FAIRMONT STATE UNIVERSITY

MEMORANDUM

TO: Faculty Senate

FROM: Jack Kirby JRK

DATE: March 8, 2017

SUBJECT: Curriculum Proposal #16-17-12, REV #1

Math Course Updates

I recommend approval of the attached REVISION #1 of Curriculum Proposal 16-17-12. This proposal seeks to make multiple changes to the MATH courses. 1) MATH 1125 and MATH 1170 will be deleted form the catalog; 2) MATH 1561 will replace both MATH 1125 and MATH 1170; 3) MATH 1190 and MATH 2501 will replace MATH 1185 and MATH 1585 as a requirement for the Mathematics 5-9 Specialization; 4) the remainder of the changes consist of alterations to course numbers.

Dr. Christina Lavorata
Dr. Don Trisel
Dr. Joseph Riesen
Ms. Leslie Lovett
Ms. Laura Ransom
Dr. Shayne Gervais

FAIRMONT STATE UNIVERSITY

MEMORANDUM

TO: Curriculum Committee

FROM: Jack Kirby

DATE: February 13, 2017

SUBJECT: Curriculum Proposal #16-17-12

Math Course Updates

I recommend approval of the attached Curriculum Proposal 16-17-12. This proposal seeks to make multiple changes to the MATH courses. 1) MATH 1125 and MATH 1170 will be deleted form the catalog; 2) MATH 1561 will replace both MATH 1125 and MATH 1170; 3) MATH 1190 and MATH 2501 will replace MATH 1185 and MATH 1585 as a requirement for the Mathematics 5-9 Specialization; 4) the remainder of the changes consist of alterations to course numbers.

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CURRICULUM PROPOSAL (Submit one hard copy and an electronic copy to the Associate Provost by the second Tuesday of the month.)

Proposal Number: 16-17-12

School/Department/Program: Science and Technology—Computer Science, Math, and Physics—Mathematics

Preparer/Contact Person: Joseph Riesen

Telephone Extension: 4505

Date Originally Submitted: February 10, 2017

Revision (Indicate date and label it Revision #1, #2, etc.): Revision #1

Implementation Date Requested:

I. **PROPOSAL**. Write a brief abstract, not exceeding 100 words, which describes the overall content of the proposal.

There will be one math course created (MATH 1561), two revised and renumbered (MATH 2216 and 2212), and many others renumbered.

- *MATH 1125 and 1170 will be deleted from the catalog.*
- *MATH 1561 will replace BOTH MATH 1125 (which will be deleted from the Math/Math Ed. Programs) AND MATH 1170 (which will be removed from the Computer Science/Computer Security programs in a Computer Science proposal).*
- *MATH 1190/2501 will replace MATH 1185/1585 as a requirement for the Mathematics 5-9 Specialization.*
- *The rest of the changes consist of alterations to course numbers. These changes complete the math course renumbering.*

II. **DESCRIPTION OF THE PROPOSAL**. Provide a response for each letter, A-H, and for each Roman Numeral II–V. If any section does not apply to your proposal, reply N/A.

A. Deletion of course(s) or credit(s) from program(s)

MATH 1125-Math Reasoning: Reading and Writing
(MATH 1170-Introduction to Mathematical Analysis will be deleted from catalog and from the computer science curriculum-contained in the Computer Science Curriculum Proposal.)
MATH 1185/1585-Applied Calculus I (Mathematics 5-9 Specialization)

Total hours deleted. 3

B. Addition of course(s) or credit(s) from program(s)

MATH 1561 Introduction to Mathematical Reasoning
MATH 1190/2501- Calculus I (Mathematics 5-9 Specialization)

Total hours added. 3

C. Provision for interchangeable use of course(s) with program(s)
N/A

D. Revision of course content. Include, as an appendix, a revised course description, written in complete sentences, suitable for use in the university catalog.

MATH 2216-Discrete Mathematics (revised and renumbered) becomes
MATH 2562-Introduction to Discrete Mathematics

MATH 2212-Sets, Relations, and Functions (revised, renamed, and renumbered) becomes
MATH 2563-Transition to Higher Mathematics

See Appendix B for course descriptions. Course Outlines and outcomes are located in Appendices C and D, respectively.

