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INDIANA UNIVERSITY OF PENNSYLVANIA
SENATE CURRICULUM COMMITTEE B-2

NEW COURSE PROPOSAL

Course Prefix and Number: MA 117

Course Title: Principles of Mathematics

Department: Mathematics

Person to Contact for Further Information: Dr. Marlin E. Hartman

Course Affected: None

Desired Effective Semester for Change: Fall Semester 1987

Approvals:

Department Committee Chairperson Marlin E. Hartman

Department Chairperson John Broughton

School Committee Chairperson Charles W. Ryan

School Dean Charles W. Ryan

A. DESCRIPTION AND ACADEMIC NEED

A1. See attached catalog description of course.

A2. See attached course syllabus.

A3. This first course for prospective secondary school mathematics teachers is designed specifically for mathematics education majors. It is not intended for students in other majors nor is it proposed for inclusion on the regular General Education course list. It responds to some of the concerns expressed by our external evaluators during our recent departmental self-evaluation and helps our teacher preparation curriculum to be in line with recommendations made in the 1983 report of the CUPM Panel on Teacher Training of the Mathematical Association of America and guidelines developed by the Commission on the Education of Teachers of Mathematics of The National Council of Teachers of Mathematics. Some of the topics in the course will be those included in the student's high school background; however, those topics are expected to be only lightly touched upon to facillitate recollection. Some are topics with which our prospective teachers may have some familiarity, but which they may have to teach, so that a more detailed examination would be in order. Others are topics that the student may not have seen in high school, and are not likely to have in their undergraduate program unless certain courses are elected. (See attached statement of course rationale.)

A4. This proposed course is part of a package proposal for revision of the secondary mathematics education program. It does not require changes in content of other existing courses.

A5. This course is novel in the sense that it will be taught by the advisor of freshmen secondary mathematics education majors, enabling the advisor to become more aware of the strengths and weaknesses of his advisees so as to enable him to more effectively help his advisees in making decisions on the options available in the mathematics education curriculum. This advisor is to be selected by the department's Secondary Mathematics Education Committee and is to be a faculty member with an expressed interest in mathematics education.

A6. This course has never been offered at IUP on a trial basis.

A7. This course is not to be a dual-level course.

A8. Although some other institutions offer courses which include some of the topics on the proposed outline, in particular courses in descrete or finite mathematics, the course is nevertheless unique in its approach and design. This is attested to by the difficulty experienced in finding an available textbook appropriate for the course.

A9. As stated above, the course was designed following recommendations made by the Committee on the Undergraduate Program of the Mathematical Association of America in its 1983 report entitled "Recommendations on the Mathematical Preparation of Teachers" and according to guidelines developed by the Commission on the Education of Teachers of Mathematics of The National Council of Teachers of Mathematics in their report

entitled "Guidelines for the Preparation of Teachers of Mathematics".

B. INTERDISCIPLINARY IMPLICATIONS

B1. This course will be taught by one instructor.

B2. No additional or corollary courses are needed with this course, now or later.

B3. There is no relationship of the content of this course to the content of courses offered by other departments.

B4. This course is not applicable in a program of the School of Continuing Education directed to a clientele other than our full-time students.

C. EVALUATION

C1. Written examinations, quizzes, and classroom participation are expected to be used to evaluate student progress.

C2. This course may not be taken for variable credit.

D. IMPLEMENTATION

D1. Resources, including faculty and space, are adequate to teach this course.

D2. At the present time, on the basis of current student enrollment, we expect to offer this course each fall semester. If the number of mathematics education majors increases, we would offer the course in both the fall and spring semesters as need dictates.

D3. We presently anticipate one section each time the course is offered.

D4. We plan to accommodate a maximum of 20 students in a section of this course.

E. MISCELLANEOUS

All pertinent information has been included in the above.

RATIONALE FOR PROPOSED COURSE
MA 117 PRINCIPLES OF MATHEMATICS

This first course for secondary school mathematics teachers is the product of long hours of discussion and examination by the Secondary Mathematics Education Committee of the Mathematics Department. It responds to some of the concerns expressed as a result of our recent external evaluation and helps our curriculum for mathematics teachers to be in line with recommendations and guidelines of the Mathematical Association of America and the National Council of Teachers of Mathematics. It represents much compromise, but in the end, there was unanimous agreement that the course would be a benefit to anyone desiring to enter the profession of mathematics education.

It is true that some of the topics will be those included in the student's high school background, but those topics are expected to be only lightly touched to facilitate recollection. Some are topics with which our prospective teachers may have some familiarity, but which they may have to teach, so a more detailed examination would be in order. Others are topics that the student may not have seen in high school, and are not likely to have in their undergraduate program unless certain courses are elected.

