REV. 3/2012

# REQUEST FOR **ADDITION** OF NEW COURSE

| **FORM A** ADMINISTRATIVE USE ONLY | | | |
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Effective Date:_____
CIP #:_____

Department: Mathematics Date: 10/23/12

College: Science

**PROPOSED COURSE** Short Title: Impl Stds Sec Math (≤ 19 characters)

Rubric & No.: MATH6303 Title: Implementing Curriculum Standards for Mathematics in High School

**COURSE CREDIT** Graduate Credit: X YES ___ NO

Semester Hours of Credit: 1-3 (For combination course types only : ___ Lecture Hrs. ___ Lab/Sem/Rec Hrs.

If course may be repeated for credit (i.e. special topics), course may be taken for a max. of 9 credit hours.

Credit will not be given for this course and: _____
(Indicate rubrics and course numbers)

**GRADING** Final Exam: X YES ___ NO Grading System: X Letter Grade ___ Pass/Fail

(**Attach justification** if the proposed course will **not** hold a final exam during examination week.)

**COURSE TYPE** **(Indicate hours in the appropriate course type)**

/ LEC/REC 1/2 LEC/SEM ___ LEC ___ LAB / LEC/LAB ___ SEM ___ CLIN /PRACT ___ RES/IND

Maximum enrollment per section: 40 (use integer, e.g. 25 not 20-30)

**CATALOG TEXT** (Concise catalog statement exactly as you wish it to appear in the *LSU General Catalog*)

**6303 Implementing Curriculum Standards for Mathematics in High School (1-3)** *This course is intended primarily for participants in teacher-training programs.* Mathematics selected from nationally recognized curriculum standards for high school, treated with attention to depth and the specific needs of teachers. *May be repeated for up to 9 sem. hrs. credit if topics vary.*

**BUDGET IMPACT** If this course is approved, will additional staff be needed? ___ YES X NO

Will additional space, equipment, special library materials or other major expense be involved? ___ YES X NO

(If answer to either question above is "yes" **attach explanation**.) Academic Affairs Approval: _____ Date:_____

**ATTACHMENTS** ATTACH THE FOLLOWING TO YOUR PROPOSAL.

JUSTIFICATION: Justification must explain why this course is needed and how it fits into the curricula. Will the course duplicate other courses?

SYLLABUS: Including 14 week outline of the subject matter; titles of text, lab manual, and/or required readings; grading scale and criteria (For 4000-level, specify graduate student grading criteria if requirements differ for graduate and undergraduate students).

**APPROVALS**

Department Faculty Approval _____ (date)

College Faculty Approval _____ (date)

Department Chair's Signature (date)

College Dean's Signature (date)

Graduate Dean's Signature (for 4000 level and above) (date)

Chair, FS C&C Committee (date)

College Contact: _____
(Please print name.)

College Contact E-mail: _____

Academic Affairs Approval (date)

**Math 6303: Implementing Curriculum Standards for Mathematics in High School**

## Justification

The Mathematics Department does not have a course parallel to Math 6301 Implementing Curriculum Standards for Mathematics in the Elementary Grades (proposed new title) and 6302 Implementing Curriculum Standards for Mathematics in the Middle Grades (proposed new title) that is specifically for the high school level. Math 6300 in the past could have served this purpose, though it had different requirements and restrictions. But we have proposed eliminating 6300 and replacing it with a different course that will better address the original intent of 6300. This leaves a gap in the 6300 series, which this Math 6303 will fill.

**Relationship to other courses.** This course is not an "instructional methods" course, and does not overlap with School of Education courses such as EDCI 7109 Studies in the Teaching of Elementary Mathematics or EDCI 7141 Studies in the Teaching of Mathematics in Secondary Schools, which (quoting the LSU Catalog) are concerned with "techniques and materials for teaching…mathematics" and with "relationship[s] between learning theories and acquisition of mathematical skills and concepts".

**Comment.** Math 6303 will treat mathematical concepts that are significant in recognized curriculum standards. The course are balanced in treating mathematics with rigor and depth as well as paying attention to the problems that teachers encounter in communicating about mathematics and in designing and delivering instruction.

