies Approval only (course previously has been approved by the University Senate)

III. APPROVALS

Elvoss Spokman  
Department Curriculum Committee

Debra A. [Signature]  
College Curriculum Committee

Charles D. [Signature]  
Director of Liberal Studies  
(where applicable)

John Broughton  
Department Chairperson

Ann [Signature]  
College Dean\*

\_\_\_\_\_  
Provost  
(where applicable)

\*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. TIMETABLE

Date Submitted to LSC \_\_\_\_\_  
to UWUCC \_\_\_\_\_

Semester/Year to be implemented \_\_\_\_\_

Date to be published in Catalog \_\_\_\_\_

INDIANA UNIVERSITY OF PENNSYLVANIA  
MATHEMATICS DEPARTMENT

COURSE NUMBER: MA 123

COURSE TITLE: Calculus I for Physics and Chemistry

CREDITS: 4 semester hours

CATALOG DESCRIPTION:

Techniques of differentiation and integration, with application to analytic geometry of two and three dimensions by means of vector analysis (algebra and calculus), kinematics, surface integrals, line integrals, infinite series, matrices and simultaneous linear equations, differential equations with numerous applications to physical problems.

PREREQUISITE: High school algebra, geometry, and trigonometry

PRESENT TEXT: Calculus with Analytic Geometry  
Dennis G. Zill

COURSE OUTLINE:

I. Functions

- A. The Real Numbers
- B. The Cartesian Plane
- C. Lines
- D. Functions
- E. Combining Functions
- F. Trigonometric Functions

II. Limits of Functions

- A. Intuitive Notion of a Limit
- B. Theorems on Limits
- C. Limits That Involve Infinity
- D. Continuity
- E. The Definition of a Limit

III. The Derivative

- A. The Rate of Change of a Function
- B. The Derivative
- C. Rules of Differentiation I: Power and Sum Rules
- D. Rules of Differentiation II: Product and Quotient Rules
- E. Derivatives of the Trigonometric Functions
- F. Rules of Differentiation III: The Chain Rule
- G. Higher Order Derivatives
- H. Implicit Differentiation

- I. Rules of Differentiation IV: Extended Power Rules
- J. Differentials
- K. Newton's Method

#### IV. Applications of the Derivative

- A. Rectilinear Motion and the Derivative
- B. Related Rates
- C. Extrema of Functions
- D. Rolle's Theorem and the Mean Value Theorem
- E. Graphing the First Derivative

#### V. The Integral

- A. Antiderivatives
- B. Indefinite Integrals and the u-Substitution
- C. Sigma Notation
- D. Area Under a Graph
- E. The Definite Integral
- F. Properties of the Definite Integral
- G. The Fundamental Theorem of Calculus
- H. Approximate Integration

#### VI. Applications of the Integral

- A. Area and Area Between Two Graphs
- B. Volumes by Slicing
- C. Solids of Revolution: Disk and Washer Method
- D. Solids of Revolution: The Shell Method
- E. Arc Length
- F. Surfaces of Revolution
- G. Average Value of a Function and the Mean Value Theorem
- H. Rectilinear Motion and the Integral
- I. Work

#### VII. Inverse Trigonometric Functions

- A. Inverse Functions
  - B. Inverse Trigonometric Functions
  - C. Derivatives and Integrals
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ADDENDUM TO THE SYLLABI FOR THE COURSES MA 121, MA 122, MA 123, MA 124,  
AND MA 127

Course Objectives for the Calculus Courses MA 121, MA 122, MA 123, MA 124,  
and MA 127:

I. General Objectives:

- A. Students will develop an appreciation for the nature, the breadth, and the power of mathematics and for its role in a technological society.
- B. Students will develop an understanding for Mathematical Logic and will use that understanding as a basis for the improvement of their logical thinking.
- C. Students will develop computational skills using the techniques studied in class.
- D. Students will learn to communicate in the language of mathematics. This learning will involve reading, writing, listening, and speaking.
- E. Students will develop the skill of applying the information learned in the classroom to the solution of problems. Such solutions will involve both the application of computation skills and theoretical (thinking) skills.
- F. Students will learn to appreciate the meaningful role played by mathematics in both the development of our society and the scientific discoveries of contemporary times.