E. Other changes to existing courses such as changes to title, course number, and elective or required status.

The registrar has responded in an email that the following number changes are acceptable to his office. (e-mail dated 01/27/2017, 11:11am)

Current number	Proposed number	Notes	Additional Notes
1125	N/A	Delete from catalog	(Math/MathEd req)
1170	N/A	Delete from catalog	(CompSci/CompSec req)
1190	2501	Number change only	
2200	2510	Number change only	
2206	2520	Number change only	
2212	2563	Course revision	New Title: "Transition to Higher Mathematics"
2216	2562	Course Revision	Title remains "Introduction to Discrete Mathematics"
2251	2551	Number change only	
2252	2552	Number change only	
3315	2502	Number change only	
3316	3503	Number change only	
3335	3550	Number change only	
3342	3540	Number change only	
3353	3553	Number change only	
3361	4520	Number change only	
3362	3520	Number change only	
3372	3570	Number change only	
3375	4580	Number change only	
3391	4590	Number change only	
4400	Unchanged	Course number is standard in many FSU disciplines.	
4401	3504	Number change only	

Current number	Proposed number	Notes	Additional Notes
4431	4531	Number change only	
4498	Unchanged	Course number is standard in many FSU disciplines.	

F. Creation of new course(s). For each new course

1. Designate the course number, title, units of credit, prerequisites (if any), ownership (FSU or shared) and specify its status as an elective or required course. If you are creating a shared course, attach a memo from the Deans of the affected Schools explaining the rationale for the course being shared.

MATH 1561 Introduction to Mathematical Reasoning……. 3 credit hours
Prerequisite: ***Math ACT 24 OR "C" or better in MATH 1115 OR (MATH 2251 and 2252)***

2. Include, as an appendix, a course description, written in complete sentences, suitable for use in the college catalog.

See Appendix B.

3. Include, as an appendix, a detailed course outline consisting of at least two levels.

See Appendix C.

4. In order to meet the requirements as outlined in Goal One of the Strategic Plan, please include Outcome Competencies and Methods of Assessment as an appendix. Examples are available upon request from the Chair of the Curriculum Committee.

See Appendix D.

G. Attach an itemized summary of the present program(s) affected, if any, and of the proposed change(s).

Describe how this proposal affects the hours needed to complete this program. Specifically, what is the net gain or loss in hours? Use the format for Current and Proposed Programs in Appendix A.

- B.S. in Mathematics: MATH 1125 will be replaced by the new course, MATH 1561.
- B.A. in Education in Specialization Mathematics 5-Adult: MATH 1125 will be replaced by MATH 1561.
- Specialization in Mathematics Education Grade 5-9: MATH 1125 will be replaced by MATH 1561.
- Specialization in Mathematics Education Grade 5-9: MATH 1185 will be replaced by MATH 2501.
- Minor in Mathematics: In the list of electives, MATH 1125 will be replaced by MATH 1561.

Note: The math department plans to offer the new course MATH 1561 as a MATH 1199-special topics course in the fall and until the proposal takes effect. MATH 1561 will replace the requirement of MATH 1125 or MATH 1170 in all (current) programs affected. A Letter of Course Substitution will be provided to the Registrar's Office, as necessary for students enrolling in MATH 1199-*Introduction to Mathematical Reasoning*.

All students with credit for MATH 1125 or 1170 may substitute those courses for MATH 1561 requirement in any program which has either as a requirement.

III. **RATIONALE FOR THE PROPOSAL**.

A. **Quantitative Assessment**: Indicate the types of assessment data, i.e., surveys, interviews, capstone courses, projects, licensure exams, nationally-normed tests, locally developed measurements,

accreditation reports, etc., that were collected and analyzed to determine that curricular changes were warranted. Quantitative data is preferred.

The Computer Science department is in the process of accreditation with ACM/IEEE and has asked the math department to develop a "foundations of math course." After consultation with the CS faculty, examinations of accreditation documents, current courses in the math department, and CS and MATH major requirements, it was decided to streamline and reorganize some of our math offerings.

Requiring students pursuing the Mathematics 5-9 specialization to take Calculus I instead of Applied Calculus I would enable them to better meet national accreditation standards. CAEP requires students to understand the Fundamental Theorem of Calculus and techniques of integration, both of which are better addressed in Calculus I.