## Sample Syllabus

This **3-credit-hour** course focuses on the algebra and geometry presented in high-school. Topics include: number systems, expressions and equations, functions (linear, quadratic, polynomial and exponential), coordinates, analytic geometry, Euclidean geometry, and applications of mathematics to modeling. The student is expected to have mastery of these topics at or above the minimum level expected of a certified high school math teacher. This course aims to analyze these topics with the rigor and depth needed to understand the underlying logic of the high school curriculum, the meaning and relevance of national and international content standards and connections to the university-level mathematics curriculum. This knowledge will be applied to the problems that teachers encounter in designing and delivering instruction and in communicating about mathematics.

**Format.** This course is delivered to MNS candidates over a period of six weeks in the summer. A minimum of 84 clock hours is scheduled, in blocks no longer than 4 hours. All work related to this course will take place within these time blocks. In order to meet contact hour requirements, at least 37.5 hours of this time is in the presence of the instructor and directly under his or her supervision. The remaining time is for assigned work, some of which will require students to assemble in small groups. The contact time is allocated as follows: 1/3 Lecture, 2/3 Seminar. (In a 14-week semester format, the 37.5 hours would be scheduled like a normal 3-hour class and the additional time would be the assumed time required for homework and writing assignments.)

**Grading.** Grading is based on:

a) [40%] 10 to 15 written assignments, given periodically during the summer. Standards for each assignment will be provided in writing the time it is given. Students are expected to work on assignments until the standards are met.
b) [20%] a written final exam.
c) [40%] participation in seminar activities. Students are expected to be fully engaged in all seminar activities, and to be free of distractions from cell phones of web browsers.

Points will be assigned for each component and a total calculated. Letter grades are determined as follows: A = 90-100% (total), B = 80-89%, C = 70-79%, D = 60-69%, F = less than 60%.

**Core Topics**

1. Real Numbers
2. Order of Operations and Algebraic Expressions
3. Laws of Exponents and Radicals
4. Polynomials, Factoring Polynomials
5. Linear, Quadratic, and Radical Equations
6. Linear Inequalities
7. Absolute Value
8. Rectangular Coordinates, Circles
9. Lines, Parallel and Perpendicular
10. Functions, Graphs of Functions
11. Piecewise Functions
12. Transformations
13. Composition of Functions, One-to-One and Inverse Functions
14. Quadratic Functions
15. Polynomial Functions and Inequalities
16. Rational Functions and Inequalities
17. Exponential Functions/ The Natural Exponential
18. Logarithmic Functions, Properties of Logs

**Expanded List of Topics.**

M6303 will also treat a selection of topics from the following lists.

***Algebra topics***

1. Arithmetic and Algebra
   1.1. Number systems. *Natural numbers, integers, rational numbers. The number line.*
   1.2. Decimal notation. *Algorithms for addition and multiplication. Repeating decimals. Approximation and real numbers.*
   1.3. The rules of arithmetic. *Rings and fields.*
   1.4. Advanced topic: *Euclidean algorithm and continued fractions*
2. Expressions and Equations.
   2.1. Arithmetic expressions. *Structure. Transformations.*
   2.2. Variables and expressions with variables.
   2.3. Equations and solving equations.
   2.4. Word problems.
   2.5. Advanced topic: Descartes' *Geometry.*
3. Coordinates and Graphs
   3.1. Coordinate systems on a line. Solving problems with coordinates. Coordinate transforms.

3.2. Coordinate systems in the plane. Graphing equations.
3.3. Lines in the plane.
3.4. Linear maps from the plane to the plane; matrices.

4. Logic.
   4.1. Connectives ("and", "or" and "not") and logically complex propositions.
   4.2. Existential quantifiers ("for all" and "there exists").
   4.3. Sets defined by logical formulae. Boolean algebra. Products and projections.
   4.4. Advanced topic: Semi-linear and semi-algebraic sets.
5. Functions
   5.1. Definitions and examples. Functions between sets.
   5.2. Linear functions and groups of linear functions.
   5.3. Composition and inversion
   5.4. Exponent and Logarithm.
   5.5. Sequences and recursion.
6. Polynomials and rational functions
   6.1. Computing with polynomials and rational functions.
   6.2. Quadratics.
   6.3. Factoring and the Remainder Theorem.
   6.4. Polynomials of several variables.
   6.5. Conic sections.
   6.6. Advanced topic: Algebraic curves.
7. Word problems and modeling.