As a whole, the course will also give the student, at the beginning of his/her endeavor, an overview of the many threads that weave through the fabric of mathematics, e.g., logic, functions, sets, graphs, number, counting, and problem solving. The course will also reveal the many facets of mathematics - the deductive and inductive natures, the abstract and practical natures, and the beautifully simple and sometimes complex natures of the subject.

Teachers should have frequent contact with some of the more classical results in mathematics and should also be aware of the current directions. This course provides a first opportunity for this to be realized, and with regard to some of the topics, the only opportunity. By no means is it felt that the outline presented in the course syllabus is a "once and for all" proposal. The committee is aware that there will constantly need to be some changes made to improve and update the course. We will continue to have dialogue within the committee and the department and will constantly strive for improvement.

COURSE SYLLABUS

Date Submitted: February 28, 1986

Submitted By: Marlin E. Hartman

Department: Mathematics

I. MA 117 Principles of Mathematics

II. Catalog Description

This course is an introduction to the nature of mathematics, designed specifically as a first course for mathematics education majors. It provides an opportunity for the mathematics education major to experience several facets of mathematics including: deduction, induction, problem solving, discrete mathematics, and theory of equations. Three lecture hours per week.

III. Course Objectives

1. To give the prospective secondary school mathematics teacher, at the beginning of his/her endeavors, an overview of the many threads that weave through the fabric of mathematics, e.g., logic, functions, sets, graphs, number, counting, and problem solving.

2. To reveal the many facets of mathematics, including the inductive and deductive natures, the abstract and practical natures, and the beautifully simple and sometimes complex natures of the subject.

3. To provide an awareness of some of the more classical results in mathematics as well as current directions in mathematics.

IV. Course Outline and Schedule

A. Logic (5 hours)

1. Propositions
2. Compound propositions
3. Tautologies and contradictions
4. Negations of compound statements
5. Arguments and validity, reductio ad absurdum
6. Formal proof, conditional conclusion, indirect proof
7. Quantifiers, logical equivalence, negations
8. Disproof by counterexample

B. The Real Numbers (6 hours)

1. Field properties
2. Subsets of the real numbers and their properties
3. Unique factorization of the integers
4. Mathematical induction
5. The order properties
6. Some theorems related to the field of real numbers
7. The real numbers as a complete ordered field

C. Equations and Inequalities (3 hours)

1. Linear and quadratic equations and inequalities
2. Fundamental theorem of algebra
3. Synthetic division
4. Factor theorem, remainder theorem
5. Rational root theorem

D. Functions (6 hours)

1. Definitions
2. Functional notation
3. Domain and range of a function
4. Special functions: absolute value, greatest integer, principle square root, exponential, logarithmic, trigonometric
5. Algebra of functions
6. Inverse functions and their graphs

E. Complex Numbers (3 hours)

1. As an extension of the real numbers
2. Properties
3. Trigonometric representation
4. Powers and roots, DeMoivre's Theorem

F. Analytic Geometry (5 hours)

1. Distance and midpoint formulas
2. Slope and straight line equations
3. The circle
4. Other conic sections
5. Polar coordinates, polar equations
6. Parametric equations

G. Sets

1. Theorems about sets, some proofs
2. Cardinality and number
3. Cardinality and infinite sets

H. Combinatorics

1. Counting procedures
2. Permutations
3. Combinations

4. Binomial theorem

I. Probability

1. Probability experiments
2. Classical and empirical probability
3. Probabilities of compound events
4. Conditional probability
5. Binomial probability distribution
6. Testing hypotheses

J. Linear Programming

1. Open inequalities in two variables - graphic solution
2. Linear programming - graphic method
3. Simplex method for problems with two variables
4. Simplex method for problems with three or more variables
5. The minimum problem and duality

It is recommended that topics A through F be completed and the others be considered as suggested. The instructor is free to introduce his/her own materials to supplement the course and to aid in meeting course objectives as given in the catalog description.

V. Methodology and Procedure

Classroom lectures and recitations.

VI. Text

To be determined. Note: Depending upon the availability of a suitable text, any selected text will probably be supplemented by instructor prepared materials.

VII. Other Readings

To be determined by instructor, based upon needs of students.

VIII. Evaluation

Examinations, quizzes, and classroom participation.

IX. Scholarly Papers/Research Requirements

None.

X. Supplemental/Field Experiences

None.

XI. Other requirements that have not been specified above

None.

