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UWUCC USE Only
Number: 97-35h
Submission Date: _____
Action-Date: App. 2/16/97
Senate app. 2/3/98

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT

Contact Person Gerald Buriok Phone 2608

Department Mathematics

II. PROPOSAL TYPE (Check All Appropriate Lines)

X COURSE — MA 421 Advanced Calculus I
Suggested 20 character title

___ New Course* _____
Course Number and Full Title

X Course Revision — MA 421 Advanced Calculus I
Course Number and Full Title

___ Liberal Studies Approval ÷ for new or existing course _____
Course Number and Full Title

___ Course Deletion _____
Course Number and Full Title

___ Number and/or Title Change _____
Old Number and/or Full Old Title

_____
New Number and/or Full New Title

___ Course or Catalog Description Change _____
Course Number and Full Title

___ PROGRAM: ___ Major ___ Minor ___ Track

___ New Program* _____
Program Name

___ Program Revision* _____
Program Name

___ Program Deletion* _____
Program Name

___ Title Change _____
Old Program Name

_____
New Program Name

III. Approvals (signatures and date)

Department Curriculum Committee — 9/14/97

Department Chair — 9/14/97

College Curriculum Committee — 10/15/97

College Dean — 10/15/97

÷Director of Liberal Studies (where app

Provost (where applicable)

Part II. Description of Curriculum Change.

1. New syllabus of record - attached.

2. A summary of the proposed revision:

   The current prerequisite for MA421 Advanced Calculus I is "MA 124 or 227, MA 271with a C or better grade." The proposed revision would change the prerequisite to "MA 124, and MA 272 with a C or better grade."

3. Justification/rationale for the revision:

   The Mathematics Department is proposing a change in the core for all four undergraduate programs offered by the department, namely Mathematics, Applied Mathematics, Secondary Mathematics Education, and Economics/Mathematics. One aspect of this change is to extend MA271 Algebraic Structures to a two semester sequence, MA271 and MA272. MA271 will be renamed MA271 Introduction to Mathematical Proofs I, while the second course will be titled MA272 Introduction to Mathematical Proofs II. The prerequisite of MA421 will be changed to "C or higher in MA272." Faculty of the Mathematics Department have determined that the background in mathematical proofs that students acquire in MA271 is inadequate for upper level mathematics courses. Extending MA271 to a two semester sequence will provide an opportunity for students to gain a stronger background before being exposed to upper level theory oriented mathematics courses where there is an emphasis on proofs. The prerequisite change for MA421 will ensure students have the background necessary for succeeding in this course.

   A second aspect of the change in the core for all mathematics programs is to replace the MA127/128/227 calculus requirement with MA 123/124. MA 127/128/227 will be eliminated as courses offered by the department. Whereas a student is now prepared for MA 421 after completing either calculus sequence, eventually only MA 123/124 will be offered. Hence MA 227 is being deleted as a prerequisite.

4. Old syllabus of record - attached.

5. Liberal Studies course approval form and checklist.

   Not applicable.

Part III. Letters of Support.

   No other department is affected by this change.

I. Catalog Description

MA421/521 Advanced Calculus I

3 credits
3 lecture hours
(3c-0l-3sh)

Prerequisites: MA124 and MA 272 with a C or better grade.

Study of set theory, real number system. functions. topology of Cartesian space, sequences. convergence and uniform convergence. continuity, and uniform continuity.

II. Course Objectives:

1. Students will review the basics of set theory and the real line and typical proofs on those topics.

2. Students will study and be expected to give examples and prove results related to the topology of the real line and sequences.

3. Students will develop the ability to prove results about continuity, uniform continuity, and differentiability.

4. (If time permits) Students will be expected to understand and prove results related to series, convergence and uniform convergence.

III. Course Outline/Time Schedule:

A. The Real Number System (4 weeks)
   1. Review of Set Theory
   2. Constructing the Real Numbers
   3. The Topology of the Real Line
   4. Compact Subsets of the Real Line

B. Functions, Sequences, Limits, Continuity (4 weeks)
   1. Functions and Sequences
   2. Definition of Limits
   3. Limit Theorems and their Proofs
   4. Continuity
   5. Uniform Continuity

C. Differentiation (4 weeks)
   1. The derivative of functions from R to R
   2. Elementary rules of derivatives and their proofs
   3. The Mean Value Theorem and its Consequences
   4. The general derivative of functions from R^n to R^m

D. Series and Convergence (2 weeks)
   1. Infinite Series
   2. Tests for Conditional and Absolute Convergence
   3. Series and Sequences of Functions
   4. Uniform Convergence

IV. Evaluation Methods

There is variation in the weights given to evaluation methods used, but typically 40% of the grade will be determined by hand-in assignments emphasizing the writing of proofs, and about 20% of the grade will be determined by a comprehensive final examination. Approximately 5% of the grade will be determined by class activity and participation. About 35% of the grade will be determined by a mixture of quizzes, mini-tests, and tests. This varies with the individual instructor. One instructor typically uses 6 mini-tests when the course meets only two times a week. Another instructor typically uses three tests and no quizzes.

The final course grade will be determined by the total number of points accumulated on assignments and examinations, with the grading scale approximately as follows: 90% and above A, 80-89% B, 70-79% C, 60-69% D, and below 60% F.

V. Appropriate Textbooks: These books contain the appropriate material at the appropriate level and each has been used as the required textbook for the course.

Belding, David F. and Kevin J. Mitchell, *Foundations of Analysis* , Englewood Cliffs, NJ: Prentice-Hall, 1991
Buck, R. Creighton, *Advanced Calculus* , New York: McGraw-Hill, 1978.
Gaughan, Edward D., *Introduction to Analysis* , Monterey, CA: Brooks/Cole, 1987.

VI. Special Resource Requirements: None.

VII. Bibliography

Apostol, Tom: *Mathematical Analysis*, second edition. Reading, MA: Addison Wesley, 1974.

Bartle, Robert: *The Elements of Real Analysis*. New York: John Wiley, 1964.

Bressoud, David: *A Radical Approach to Real Analysis*. Washington, DC: Mathematical Association of America, 1994.

Parzynski, William R. and Philip W. Zipse, *Introduction to Mathematical Analysis*, New York: McGraw-Hill, 1982.

Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705

Course Number: MA 421/521

Course Title: Advanced Calculus I

Credits: 3 semester hours

Prerequisites: MA 124 or MA 227, and MA 271 with a grade of C or better

Textbook: Foundations of Analysis
David Belding - Kevin Mitchell
Prentice Hall

Revised: 9/94

Catalog Description:
Study of set theory, real number system, functions topology of Cartesian space, sequences, convergence and uniform convergence, continuity, and uniform continuity.

Course Outline/Time Schedule:

I. The Real Number System
   A. Irrational Numbers
   B. Constructing the Real Numbers
   C. The Axiom System for the Real Numbers
   D. The Heine-Borel Theorem

II. Functions, Limits, Continuity
   A. Functions
   B. Limits
   C. Limit Theory
   D. Other Types of Limits
   E. Continuity
   F. Continuity on Closed Intervals

III. Differentiation and Integration
   A. The Derivative
   B. Elementary Laws of Differentiation
   C. The Mean Value Theorem and Its Consequences
   D. Integration
   E. Properties of the Integral
   F. The Fundamental Theorems of Calculus
   G. Taylor Polynomials

IV. Sequences and Series
   A. Infinite Sequences
   B. Monotone and Cauchy Sequences
   C. Infinite Series and Convergence Tests
   D. Absolute and Conditional Convergence