II. Some Specific Course Objectives:

- A. Students will be able to understand and apply the concept of limits and of continuity.
- B. Students will be able to apply the concept of limit to develop the derivative operation.
- C. Students will develop and apply the rules for differentiation.
- D. Students will be able to use the derivative to graph certain functions.
- E. Students will be able to solve related rate word problems using the concept of the derivative.
- F. Students will be able to understand and apply the concept of integration and the definite integral.
- G. Students will study methods for the differentiation and integration of inverse, logarithmic, exponential, and trigonometric functions.
- H. Students will study the application of other techniques of integration for more difficult functions.
- I. Students will study the extension of the principles of calculus to multivariable functions.
- J. Students will apply the principles of calculus to the study of infinite sequences and series and conditions for convergence for each.
- K. Students will use the principles of calculus to solve certain elementary differential equations.
- L. Students will apply calculus to certain specialized areas such as hyperbolic functions, polar coordinates, and

indeterminate forms and improper integrals.

- M. Students will study the application of calculus to the 3-dimensional space of analytic geometry.
- N. Students will understand vectors in 3-dimensional space and their related calculus properties.
- O. Students will study the differentiation and integration of functions of several variables and will be able to interpret the results of these operations geometrically.

# LIBERAL STUDIES COURSE APPROVAL FORM

**About this form:** Use this form only if you wish to have a course included for Liberal Studies credit. The form is intended to assist you in developing your course to meet the university's Criteria for Liberal Studies, and to arrange your proposal in a standard order for consideration by the LSC and the UWUCC. If you have questions, contact the Liberal Studies Office, 353 Sutton Hall; telephone, 357-5715.

**Do not use this form for technical, professional, or pre-professional courses or for remedial courses, none of which is eligible for Liberal Studies. Do not use this form for sections of the synthesis course or for writing-intensive sections; different forms will be available for those.**

## PART I. BASIC INFORMATION

**A. For which category(ies) are you proposing the course? Check all that apply.**

### LEARNING SKILLS

- First English Composition Course
- Second English Composition Course
- Mathematics

### KNOWLEDGE AREAS

- Humanities: History
- Humanities: Philosophy/Religious Studies
- Humanities: Literature
- Fine Arts
- Natural Sciences: Laboratory Course
- Natural Sciences: Non-laboratory Course
- Social Sciences
- Health and Wellness
- Non-Western Cultures
- Liberal Studies Elective

**B. Are you requesting regular or provisional approval for this course?**

- Regular       Provisional (limitations apply, see instructions)  
*now course*

**C. During the transition from General Education to Liberal Studies, should this course be listed as an approved substitute for a current General Education course, thus allowing it to meet any remaining General Education needs?  yes  no**

**If so, which General Education course(s)?** MA 123

**PART II. WHICH LIBERAL STUDIES GOALS WILL YOUR COURSE MEET? Check all that apply and attach an explanation.**

All Liberal Studies courses must contribute to at least one of these goals; most will meet more than one. As you check them off, please indicate whether you consider them to be primary or secondary goals of the course. [For example, a history course might assume "historical consciousness" and "acquiring a body of knowledge" as its primary goals, but it might also enhance inquiry skills or literacy or library skills.] Keep in mind that no single course is expected to shoulder all by itself the responsibility for meeting these goals; our work is supported and enhanced by that of our colleagues teaching other courses.

	Primary	Secondary
<b>A. Intellectual Skills and Modes of Thinking:</b>		
1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. Literacy--writing, reading, speaking, listening	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. Understanding numerical data	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. Historical consciousness	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Scientific inquiry	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6. Values (ethical mode of thinking or application of ethical perception)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. Aesthetic mode of thinking	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>C. Understanding the Physical Nature of Human Beings</b>		
<b>D. Certain Collateral Skills:</b>		
1. Use of the library	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2. Use of computing technology	<input type="checkbox"/>	<input checked="" type="checkbox"/>

## ADDENDUM TO LIBERAL STUDIES PROPOSALS: PART II

The Liberal Studies Goals met by the Calculus Courses MA 121, MA 122, MA 123, MA 124, and MA 127 are:

