~~14-4a.~~ ~~15-3a.~~
~~13-9a~~ 16-2a.
~~12-16a.~~

LSC Use Only Proposal No: | UWUCC Use Only Proposal No: ~~11-105b~~
LSC Action-Date: AP- 10/23/14 | UWUCC Action-Date: App -2/21/17 Senate Action Date: App -3/7/17

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	Course Prefix Change	Course Deletion
✓ Course Revision	Course Number and/or Title Change	Catalog Description Change

Current course prefix, number and full title: Math 126 - Calculus II 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)	Judeth Collins	2/13/12
Department Chairperson(s)	[signature]	2/13/12
College Curriculum Committee Chair	Anne Kondo	2/16/12
College Dean	Deane [signature]	2/16/12
Director of Liberal Studies (as needed)	Edel Reilly	6/2/17
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail Sechrist	2/21/17

Received
FEB 17 2012
Liberal Studies

VIII. Special Resource Requirements.

IX. Bibliography.

2. A summary of the proposed revisions.
3. Justification/rationale for the revision.
4. The old syllabus of record.

Part II. Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

MATH 126 Calculus II/Physics, Chemistry, Mathematics

3 class hours
0 lab hours
3 credits
3c-01-3cr

Prerequisite: MATH 125 or the equivalent
The second of a three semester sequence for math and science majors. Topics include: techniques and applications of integration, sequences and series, convergence tests, Taylor polynomials, separable differential equations, vectors and three-dimensional coordinates. (Trigonometric, exponential and logarithmic functions are included throughout the course.)

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

Objective 1:
Use a variety of techniques of integration, including substitution, integration by parts, algebraic and trigonometric manipulation, partial fractions, and evaluation of improper integrals.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to learn a multitude of techniques of integration since there are few general strategies as opposed to differentiation. The students will also gain a deeper understanding of mathematical modeling as it pertains to the natural sciences and finance. These techniques will allow the student to solve many integration type problems in addition to reinforcing algebraic and trigonometric skills.

Objective 2:
Express area and volume in terms of definite integrals.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to translate problems from the applied setting to a mathematical setting in which the problem can be readily solved, say by the techniques of integration. Students will gain a deeper understanding of how these applied problems can be interpreted and modeled as area and volume problems. In particular how total accumulation may be viewed as an area.

Objective 3
Solve separable differential equations.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:

Assignments will require students to learn how to solve separable differential equations. Mathematical models are used to explain natural phenomenon. These models will involve equations containing rates of change, the solution of which will employ the techniques of integration and differentiation.

Objective 4:
Demonstrate understanding of the concepts of series and sequences, particularly the convergence and divergence of Taylor series.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require students to apply a variety of techniques in order to determine the convergence or divergence of sequences and series. Students will also understand the close relationship between a series and its underlying sequence. In particular, the students will learn of Taylor series can be used to model applied problems understand the underlying connection between definite integrals and areas and volumes.
Objective 5:
Utilize alternate coordinate systems for multidimensional spaces.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:

Assignments will require student to learn how to perform computations in different coordinate systems. The students will also develop the ability to transform a particular problem from one coordinates system to the other. The ability to be able to do this is important in that it can often simplify the main problem to be solved. Further, it is possible for additional insight to be gained from the conversion into another coordinate system.

Objective 6:
Select and apply technology as an aid to problem solving.
Expected Student Learning Outcomes 1 and 2:
Informed and Empowered Learners
Rationale:
Assignments will require student to learn how to implement various technological tools such as a graphing calculator or computer software packages. This will allow students to model certain phenomenon which otherwise would not be possible. Students will enhance their problem solving and critical thinking skill as a result of analyzing data generated from the technology. Student will develop a further understanding of the concepts being introduced.

III. Detailed Course Outline

A. Integration Techniques and Improper Integrals (5 classes)
   1. Integration by Parts
   2. Additional Techniques (Partial Fractions, Trigonometric Substitution)
   3. Approximate Integration (Simpson's Rule, Trapezoidal Rule, Midpoint Rule, etc)
   4. Improper Integrals
B. Application of Integration (6 classes)
   1. Volumes of Revolution

2. Arc Length
3. Average Value
4. Physics Applications (Work, Centers of Mass, Moments, Pressure, Force)

C. Differential Equations (3 classes)
1. Separable Equations
2. Exponential Growth and Decay

D. Sequences and Series (12 classes)
1. Sequences
2. Series
3. Integral Test, Comparison Test, Alternating Series Test, Ratio Test
4. Absolute Convergence
5. Estimating Sums
6. Power Series
7. Functions as Power Series (using only Geometric summation)
8. Taylor and Maclaurin Series

E. Vectors and 3 Dimensional Geometry (10 classes)
1. 3-Dimensional Coordinates
2. Vectors
3. Dot Product
4. Cross Product
5. Lines and Planes
6. Functions of Surfaces
7. Cylindrical and Spherical Coordinates

Additional class time for review periods and examinations (6classes) 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%

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., *Essential Calculus, Early Transcendentals*, Brooks/Cole, 2007.
Coverage: Chapters 6-9.

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.

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.

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 126 Calculus II/Physics, Chemistry, Mathematics	3 class hours 0 lab hours 3 credit hours 3c-01-3cr

Prerequisite: MATH 125 or the equivalent
The second of a three semester sequence for math and science majors. Topics include: techniques and applications of integration, sequences and series, convergence tests, Taylor polynomials, separable differential equations, vectors and three-dimensional coordinates. (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 a variety of techniques of integration, including integration by parts, algebraic and trigonometric manipulation, and partial fractions.
2. Apply techniques of integration to physical problems.
3. Recognize and compute improper integrals.
4. Express area and volume in terms of definite integrals.
5. Solve separable differential equations.
6. Demonstrate understanding of the concepts of series and sequences.
7. Determine the convergence or divergence of a given series.
8. Compute Taylor series for a function and analyze convergence.
9. Utilize alternate coordinate systems for multidimensional spaces
10. Select and apply technology as an aid to problem solving.
11. Formulate mathematical models for applied problems and analyze these using methods of differential and integral calculus.

III. Detailed Course Outline

F. Integration Techniques and Improper Integrals (5 classes)
   1. Integration by Parts
   2. Additional Techniques (Partial Fractions, Trigonometric Substitution)
   3. Approximate Integration (Simpson's Rule, Trapezoidal Rule, Midpoint Rule, etc)
   4. Improper Integrals

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   1. Volumes of Revolution
   2. Arc Length
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   4. Physics Applications (Work, Centers of Mass, Moments, Pressure, Force)

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   1. Separable Equations
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1. Sequences
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2. Vectors
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[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: Sections 5.6, 5.7, 5.9, 5.10, 6.2 to 6.5, 7.1, 7.4, 8.1 to 8.7, and Chapter 9.

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.

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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

Major assignments for this course consist of 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 and grading criteria on an individual basis.

6. Answers to Liberal Studies Questions

A. This will be a multiple-section course. Because this is the second course (of three) in a sequence, it is essential that there is basic equivalency among the sections because students could schedule a different instructor for the last course 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 course we would like to exercise the exception to the use of a work of fiction or non-fiction because the primary purpose is the development of quantitative skills. We do make use of readings in this course, but they are typically from anthologies or from articles in scientific disciplines. These readings are at a level that introductory students can understand.

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.