MATH 1561, 2562, and 2563 were created/revised in response to the following:

- The need for better alignment with CAEP standards, CS National standards (ACM/IEEE)
- Extensive interviews with CS faculty about their needs for two introductory math courses
- Surveys of CS and math faculty concerning the required content of 5-6 introductory courses. (MATH 1561, 2652, and 2563 are the result of streamlining those courses.)
- Faculty reviews of other university mathematics programs and the MAA CUPM guide.
- Faculty expertise, which was taken into account to make course adjustments.

B. **Qualitative Assessment**: Based upon the assessment data above, indicate why a curricular change is justified. Indicate the expected results of the change. Be sure to include an estimate of the increased cost, or reduction in cost of implementation. FOR EXAMPLE: Will new faculty, facilities, equipment, or library materials be required?

The overriding goal of the course revision and creation is to streamline the first-and second-year mathematics courses in order to:

- Use one introductory course to satisfy both Math and CS programs, as well as numerous accreditation guidelines-for math, math education, and computer science.
- Encourage more students to double major in Math and CS.
- Increase the success of mathematics majors who enter college with little to no experience with proof-writing.

The second goal of this proposal is to change the course numbers to better reflect their content level.

MATH 1561 will be offered each semester and the courses it replaces (1125 and 1170) were each offered once per year. The number of courses offered will remain the same. Further, all other courses will be offered in the approximate numbers as presently offered; therefore the need for new faculty and new resources is not anticipated.

IV. Should this proposal affect any course or program in another school, a memo must be sent to the Dean of each school impacted and a copy of the memo(s) must be included with this proposal. In addition, the Deans of the affected schools must sign below to indicate their notification of this proposal.

By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature
School of Education	Dr. Carolyn Crislip-Tacy	Carolyn Crislip-Tacy

V. Should this proposal affect any course to be added or deleted from the general studies requirements, a memo from the chair of the General Studies Committee indicating approval of the change must be included with this proposal.

N/A

VI. ADDITIONAL COMMENTS.

APPENDIX A
B.S. Degree in Mathematics
Current Program

Required Major Courses		**HRS**
MATH 1113	Applied Statistics	3
MATH 1125	Math Reasoning: Reading & Writing	3
MATH 1190	Calculus I	4
MATH 2200	Mathematical Logic	3
MATH 2212	Sets, Relations, & Functions	3
MATH 3315	Calculus II	4
MATH 3316	Calculus III	4
MATH 3335	Probability & Statistics	3
MATH 3361	Abstract Algebra	3
MATH 3362	Linear Algebra	3
COMP 1102	Principles of Programming I	3
	Any one of the following science courses	
CHEM 1101	General Chemistry I	Counted as General Studies hours XX
CHEM 1105	Chemical Principles	
PHYS 1101	Introduction to Physics I	
PHYS 1105	Principles of Physics I	
TOTAL Required Major Courses		36
Major Electives		9
Major Electives	Choose three courses from Groups A and B. At least one course must be chosen from Group A.	
	Group A MATH 3375 Topology MATH 3391 Real Analysis **Group B** MATH 2206 Introduction to the Theory of Numbers Math 2216 Introduction to Discrete Mathematics MATH 3342 Numerical Analysis MATH 3372 Modern Geometry MATH 4401 Differential Equations	
Minor Electives		18-24
TOTAL HOURS FOR MAJOR		63-69

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 1102* or any course in IA	
Attribute IB – Quantitative Literacy		X
	Major Course MATH 1190* or (MATH 1107 or higher in IB, but courses below Math 1190 will increase graduation hours.)	
Attribute IC – Written Communication		3
	ENGL 1101* or any course in IC	
Attribute ID - Teamwork		3
	COMM 2200* or any course in 1D	
Attribute IE – Information Literacy		X
	ENGL 1102*(Met in IA) or any course in 1E	
Attribute IF – Technology Literacy		3
	Any course in IF	
Attribute IG – Oral Communication		X
	COMM 2200* (Met in ID) or any course in 1G	
Attribute III - Citizenship		3
	POLI 1103* or any course in III	
Attribute IV - Ethics		3
	ENGL 2220* or any course in IV	
Attribute V - Health		2-3
	PHED 1100* or any course in V	
Attribute VI - Interdisciplinary		X
	POLI 1103* (Met in III) or any course in VI	
Attribute VIIA - Arts		3
	Any course in VIIA	
Attribute VIIB - Humanities		X
	ENGL 2220* (Met in IV) or any course in VIIB	
Attribute VIIC – Social Sciences		3
	GEOG 2210* or any course in VIIC	
Attribute VIID - Natural Science		4-5
	Required choices: PHYS 1101, PHYS 1105, CHEM 1101, CHEM 1105	
Attribute VIII – Cultural Awareness		X
	GEOG 2210* (Met in VIIC) or any course in VIII	
Additional General Studies hours		X
	Major Course – MATH 3361 writing intensive course	
	*Starred courses are recommended choices. Choosing a different course may result in more than 120 hours needed to graduate.	
TOTAL GENERAL STUDIES HOURS		**30-32**
TOTAL FREE ELECTIVES		**19-27**
TOTAL HOURS		**120**