### A. Intellectual Skills and Modes of Thinking:

1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process is a primary goal of the course. It is apparent that the study of Mathematics requires that the student learn to apply the pattern of using these categories to collect data, clearly state the problem under study, apply the methods known to affect a solution to the problem, and then to analyze and interpret the resulting solution.
2. Literacy—writing, reading, speaking, listening, is a secondary goal of this course. All of these areas can be applied and improved during a course of study in mathematics. Reading skills are absolutely necessary for a clear understanding of the material; the writing of solutions to mathematical problems requires clarity of mind and organization of thought; the requirement of discussing mathematics in the classroom shows the student the importance of clear patterns of thinking and of the expression of those thoughts orally; and listening skills are very important in the understanding of mathematics. These skills can be improved through the writing of tests and of assigned papers, through the oral response to classroom questions, and through the reading of assignments.
3. Understanding numerical data is a primary goal of this course. No data is meaningful without interpretation and the study of mathematics attempts to train the student in the methods and skills needed to interpret data correctly.
4. Historical consciousness is a secondary goal. Students should have some awareness of the historical significance of the role of mathematics in the development of western and other civilizations and its importance in contemporary technological times.
5. Scientific inquiry is a secondary goal. Students should be made aware of the importance of mathematical logic and the role it plays in scientific inquiry and problem solving techniques used throughout science. In addition, students should be made aware that mathematics is the language of science and discovery.
6. Aesthetic mode of thinking is a secondary goal. Mathematics to mathematicians and other users is a beautiful art form for communication. An effort should be made to develop in the student a sense of this beauty and an appreciation for its power and utility.

### B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person:

#### Secondary Goal

Although specific mastery of mathematics is not required of all students, it is important that all students taking mathematics in any

form develop a sense of the importance of mathematics to society. In addition, the course of study should develop in the student a feeling of confidence in their own ability to use the mathematical skills that have been learned in their particular mathematics course.

D. Certain Collateral Skills:

2. Use of computing technology is a secondary goal. Students need to be aware of the technology available in computing whether that technology be computers or calculators and, where possible, exposed to such even if only briefly.

**PART III. DOES YOUR COURSE MEET THE GENERAL CRITERIA FOR LIBERAL STUDIES?** Please attach answers to these questions.

- A. If this is a multiple-section, multiple-instructor course, there should be a basic equivalency (though not necessarily uniformity) among the sections in such things as objectives, content, assignments, and evaluation. Note: this should not be interpreted to mean that all professors must make the same assignments or teach the same way; departments are encouraged to develop their courses to allow the flexibility which contributes to imaginative, committed teaching and capitalizes on the strengths of individual faculty.

**What are the strategies that your department will use to assure that basic equivalency exists?** Examples might be the establishment of departmental guidelines, assignment of responsibility to a coordinating committee, exchange and discussion of individual instructor syllabi, periodic meetings among instructors, etc.

- ✓ B. Liberal Studies courses must include the perspectives and contributions of ethnic and racial minorities and of women wherever appropriate to the subject matter. **If your attached syllabus does not make explicit that the course meets this criterion, please append an explanation of how it will.**

- C. Liberal Studies courses must require the reading and use by students of at least one, but preferably more, substantial works of fiction or nonfiction (as distinguished from textbooks, anthologies, workbooks, or manuals). **Your attached syllabus must make explicit that the course meets this criterion.**

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[The only exception is for courses whose primary purpose is the development of higher level quantitative skills; such courses are encouraged to include such reading, but are not expected to do so at the expense of other course objectives. **If you are exercising this exception, please justify here.**]

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- D. If this is an introductory course intended for a general student audience, it should be designed to reflect the reality that it may well be the only formal college instruction these students will have in that discipline, instead of being designed as the first course in a major sequence. That is, it should introduce the discipline to students rather than introduce students into the discipline. **If this is such an introductory course, how is it different from what is provided for beginning majors?**

ADDENDUM TO LIBERAL STUDIES PROPOSALS: PART III

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and by minorities. Particular attention will be given to the following areas as they relate to this topic:

1. The classroom discussion will be sensitive to gender balancing with respect to language.
2. Quizzes, tests, examinations, and any other written information distributed to the students will be sensitive to gender balancing, especially in problem construction, and to minorities whenever possible.
3. Specific names and contributions made by women and other members of minority groups will be discussed in the classroom when the discussion of such is germane to the material being studied. It should be noted though that mathematics has been the domain of the male throughout history and only in recent time has there been numbers of women involved. Even today, there are too few women in the field of mathematics.