COURSE SYLLABUS

Date Submitted: February 28, 1986

Submitted By: Marlin E. Hartman

Department: Mathematics

I. MA 457 Computers and Calculators in Secondary School Mathematics Instruction

II. Catalog Description

Students will explore how computers and calculators can be used as tools to enhance the instruction in secondary school mathematics. Prerequisites: CO 205. Three lecture hours per week.

III. Course Rationale and Objectives

Calculators and computers are playing an ever increasing role in the doing of mathematics and consequently should be employed in the learning of mathematics. This course is intended to educate students in the uses of computers and calculators in the doing and learning of mathematics.

At present, our curriculum is constructed upon the assumption that this computing power is not available. In the near future (see April, 1985 issue of the Mathematics Teacher) radical changes will take place in the emphasis of what we teach in the secondary schools. Our students need to be prepared to understand and implement these changes in the curriculum.

In addition to the change in curriculum, the computer offers new pedagogical opportunities. The course is intended to demonstrate how the dynamics of the classroom can be affected by this technology. Therefore our students will be able to take advantage of this technology from both a mathematical and pedagogical point of view.

IV. Course Outline

A. Philosophical and Psychological Issues of Computers in Instruction

1. General uses of the computer in the classroom (3 hours)

(a) Computer assisted instruction
(b) Computer managed instruction
(c) The computer as a problem solving tool
(d) The computer as a pedagogical tool

(e) Limitations of the above as determined by research results

2. How the computer functions in: (3 hours)

(a) Expository teaching
(b) Discovery teaching
(c) Individualized instruction

B. The Computer and the Curriculum

1. The computer in algebra (3 hours)

Discussion of the use of the computer in teaching algebra. These discussions will include how the computer might be used to instruct students in the following topics:

(a) Equations
(b) Pythagorean theorem
(c) Ratio and proportion
(d) Cramer's rule
(e) Quadratic formula
(f) Graphing

2. Geometry (6 hours)

The students will explore how computer language can be used as an environment in studying concepts of distance, congruence, similarity, arc length and angle measurement, as well as other geometrical concepts of secondary school mathematics. The students will see how the world of the Turtle (LOGO) can be used to construct an axiomatic system, thus eliciting a greater understanding of Euclidean geometry and creating a need for proof.

3. Probability and statistics (3 hours)

(a) Monte Carlo methods
(b) Binomial theorem
(c) Random walks on a computer
(d) Using statistical packages

4. Simulations and modeling (3 hours)

(a) Dynamo
(b) Visicalc for modeling mathematical problems
(c) Using commerical simulations software

5. Trigonometry and calculus (6 hours)

(a) Functions
(b) Wrapping function
(c) Functional notation
(d) Roots and graphs of functions
(e) Limits
(f) Differentiation and integration (an historical approach)

6. Number theory (3 hours)

   (a) Prime tests and generators
   (b) Euclidean algorithm
   (c) Perfect, abundant, and deficient numbers
   (d) Polygonal numbers
   (e) Sorting numbers

C. Other Isues in Technologically Enhanced Instruction

1. Teacher authoring (6 hours)

   (a) Superpilot
   (b) Methods of evaluating software
   (c) Software development

2. Classroom management (1 hour)

   (a) How to manage and maintain equipment

3. Resources (2 hours)

   (a) Projects (i.e., MECC, CONDUIT)
   (b) Public domain materials

   3 hours are allotted for class examinations.

V. Methodology and Procedure

Classroom lectures and discussion. Much of the instruction will be in a microcomputer laboratory setting with the students engaged in a hands-on approach to learning.

VI. Probable Text

Much of the material for this course will be prepared primarily by the instructor. The instructor may use one of the following as a basis for the course:

1. Elgarten, G. H., Posamentier, A. S., and Moresh, S. E. Using Computers in Mathematics. Addison-Wesley Publishing Company: Menlo Park, CA, 1983.

2. Hansen, Viggo P. Computers in Mathematics Education. National Council of Teachers of Mathematics: Reston, Virginia, 1984.

3. Kelman, P., Bardige, A., et. al. Computers in Teaching Mathematics. Addison-Wesley Publishing Company: Reading, Massachusetts, 1983.

4. Krist, B. and Giambrone T. Putting the Byte in Mathematics Education. (In Press).

VII. Other Readings

See Bibliography.

VIII. Evaluation

Examinations, quizzes, classroom participation, and individual laboratory projects/programs.

IX. Scholarly Papers/Research Requirements

The students will be expected to construct a unit in teaching secondary mathematics utilizing the computer.

X. Supplemental/Field Experiences

None.

XI. Other requirements that have not been specified above

None.

Bibliography

Abelson, H. and diSessa, A. Turtle Geometry: The Computer as a Medium for Exploring Mathematics. The Massachusetts Institute of Technology: Cambridge, Massachusetts, 1980.

