

Ogden College of Science and Engineering
Western Kentucky University
Office of the Dean
745-6371

REPORT TO THE GRADUATE COUNCIL COMMITTEE

DATE: February 27, 2015
FROM: Ogden College of Science and Engineering

Ogden College of Science and Engineering Committee Members: Dr. Ferhan Atici, Dr. Rajalingam Dakshinamurthy, Dr. Fred DeGraves, Dr. Sanju Gupta, Dr. David Keeling, Dr. John Khouryieh, Dr. Sharon Mutter, Dr. Shane Palmquist, Dr. Michael Smith, Dr. Zhonghang Xia

Chair: Dr. Cathleen Webb

The Ogden College of Science and Engineering submits the following items for consideration at the October meeting:

| | |
|---------|--|
| Consent | Proposal to Revise Course Prerequisites/Corequisites Math 532, Real Analysis Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 5-6229 |
| Action | Proposal to Revise a Course Math 429G Contact Person: Ngoc Nguyen, ngoc.nguyen@wku.edu, 5-6221 |
| Action | Proposal to Revise a Program Math 085, Master of Science: in Mathematics Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 5-6229 |

Proposal Date: 02/02/2015

**Ogden College of Science and Engineering
Department of Mathematics
Proposal to Revise Course Prerequisites/Corequisites
(Consent Item)**

Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 5-6229

- 1. Identification of course:**
 - 1.1 Course prefix (subject area) and number: MATH 532
 - 1.2 Course title: Real Analysis

- 2. Current prerequisites/corequisites/special requirements:**
Math 432

- 3. Proposed prerequisites/corequisites/special requirements:**
Math 431 or permission of instructor.

- 4. Rationale for the revision of prerequisites/corequisites/special requirements:**
Math 432 and Math 432G has been deleted. Math 532 can be considered as continuation of Math 431 in terms of its contents and topics.

- 5. Effect on completion of major/minor sequence:**
We offer Math 431 in one semester and Math 532 in the following semester, , so the change in the prerequisite should not delay completion of the program.

- 6. Proposed term for implementation:**
Fall 2015

- 7. Dates of prior committee approvals:**

Mathematics Department

Ogden College Graduate Curriculum Committee

Graduate Council

University Senate

2-13-15

Proposal Date: 2/1/2015

**Ogden College of Science and Engineering
Department of Mathematics
Proposal to Revise Course Number
(Consent Item or Action)**

Contact Person: Ngoc Nguyen, ngoc.nguyen@wku.edu, 270-745-6221

1. Identification of proposed course

- 1.1 Course prefix (subject area) and number: Math 429G
- 1.2 Course title: Probability and Statistics II

2. Proposed course number: Math 482G

3. Rationale for revision of course number: MATH 429 was renumbered as MATH 482 in the 2009-2010 academic year. We are now renumbering MATH 429G to MATH 482G for consistency.

4. Proposed term for implementation: Fall 2015

5. Dates of prior committee approvals:

Department/ Unit Mathematics

2/13/2015

Ogden College Graduate Curriculum Committee

Graduate Council

University Senate

Ogden College of Science and Engineering
Department of Mathematics
Proposal to Revise Graduate Program
(Action Item)

Contact Person: Ferhan Atici, ferhan.atici@wku.edu, 5-6229

1. Identification of program:

- 1.1 Current program reference number: 085
- 1.2 Current program title: Master of Science: in Mathematics
- 1.3 Credit hours:30

2. Identification of the proposed program changes:

Changing required core courses as basic requirements in the program, adding more 400G and 500 courses in the requirements and removing listed undergraduate courses in the research tool.