***Geometry Topics***

1. Euclid's *Elements*
   1.1. Informal deductive rigor: definitions, postulates and propositions
   1.2. Book I: Triangles and congruence
   1.3. Book I: The Parallel Postulate and its consequences
   1.4. Book I: Area by dissection
   1.5. Book V: Measurement, ratio and proportion
   1.6. Book VI: Similarity
2. Descartes' *Geometry*
   2.1. Introducing a unit. Multiplying and finding roots by geometry
   2.2. Dynamic figures analyzed using similarity
   2.3. Coordinates
3. Transformations
   3.1. Isometries and similarity transforms: classification
   3.2. Transformation groups
   3.3. Advanced topic: Inversion (in a circle) and hyperbolic geometry

**Research Base**

Educational research[1, 2, 3] demonstrates that mathematics teachers need:

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[1] Ball, D. L., Lubenski, S. T., & Mewborn, D. S. (2001). Research on teaching mathematics: The unsolved problem of teachers' mathematical knowledge. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 433-456). Washington, DC: American Educational Research Association.

[2] Baumert, J. Kunter, M., Blum, W., Brunner, M, Voss, T., Jordan, A., Klusman, U., Krauss, S., Neubrand, M., & Tsai, Y. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal* 47, 133-180.

- a deep understanding of the structure, content and goals of the curriculum,
- a large repertoire of fully analyzed mathematical examples that may be incorporated in lessons and tests, and
- ability to conceptualize and assess the mathematical knowledge of others and select appropriate actions in response.

This course is designed to develop these competencies.

**References**

***Main Primary Sources***

Euclid. *Euclid's Elements*, Thomas L. Heath, translator. Green Lion Press, 2002.
Viete, F. *The Analytic Art*. Dover 2006.
Descartes, R. *The Geometry of Rene Descartes.* Dover, 1954.
Newton, I. *The Mathematical Papers of Isaac Newton*, Volume I, edited by D.T.Whiteside. Cambridge Univ. Press, 1967.

***Other Important Primary Sources***

Archimedes. *The Works of Archimedes,* Thomas L. Heath, translator. Dover 2002.
Apollonius. *Conic Sections,* Catesby Taliaferro, translator. Green Lion Press, 1998.
Fibonacci. *Fibonacci's Liber Abaci*, Lawrence Sigler, translator. Springer 2002.
Kepler, J. *Selections from Kepler's Astronomia Nova.* Green Lion Press, 2004.
Newton, I. *The Principia: Mathematical Principles of Natural Philosophy,* I.B.Cohen, trans.. Univ. California Press, 1999.

***Secondary Sources***

Bashmakova, I. G. & Smirnova, G. S. *The Beginnings and Evolution of Algebra (Dolciani Mathematical Expositions).* MAA, 2000.
Bashmakova, I. G. *Diophantus and Diophantine Equations (Dolciani Mathematical Expositions).* MAA, 1998.
Klein, F., *Elementary mathematics from an advanced standpoint: Arithmetic, algebra, analysis.* Dover, 2004.
Klein, F., *Elementary mathematics from an advanced standpoint: Geometry*. Dover, 2004.
Lebesgue, H. "Measure of magnitudes," in: *Measure and the Integral by Henri Lebesgue*, Kenneth O. May, editor, Holden-Day, 1966.
Meng, S.K. *New Elementary Mathematics, Syllabus D: books 1, 2, 3A, 3B*. Singapore: Panpac, 2006.
Moise, E. *Elementary geometry from an advanced standpoint, second edition.* Addison-Wesley, 1974.
Tarski, A., *Introduction to logic and the methodology of the deductive sciences.* Dover, 1995.

***High School Reference Texts***

We will use the four CME Project texts: *Algebra I, Geometry, Algebra II* and *Precalculus.* The CME Project is a four-year, NSF-funded, comprehensive high school mathematics program that is problem-based, student centered, and organized around the traditional high-school course sequence. The series was developed by the Center for Mathematics Education at Education Development Center, Inc. (EDC) in Newton, Massachusetts, and is published by Pearson Education, Inc. See: http://cmeproject.edc.org/

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[3] Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States.* Hillsdale, NJ: Erlbaum.