APPENDIX A
B.S. Degree in Mathematics
Proposed Program

Required Major Courses			**HRS**
MATH 1550	Applied Statistics		3
MATH 1561	Introduction to Mathematical Reasoning		3
MATH 2501	Calculus I		4
MATH 2502	Calculus II		4
MATH 2510	Mathematical Logic		3
MATH 2563	Transition to Higher Mathematics		3
MATH 3503	Calculus III		4
MATH 3520	Linear Algebra		3
MATH 3550	Probability & Statistics		3
MATH 4520	Abstract Algebra		3
COMP 1102	Principles of Programming I		3
	Any one of the following science courses		
CHEM 1101	General Chemistry I	Counted as General Studies hours XX	
CHEM 1105	Chemical Principles		
PHYS 1101	Introduction to Physics I		
PHYS 1105	Principles of Physics I		
TOTAL Required Major Courses			36
Major Electives			9
Major Electives	Choose three courses from Groups A and B. At least one course must be chosen from Group A.		
	Group A		
	MATH 4580 Topology		
	MATH 4590 Real Analysis		
	Group B		
	MATH 2520 Introduction to the Theory of Numbers		
	MATH 2562 Introduction to Discrete Mathematics		
	MATH 3540 Numerical Analysis		
	MATH 3570 Modern Geometry		
	MATH 3504 Differential Equations		
Minor Electives			18-24
TOTAL HOURS FOR MAJOR			63-69

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 1102* or any course in IA	
Attribute IB – Quantitative Literacy		X
	Major Course – MATH 2501 or (MATH 1107 or higher in IB, but courses below Math 2501 will increase graduation hours.)	
Attribute IC – Written Communication		3
	ENGL 1101* or any course in IC	
Attribute ID - Teamwork		3
	COMM 2200* or any course in 1D	
Attribute IE – Information Literacy		X
	ENGL 1102* (MET in IA) or any course in 1E	
Attribute IF – Technology Literacy		3
	Any course in IF	
Attribute IG – Oral Communication		X
	COMM 2200* (Met in ID) or any course in 1G	
Attribute III - Citizenship		3
	POLI 1103* or any course in III	
Attribute IV - Ethics		3
	ENGL 2220* or any course in IV	
Attribute V - Health		2-3
	PHED 1100* or any course in V	
Attribute VI - Interdisciplinary		X
	POLI 1103* (Met in III) or any course in VI	
Attribute VIIA - Arts		3
	Any course in VIIA	
Attribute VIIB - Humanities		X
	ENGL 2220* (Met in IV) or any course in VIIB	
Attribute VIIC – Social Sciences		3
	GEOG 2210* or any course in VIIC	
Attribute VIID - Natural Science		4-5
	Required choices: PHYS 1101, PHYS 1105, CHEM 1101, CHEM 1105	
Attribute VIII – Cultural Awareness		X
	GEOG 2210* (Met in VIIC) or any course in VIII	
Additional General Studies hours		X
	Major Course – MATH 4520 writing intensive course	
	*Starred courses are recommended choices. Choosing a different course may result in more than 120 hours needed to graduate.	
TOTAL GENERAL STUDIES HOURS		**30-32**
TOTAL FREE ELECTIVES		**19-27**
TOTAL HOURS		**120**