3. Detailed program description:

| Current Program | Proposed Program |
|--|--|
| <p>The M.S. has two options available. The M.S. (general option) provides knowledge in such traditional areas as analysis, algebra, topology, and applied mathematics, and is recommended for students who wish to obtain a Ph. D. degree, to teach in a community college, or to seek employment in industry with an emphasis on conceptual foundations. The M.S. (computational option) is designed for students seeking employment in industry with an emphasis on computational mathematics and/or computer science in addition to knowledge in traditional areas.</p> <p>General Option:</p> <p>Admission Requirements Admission requirements for the M.S. in Mathematics General Option include:</p> <p>1. One of the following: (a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program; (b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on</p> | <p>The M.S. has two options available. The M.S. (general option) provides knowledge in such traditional areas as analysis, algebra, topology, and applied mathematics, and is recommended for students who wish to obtain a Ph. D. degree, to teach in a community college, or to seek employment in industry with an emphasis on conceptual foundations. The M.S. (computational option) is designed for students seeking employment in industry with an emphasis on computational mathematics and/or computer science in addition to knowledge in traditional areas.</p> <p>General Option:</p> <p>Admission Requirements Admission requirements for the M.S. in Mathematics General Option include:</p> <p>1. One of the following: (a) A minimum GAP score of 600 [GAP = (GRE-V + GRE-Q) + (Undergraduate GPA x 100)] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [GAP = (GRE-V + GRE-Q) x Undergraduate GPA] *Students who took the GRE prior to 2002 should contact the graduate advisor of the program; (b) A GRE score of at least 300. For options (a) or (b) WKU requires a minimum score of 139 on</p> |

both the verbal and quantitative parts of the GRE;
(c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their mathematics major.

2. Successful completion of the following undergraduate courses:
(a) a one year calculus sequence;
(b) linear algebra;
(c) discrete mathematics;
(d) an applied mathematics course (e.g. differential equations, probability, calculus-based statistics, numerical analysis);
(e) abstract algebra.

3. A cumulative grade point average of 3.0 (on a 4.0 scale) is required in at least one of the following:
(a) A cumulative grade point average of 3.0 (on a 4.0 scale) in at least one of the following:
(a) all mathematics courses that are applicable to the undergraduate mathematics major;
(b) courses specified in (b) through (e) of Item 2 above.

Degree Requirements minimum of 30 hours
The Master of Science in Mathematics (General Option) requires a minimum of 30 hours of graduate-level mathematics courses. A maximum of 12 hours at the 400G level may be included in the entire program. A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool must be completed during the first 15 hours of coursework and may be fulfilled by a mathematics reading course, a computer science course, a foreign language examination, or another option approved by a Mathematics Department graduate advisor. In addition, all students in the M.S. program (general option) must have a working knowledge of a high-level programming language or computer algebra system.

A student may, upon prior approval of the Mathematics Department Graduate Committee, include in his/her program a maximum of 6 hours of coursework from a related field.

Comprehensive exams are required.

Required Core

1. The following courses must be completed:

both the verbal and quantitative parts of the GRE;
(c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their mathematics major.

2. Successful completion of the following undergraduate courses:
(a) a one year calculus sequence;
(b) linear algebra;
(c) discrete mathematics;
((d) an applied mathematics course (e.g. differential equations, probability, calculus-based statistics, numerical analysis);
(e) abstract algebra.

3. A cumulative grade point average of 3.0 (on a 4.0 scale) is required in at least one of the following:
(a) A cumulative grade point average of 3.0 (on a 4.0 scale) in at least one of the following:
(a) all mathematics courses that are applicable to the undergraduate mathematics major;
(b) courses specified in (b) through (e) of Item 2 above.

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The Master of Science in Mathematics (General Option) requires a minimum of 30 hours of graduate-level mathematics courses. A maximum of 12 hours at the 400G level may be included in the entire program. A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool must be completed during the first 15 hours of coursework and may be fulfilled by a mathematics reading course, a computer science course, a foreign language examination, or another option approved by a Mathematics Department graduate advisor. ~~In addition, all students in the M.S. program (general option) must have a working knowledge of a high-level programming language or computer algebra system.~~

A student may, upon prior approval of the Mathematics Department Graduate Committee, include in his/her program a maximum of 6 hours of coursework from a related field.

Comprehensive exams are required only for students who choose not to write a thesis.