E. The Liberal Studies Criteria indicate six ways in which all courses should contribute to students' abilities. To **which of the six will your course contribute?** Check all that apply and attach an explanation.

- 1. Confront the major ethical issues which pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.
- 2. Define and analyze problems, frame questions, evaluate available solutions, and make choices
- 3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.
- 4. Recognize creativity and engage in creative thinking.
- 5. Continue learning even after the completion of their formal education.
- 6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events.

**PART IV. DOES YOUR COURSE MEET THE CRITERIA FOR THE CURRICULUM CATEGORY IN WHICH IT IS TO BE LISTED?**

Each curriculum category has its own set of specific criteria in addition to those generally applicable. The LSC provides copies of these criteria arranged in a convenient, check-list format which you can mark off appropriately and include with your proposal. **The attached syllabus should indicate how your course meets each criterion you check. If it does not do so explicitly, please attach an explanation.**

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PART III (MA 123)

A. There will be a common syllabi of topics that should be covered by each of the individual instructors teaching this course. Such common syllabi should include but not be limited to topics which introduce the student to deductive reasoning, develop in the student problem solving skills, and enable the student not only to understand the underlying principles of formulae but also to have the ability to use and interpret numerical data.

B. Whenever appropriate, information will be introduced into the classroom discussion which will reflect the contributions made to mathematics by women and by racial minorities.

C. Two readings will be assigned during the course. The student is required to respond to each assignment in writing. The purpose of the writing is for each student to formulate and express his/her interpretation and impression of the reading. A reading list for this course is as follows:

- (1) "The Problems of Mathematics" by Ian Stewart.
- (2) "The Role of Mathematics in Science" by Shiffer and Bowden.
- (3) "Did You Say Mathematics?" by Ya Khurgin.
- (4) "World of Mathematics" by Newman.
- (5) "Mathematics in Western Culture" by Kline.
- (6) "Mathematics and the Physical World" by Kline.
- (7) "Women in Mathematics" by Osen.
- (8) "Mathematics Today" by Steen.

D. The thrust of MA 123 is to develop in the student whose major is a natural science an awareness of and an appreciation for the power and usefulness of differential calculus and its important role both in the history of mathematics and in a technological society. In particular, it should prepare the student for the further study of integral calculus and/or other mathematics courses. A partial list of topics that would be appropriate for this course would include functions; limits of functions; the derivative; applications of the derivative; the integral; applications of the integral; and inverse trigonometric functions. These topics would provide the course with a suitable mathematical strata that would improve the mathematical maturity of students to the point where they would be prepared to enroll in calculus II, MA 124, or other mathematics courses which require calculus as a prerequisite. Additionally, this course would enable the student to develop confidence in handling numerical problems, would present the student with an opportunity to develop an appreciation for mathematics, and would allow the introduction to students of hand held calculators and possibly computers.

E. #2.- The very nature of mathematical study requires that problems be clearly analyzed and defined, that solutions be generated for such problems, and that an interpretation be assigned to each possible solution in order that a correct choice may be made.

#4.- Mathematics is exactly the art of creative thinking. One moves from the collection of data to the definition of the problem to the abstract generalization in which a solution or solutions are

constructed to the interpretation of the solution or solutions to the application of the solution(s). This process requires one to recognize creativity and to engage in creative thinking.

- #5.- One is constantly exposed to information which needs the principles of mathematics for proper interpretation. Skills mastered in this course can last one a life time.

**CHECK LIST -- MATHEMATICS**  
**(Learning Skills Area)**

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**Mathematics Criteria which the Course must meet:**

- Introduce students to deductive reasoning
- Develop in the student problem solving techniques appropriate for the course.
- Enable the student to understand the underlying principles of formulas.
- Enable the student to use and interpret numerical information.

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**Courses appropriate to the Mathematics Learning Skills Area must be either:**

- A. Mathematics courses that develop significant mathematical skills required by a major discipline.**
- B. Mathematics courses designed for Liberal Studies.**

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**Additional criteria which courses in Category B must meet:**

- Develop the student's confidence in handling numerical problems and data.
- Be sensitive to the diverse background characteristics of the student.
- Include elements on the history or appreciation of mathematics.
- Introduce the hand-held calculator or the computer as a tool.