B.A. in Education Degree in Specialization Mathematics 5-Adult
Current Program

Required Major Courses		HRS	
MATH 1113	Math Reasoning: Reading & Writing	3	
MATH 1125	Applied Statistics	3	
MATH 1190	Calculus I	4	
MATH 2200	Mathematical Logic	3	
MATH 2212	Sets, Relations, & Functions	3	
MATH 2216	Introduction to Discrete Mathematics	3	
MATH 3315	Calculus II	4	
MATH 3316	Calculus III	4	
MATH 3335	Probability & Statistics	3	
MATH 3361	Abstract Algebra	3	
MATH 3362	Linear Algebra	3	
MATH 3372	Modern Geometry	3	
MATH 4431	Methods & Materials of Teaching Math	3	
COMP 1102	Principles of Programming I	3	
	Any one of the following science courses		
CHEM 1101	General Chemistry I	Counted as General Studies hours XX	
CHEM 1105	Chemical Principles		
PHYS 1101	Introduction to Physics I		
PHYS 1105	Principles of Physics I		
TOTAL Required Major Courses			45
Major Electives			3
	Choose one course from the following:		
	MATH 3375 Topology MATH 3391 Real Analysis		
Professional Education as required by School of Education			39
TOTAL HOURS FOR MAJOR			**87**

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 1102* or any course in IA	
Attribute IB – Quantitative Literacy		X
	Major Course MATH 1190* or (MATH 1107 or higher in IB, but courses below Math 1190 will increase graduation hours.)	
Attribute IC – Written Communication		3
	ENGL 1101* or any course in 1C	
Attribute ID - Teamwork		3
	COMM 2200* or any course in 1D	
Attribute IE – Information Literacy		X
	ENGL 1102*(Met in IA) or any course in 1E	
Attribute IF – Technology Literacy		3
	Any course in IF	
Attribute IG – Oral Communication		X
	COMM 2200* (Met in ID) or any course in IG	
Attribute III - Citizenship		3
	POLI 1103* or any course in III	
Attribute IV - Ethics		3
	ENGL 2220* or any course in IV	
Attribute V - Health		2-3
	PHED 1100* or any course in V	
Attribute VI - Interdisciplinary		X
	POLI 1103* (Met in III) or any course in VI	
Attribute VIIA - Arts		3
	Any course in VIIA	
Attribute VIIB - Humanities		X
	ENGL 2220* (Met in IV) or any course in VIIB	
Attribute VIIC – Social Sciences		3
	GEOG 2210* or any course in VIIC	
Attribute VIID - Natural Science		4-5
	Required choices: PHYS 1101, PHYS 1105, CHEM 1101, CHEM 1105	
Attribute VIII – Cultural Awareness		X
	GEOG 2210* (Met in VIIC) or any course in VIII	
Additional General Studies hours		X
	Major Course – MATH 3361 writing intensive course	
	*Starred courses are recommended choices. Choosing a different course may result in more than 120 hours needed to graduate	
TOTAL GENERAL STUDIES HOURS		**30-32**
TOTAL FREE ELECTIVES		**1-3**
TOTAL HOURS		**120**

B.A. in Education Degree in Specialization Mathematics 5-Adult
Proposed Program

Required Major Courses			**HRS**	
MATH 1561	Introduction to Mathematical Reasoning		3	
MATH 1550	Applied Statistics		3	
MATH 2501	Calculus I		4	
MATH 2502	Calculus II		4	
MATH 2510	Mathematical Logic		3	
MATH 2562	Introduction to Discrete Mathematics		3	
MATH 2563	Transition to Higher Mathematics		3	
MATH 3503	Calculus III		4	
MATH 3520	Linear Algebra		3	
MATH 3550	Probability & Statistics		3	
MATH 3570	Modern Geometry		3	
MATH 4520	Abstract Algebra		3	
MATH 4531	Methods & Materials of Teaching Math		3	
COMP 1102	Principles of Programming I		3	
	Any one of the following science courses			
CHEM 1101	General Chemistry I		Counted as General Studies hours XX	
CHEM 1105	Chemical Principles			
PHYS 1101	Introduction to Physics I			
PHYS 1105	Principles of Physics I			
TOTAL Required Major Courses				45
Major Electives				3
	Choose one course from the following:			
	MATH 4580 Topology			
	MATH 4590 Real Analysis			
Professional Education as required by School of Education				39
TOTAL HOURS FOR MAJOR				**87**