Basic Requirements

1. The following courses must be completed:

MATH 417G Algebraic Systems*
MATH 431G Intermediate Analysis I*
MATH 439G Topology I*

2. One of the following applied mathematics courses:

MATH 529 Applied Probability
MATH 531 Advanced Differential Equations
MATH 535 Advanced Applied Mathematics I
MATH 536 Advanced Applied Mathematics II
MATH 540 Stochastic Processes
MATH 541 Graph Theory
MATH 542 Advanced Topics in Discrete Mathematics
MATH 550 Complex Analysis
MATH 570 Topics in Operations Research
STAT 549 Statistical Methods I
STAT 550 Statistical Methods II

Another course as approved by the Mathematics Department Graduate Committee.

3. The following course is required:
MATH 532 Real Analysis

4. One of the following two-course sequences:

MATH 417G Algebraic Systems AND MATH 517 Topics from Algebra
MATH 439G Topology I AND MATH 539 Topology II
MATH 450G Complex Variables AND MATH 550 Complex Analysis
MATH 435G Partial Differential Equations AND MATH 535 Advanced Applied Mathematics I
MATH 470G Introduction to Operations Research AND MATH 570 Topics in Operations Research
MATH 529 Applied Probability AND MATH 540 Stochastic Processes
MATH 435G Partial Differential Equations AND MATH 531 Advanced Differential Equations
MATH 535 Advanced Applied Mathematics I AND MATH 536 Advanced Applied Mathematics II
MATH 405G Numerical Analysis I AND MATH 406G^ Numerical Analysis II

- a) MATH 431G Intermediate Analysis I
- b) MATH 417G Algebraic Systems, or MATH 439G Topology, or MATH 450G Complex Variables, or MATH 435G Partial Differential Equations
- c) MATH532 Real Analysis, or MATH 550 Complex Analysis, or MATH 535 Advanced Applied Mathematics-I, or MATH 541 Graph Theory

2. One of the following applied mathematics courses:

MATH 529 Applied Probability
MATH 531 Advanced Differential Equations
MATH 535 Advanced Applied Mathematics I
MATH 536 Advanced Applied Mathematics II
MATH 540 Stochastic Processes
MATH 541 Graph Theory
MATH 542 Advanced Topics in Discrete Mathematics
MATH 550 Complex Analysis
MATH 570 Topics in Operations Research
STAT 549 Statistical Methods I
STAT 550 Statistical Methods II

Another course as approved by the Mathematics Department Graduate Committee.

3. The following course is required:
MATH 532 Real Analysis

4. One of the following two-course sequences:

MATH 417G Algebraic Systems AND MATH 517 Topics from Algebra
MATH 439G Topology I AND MATH 539 Topology II
MATH 450G Complex Variables AND MATH 550 Complex Analysis
MATH 435G Partial Differential Equations AND MATH 535 Advanced Applied Mathematics I
MATH 470G Introduction to Operations Research AND MATH 570 Topics in Operations Research
MATH 529 Applied Probability AND MATH 540 Stochastic Processes
MATH 435G Partial Differential Equations AND MATH 531 Advanced Differential Equations
MATH 535 Advanced Applied Mathematics I AND MATH 536 Advanced Applied Mathematics II
MATH 405G Numerical Analysis I AND MATH 406G^ Numerical Analysis II

STAT 549 Statistical Methods I AND STAT 550
Statistical Methods II

**If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.*

^Sequence can be taken by students who have substituted a 500-level course for at least one of the three courses listed in (1)

Electives

The remaining mathematics courses in the student program must be chosen from:

MATH 405G Numerical Analysis I
MATH 406G Numerical Analysis II
MATH 415G Algebra and Number Theory
MATH 423G Geometry II
MATH 435G Partial Differential Equations
MATH 450G Complex Variables
MATH 470G Introduction to Operations Research
MATH 504 Application of Technology to Problems in Mathematics
MATH 517 Topics from Algebra
MATH 529 Applied Probability
MATH 531 Advanced Differential Equations
MATH 535 Advanced Applied Mathematics I
MATH 536 Advanced. Applied Mathematics II
MATH 539 Topology II
MATH 540 Stochastic Processes
MATH 541 Graph Theory
MATH 542 Advanced Topics in Discrete Mathematics
MATH 550 Complex Analysis
MATH 560 Functional Analysis
MATH 570 Topics in Operations Research
MATH 590 Special Topics in Mathematics
MATH 598 Graduate Seminar
STAT 549 Statistical Methods I
STAT 550 Statistical Methods II