Allen, J.R., Davis, R.E., and Johnson, J.F. Thinking About [TLC] LOGO: A Graphic Look at Computing with Ideas. Holt, Rinehart and Winston: New York, 1984.

Babbie, Earl. Apple Logo for Teachers. Wadsworth Publishing Company: Belmont, Ca, 1984.

Billstein, R., Libeskind, S., and Lott, J.W. Logo: MIT Logo for the Apple (Terrapin/Krell). The Benjamin/Cummings Publishing Company, Inc.: Menlo Park, CA, 1985.

Carmony, L. A., McGlinn, R.J., et. al. Problem Solving in Apple Pascal. Computer Science Press, Inc.: Rockville, MD, 1984.

Coburn, P., Kelman, P., et al. Practical Guide to Computers in Education. Addison-Wesley Publishing Company, Inc.: Reading, MA, 1985.

Cooper, Doug and Clancy, Michael. Oh! Pascal! W.W.Norton & Company, Inc.: New York, 1982.

Dennis, J.R. and Kansky, R.J. Instructional Computing: An Action Guide for Educators. Scott, Foresman and Company: Glenview, Illinois, 1984.

Elgarten, G. H., Posamentier, A. S., and Moresh, S. E. Using Computers in Mathematics. Addison-Wesley Publishing Company: Menlo Park, CA, 1983.

Flake, J.L., McClintock, E., et al. Classroom Activities for Computer Education. Wadsworth Publishing Company: Belmont, CA, 1987.

Hansen, Viggo P. Computers in Mathematics Education. National Council of Teachers of Mathematics: Reston, Virginia, 1984.

Harper, D.O. and Stewart, J.H. RUN: Computer Education. Brooks/Cole Publishing Company: Monterey, CA, 1986.

Hofmeister, Alan. Microcomputer Applications in the Classroom. Holt, Rinehart and Winston: New York, 1984.

Kelman, P., Bardige, A., et al. Computers in Teaching Mathematics. Addison-Wesley Publishing Company, Inc.: Reading, MA, 1983.

Krist, Betty Jane. The Programmable Calculator in Senior High School: A Didactical Analysis. Unpublished Dissertation: SUNY at Buffalo, 1980.

Krist, B. and Giambrone, T. Putting the Byte in Mathematics Education. (In Press).

Krute, Stan. PASCAL Discoveries: A Problem Solving Approach to Beginning Programming. Creative Publications: Palo Alto, CA, 1983.

Malone, Linda and Johnson, Jerry. BASIC Discoveries: A Problem Solving Approach to Beginning Programming. Creative Publications: Palo Alto, CA, 1981.

National Council of Teachers of Mathematics. Computers Oriented Mathematics. The National Council of Teachers of Mathematics, Inc.: Washington, D.C., 1963.

Savitch, Walter J. PASCAL: An Introduction to the Art and Science of Programming. The Benjamin/Cummings Publishing Company, Inc.: Menlo Park, CA, 1984.

Shumway, Richard J. 101 Ways to Learn Mathematics Using BASIC (K-8). Prentice-Hall: Englewood Cliffs, N.J., 1987.

Wright, E.B. and Forcier, R.C. The Computer: A Tool for the Teacher. Wadsworth Publishing Company: Belmont, CA, 1985.

ADDENDA TO COURSE SYLLABUS

MA 117 Principles of Mathematics

Suggested Time Line for Topics G - J

G:	Sets	3 hours
H:	Combinatorics	3 hours
I:	Probability	6 hours
J:	Linear Programming	6 hours

Note: The instructor will have approximately 11 hours remaining after the completion of topics A - F. The instructor may then select from the topics above using as a criteria for selection the background, need and preparation of the students in the class. The hours suggested for each of those topics is the time needed for adequate treatment of all items under the topic.

BIBLIOGRAPHY

Explanation:

At present, we have not located one single text that will accomplish what needs to be accomplished with entering students in mathematics education. Historically, course outlines are dictated by the content of the text. Currently, we have very few texts available which might serve as the primary text for the course. These are listed below. It is expected that the instructor and/or members of the Secondary Mathematics Education Committee will need to write some of the materials to be used in the course.

1. Introductory Discrete Structures with Application Prentice Hall, 1987
2. Discrete Mathematics, Scott Foresman, 1987
3. Principles of Mathematics, Prentice Hall
4. Finite Mathematics & Its Application, Prentice Hall, 1980
5. Applied Finite Mathematics, West, 1985
6. Fundamentals of Finite Mathematics, Nelson Hall, 1985