Required General Studies Courses		
Attribute IA – Critical Analysis		3
	ENGL 1102* or any course in IA	
Attribute IB – Quantitative Literacy		X
	Major Course – MATH 2501 or (MATH 1107 or higher in IB, but courses below Math 2501 will increase graduation hours.)	
Attribute IC – Written Communication		3
	ENGL 1101* or any course in IC	
Attribute ID - Teamwork		3
	COMM 2200* or any course in ID	
Attribute IE – Information Literacy		X
	ENGL 1102* (Met in IA) or any course in IE	
Attribute IF – Technology Literacy		3
	Any course in IF	
Attribute IG – Oral Communication		X
	COMM 2200* (Met in ID) or any course in IG	
Attribute III - Citizenship		3
	POLI 1103* or any course in III	
Attribute IV - Ethics		3
	ENGL 2220* or any course in IV	
Attribute V - Health		2-3
	PHED 1100* or any course in V	
Attribute VI - Interdisciplinary		X
	POLI 1103* (Met in III) or any course in VI	
Attribute VIIA - Arts		3
	Any course in VIIA	
Attribute VIIB - Humanities		X
	ENGL 2220* (Met in IV) or any course in VIIB	
Attribute VIIC – Social Sciences		3
	GEOG 2210* or any course in VIIC	
Attribute VIID - Natural Science		4-5
	Required choices: PHYS 1101, PHYS 1105, CHEM 1101, CHEM 1105	
Attribute VIII – Cultural Awareness		X
	GEOG 2210* (Met in VIIC) or any course in VIII	
Additional General Studies hours		X
	Major Course – MATH 4520 writing intensive course	
	*Starred courses are recommended choices. Choosing a different course may result in more than 120 hours needed to graduate	
TOTAL GENERAL STUDIES HOURS		**30-32**
TOTAL FREE ELECTIVES		**1-3**
TOTAL HOURS		**120**

Minor in Mathematics

Current Program

MINOR IN MATHEMATICS..... 24 SEM. HRS.
Required Courses (12 hrs.)
- MATH 1190 CALCULUS I.....4
- MATH 3315 CALCULUS II.....4
- MATH 3316 CALCULUS III.....4

Electives (12 hrs.)
(Choose four courses from the following list with at most one 1000 level course and at least one 3000/4000 course).
- MATH 1113 APPLIED STATISTICS.....3
- MATH 1125 MATH REASONING: READING AND WRITING.....3
- MATH 2200 MATHEMATICAL LOGIC.....3
- MATH 2206 INTRODUCTION TO THE THEORY OF NUMBERS.....3
- MATH 2212 SETS, RELATIONS AND FUNCTIONS.....3
- MATH 2216 INTRODUCTION TO DISCRETE MATHEMATICS.....3
- MATH 3335 PROBABILITY AND STATISTICS I.....3
- MATH 3342 NUMERICAL ANALYSIS.....3
- MATH 3361 ABSTRACT ALGEBRA.....3
- MATH 3362 LINEAR ALGEBRA.....3
- MATH 3372 MODERN GEOMETRY.....3
- MATH 3375 TOPOLOGY.....3
- MATH 3391 REAL ANALYSIS.....3
- MATH 4401 DIFFERENTIAL EQUATIONS.....3

Minor in Mathematics
Proposed Program

MINOR IN MATHEMATICS..... 24 SEM. HRS.
Required Courses (12 hrs.)
- MATH 2501 CALCULUS I.....4
- MATH 2502 CALCULUS II.....4
- MATH 3503 CALCULUS III.....4

Electives (12 hrs.)
(Choose four courses from the following list with at most one 1000 level course and at least one 3000/4000 course).
- MATH 1550 APPLIED STATISTICS.....3
- MATH 1561 INTRODUCTION TO MATHEMATICAL REASONING..3
- MATH 2510 MATHEMATICAL LOGIC.....3
- MATH 2520 INTRODUCTION TO THE THEORY OF NUMBERS.....3
- MATH 2562 INTRODUCTION TO DISCRETE MATHEMATICS.....3
- MATH 2563 TRANSITION TO HIGHER MATHEMATICS…….....3
- MATH 3504 DIFFERENTIAL EQUATIONS.....3
- MATH 3520 LINEAR ALGEBRA.....3
- MATH 3540 NUMERICAL ANALYSIS.....3
- MATH 3550 PROBABILITY AND STATISTICS I.....3
- MATH 3570 MODERN GEOMETRY.....3
- MATH 4520 ABSTRACT ALGEBRA.....3
- MATH 4580 TOPOLOGY.....3
- MATH 4590 REAL ANALYSIS.....3

MATHEMATICS TEACHING
SPECIALIZATION, GRADES 5-9

Current Program

This specialization prepares teacher candidates for general mathematics through Algebra I.
Required courses (31 hrs.)