Research Tool

A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool can be fulfilled in a variety of ways, some of which are listed below:

- Taking the MATH 598 Graduate Seminar
- Courses in other disciplines. The research tool

~~STAT 549 Statistical Methods I AND STAT 550
Statistical Methods II~~

~~*If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.~~

~~^Sequence can be taken by students who have substituted a 500-level course for at least one of the three courses listed in (1).~~

~~Electives~~

~~The remaining mathematics courses in the student program must be chosen from:~~

MATH 405G Numerical Analysis I
MATH 406G Numerical Analysis II
MATH 415G Algebra and Number Theory
MATH 417G Algebraic Systems
MATH 439G Topology
MATH 423G Geometry II
MATH 435G Partial Differential Equations
MATH 450G Complex Variables
MATH 470G Introduction to Operations Research
~~MATH 504 Application of Technology to Problems in Mathematics~~
MATH 500 Readings in Mathematics
MATH 517 Topics from Algebra
MATH 529 Applied Probability
MATH 531 Advanced Differential Equations
MATH 532 Real Analysis
MATH 535 Advanced Applied Mathematics I
MATH 536 Advanced. Applied Mathematics II
MATH 539 Topology II
MATH 540 Stochastic Processes
MATH 541 Graph Theory
MATH 542 Advanced Topics in Discrete Mathematics
MATH 550 Complex Analysis
MATH 560 Functional Analysis
MATH 570 Topics in Operations Research
MATH 590 Special Topics in Mathematics
MATH 598 Graduate Seminar
STAT 549 Statistical Methods I
STAT 550 Statistical Methods II

~~Research Tool~~

~~A research tool is required and may entail coursework beyond the 30 hours of mathematics. The research tool can be fulfilled in a variety of ways, some of which are listed below:~~

- ~~·Taking the MATH 598 Graduate Seminar~~
- ~~·Graduate level courses in other disciplines. The~~

course should be in disciplines that have a strong relation to mathematics. For example, any graduate or 400 level computer science course pre-approved by the student's graduate advisor will be accepted. However, a student with no prior programming experience cannot take such a course and instead could choose a first year undergraduate programming course.

·Learning how to use a standard statistical or mathematical package (such as SAS, SPSS, R or Mathematica) by taking a course.

The research tool cannot be taken during the last semester.

Optional Thesis 6 hours

Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.

Computational Mathematics Option

Admission Requirements

1. One of the following:

(a) A minimum GAP score of 600 [$GAP = (GRE-V + GRE-Q) + (Undergraduate\ GPA \times 100)$] or a minimum GAP score of 3000 for students who took the GRE prior to August 2011 [$GAP = (GRE-V + GRE-Q) \times Undergraduate\ GPA$]

*Students who took the GRE prior to 2002 should contact the graduate advisor of the program;

(b) A GRE score of at least 300. For options (a) or

(b) WKU requires a minimum score of 139 on both the verbal and quantitative parts of the GRE;

(c) For students that graduate from WKU with a mathematics major, a GPA of at least 3.3 in their mathematics major.

2. Completion of the following undergraduate courses:

(a) a one year calculus sequence;

(b) linear algebra;

(c) discrete mathematics;

(d) a one year sequence of programming courses;

(e) a B.A. degree with a major in either Computer Science, Engineering, Mathematics or Physics.

3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following:

(a) all mathematics and computer science courses that are listed in (a) through (d) of Item 2 above;

or

research tool course should be in disciplines that have a strong relation to mathematics. For example, any graduate level course pre-approved by the student's graduate advisor will be accepted. However, a student with no prior programming experience cannot take such a course and instead could choose a first year undergraduate programming course.

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(d) a one year sequence of programming courses;

(e) a B.A. degree with a major in either Computer Science, Engineering, Mathematics or Physics.

3. A cumulative grade point average of at least 3.0 (on a 4.0 scale) in at least one of the following:

(a) all mathematics and computer science courses that are listed in (a) through (d) of Item 2 above;

or

(b) all courses in the major listed in (e) of Item 2 above. Students cannot enter the program if they have a deficiency in the courses listed in Item 2 above

*Degree Requirements minimum of 30 hours
The Master of Science in Mathematics
(Computational Mathematics Option) requires a minimum of 30 hours of graduate-level mathematics and computer science courses. A maximum of 12 hours at the 400G level may be included in the entire program. All students in the M.S. program (computational mathematics option) must have a working knowledge of a high-level programming language. The CS classes required in this option do not allow for additional courses in a related field.*

Comprehensive exams are required.

Required Core

MATH/CS 405G Numerical Analysis I
MATH 470G Introduction to Operations Research*
CS 549 Algorithms Analysis*
STAT 549 Statistical Methods I
MATH 406G Numerical Analysis II
At least two courses from the list below:
CS 562 Parallel and Distributed Computing
CS 565 Data Mining Techniques and Tools
CS 595 Advanced Topics in Computer Science
(with advisor approval)*

**If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.*

Electives

*MATH 431G Intermediate Analysis I
MATH 541 Graph Theory
MATH 570 Topics in Operations Research
MATH 504 Application of Technology to Problems in Mathematics
MATH 540 Stochastic Processes
MATH 542 Advanced Topics in Discrete Mathematics
MATH 590 Special Topics in Mathematics (with advisor approval)
STAT 550 Statistical Methods II*

Research Tool

This requirement is satisfied by the computer science classes.

(b) all courses in the major listed in (e) of Item 2 above. Students cannot enter the program if they have a deficiency in the courses listed in Item 2 above

Degree Requirements minimum of 30 hours
The Master of Science in Mathematics
(Computational Mathematics Option) requires a minimum of 30 hours of graduate-level mathematics and computer science courses. A maximum of 12 hours at the 400G level may be included in the entire program. All students in the M.S. program (computational mathematics option) must have a working knowledge of a high-level programming language. The CS classes required in this option do not allow for additional courses in a related field.

Comprehensive exams are required only for students who choose not to write a thesis.

Required Core

MATH/CS 405G Numerical Analysis I*
MATH 470G Introduction to Operations Research*
CS 549 Algorithms Analysis*
STAT 549 Statistical Methods I
MATH 406G Numerical Analysis II
At least two courses from the list below:
CS 562 Parallel and Distributed Computing
CS 565 Data Mining Techniques and Tools
CS 595 Advanced Topics in Computer Science
(with advisor approval)

*If equivalent courses were taken at the undergraduate level, then the student must substitute appropriate graduate mathematics courses selected in consultation with a Mathematics Department graduate advisor.

Electives

MATH 431G Intermediate Analysis I
MATH 541 Graph Theory
MATH 570 Topics in Operations Research
MATH 504 Application of Technology to Problems in Mathematics
MATH 540 Stochastic Processes
MATH 542 Advanced Topics in Discrete Mathematics
MATH 590 Special Topics in Mathematics (with advisor approval)
STAT 550 Statistical Methods II

Research Tool

This requirement is satisfied by the computer science classes.

| | |
|---|---|
| <p><i>Optional Thesis 6 hours</i> <i>Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.</i></p> | <p>Optional Thesis 6 hours Students who choose to write a thesis are required to complete 6 hours of MATH 599 Thesis Research and Writing and to give an oral defense of the thesis.</p> |
|---|---|

4. Rationale for the proposed program change:

The current core includes three 400 level graduate courses. With this new proposal, students will get to choose two of the other 400 level graduate courses, such as 405G-406G. This new Program of Study also gives the student the opportunity to choose a 400 level graduate course as a research tool. The new proposal gives students greater flexibility for choosing graduate level courses in their area of interest.

5. Proposed term for implementation and special provisions (if applicable):
Fall 2015

6. Dates of prior committee approvals:

| | |
|---|-------------------|
| Department of Mathematics | <u>02/13/2015</u> |
| Ogden College Graduate Curriculum Committee | _____ |
| Graduate Council | _____ |
| University Senate | _____ |