MATH 1112 COLLEGE ALGEBRA*.....3
MATH 1113 APPLIED STATISTICS.....3
MATH 1115 TRIG. AND ELEMENTARY FUNCTIONS.....3
MATH 1125 MATH REASONING: READING AND WRITING.....3
MATH 1185 APPLIED CALCULUS I.....4
MATH 2251 STRUCTURE OF THE REAL NUMBERS.....3
MATH 2252 DATA ANALYSIS AND GEOMETRY.....3
MATH 3353 MATH METHODS FOR ELEMENTARY TEACHERS.....3
MATH* 4431 METHODS & MATERIALS IN TEACHING MATH.....3
* omit if Math ACT greater than or equal to 23

MATHEMATICS TEACHING
SPECIALIZATION, GRADES 5-9

Proposed Program

This specialization prepares teacher candidates for general mathematics through Algebra I.
Required courses (31 hrs.)

MATH 1530 COLLEGE ALGEBRA*.....3
MATH 1540 TRIG. AND ELEMENTARY FUNCTIONS.....3
MATH 1550 APPLIED STATISTICS.....3
MATH 1561 INTRODUCTION TO MATHEMATICAL REASONING.....3
MATH 2501 CALCULUS I.....4
MATH 2551 STRUCTURE OF THE REAL NUMBERS.....3
MATH 2552 DATA ANALYSIS AND GEOMETRY.....3
MATH 3553 MATH METHODS FOR ELEMENTARY TEACHERS.....3
MATH 4531 METHODS & MATERIALS IN TEACHING MATH.....3
* omit if Math ACT greater than or equal to 23

APPENDIX B
Course Descriptions for Created and Revised Courses

NEW COURSE:

MATH 1561 **Introduction to Mathematical Reasoning …**3 cr

This course is designed to help students transition into upper level college mathematics. Students will learn how to reason mathematically by reading and writing using technical mathematical terminology. Topics covered include basic set theory, mathematical logic, basic methods of proof including mathematical induction, properties of the field of real numbers, basic number theory and function notions, as well as sequences and series.

PR: **C or better in MATH 1115 OR math ACT 24 OR (MATH 2251 and 2252)**

REVISED COURSES:

(Formerly, MATH 2216-Introduction to Discrete Mathematics)

MATH 2562 Introduction to Discrete Mathematics… 3 cr

This course is designed to provide a survey of the reasoning and objects of study found in discrete mathematics. Topics considered include sets, relations, functions, combinatorics, graphs, trees, discrete probability, algorithms, and recurrence relations. Interspersed throughout the course will be material on the nature of proofs. Spring Semester only.

PR: **MATH 1561**

(Formerly, MATH 2212-Sets, Relations, and Functions)

MATH 2563 Transition to Higher Mathematics…3 cr

The goal of this course is to transition the student into the more formal and proof-oriented world of advanced mathematics. The focus of the course will be developing the requisite skills needed to write an effective and elegant proof. The course will use as its means of approaching proofs the subjects of number theory, relations, and functions. Fall semester only.

PR: **MATH 1561 AND MATH 2501**

APPENDIX C
Course Outlines

NEW COURSE:

MATH 1561 –Introduction to Mathematical Reasoning

(1) Intro to Set Theory
- (A.) Terminology: Set; element of a set; null set
- (B.) Notations: Verbal; roster; set-builder
- (C.) Cardinality
  - (i) Equivalent sets
  - (ii) Finite vs. infinite sets
- (D.) Subsets
  - (i) Proper/improper subsets
  - (ii) Power sets
- (E.) Well-defined sets/Russell's Paradox
- (F.) Set operations
  - (i) Union, intersection, complement, difference
  - (ii) Disjoint sets
  - (iii) Cartesian product
- (G.) Venn Diagrams: visual proofs and problem solving
- (H.) Analytical proof of the equality of two sets

(2) Intro to Mathematical Logic
- (A.) Logical statements
  - (i) Open sentences, variables, quantifiers
  - (ii) Identifiers and contradictions
  - (iii) Compound sentences (Conjunctions, disjunctions, negations)
  - (iv) Conditional and biconditional sentences
    - (a.) Antecedent and Consequent
    - (b.) Contrapositive, converse, inverse of a sentence
  - (v) Truth tables/logical equivalence
- (B.) Proof strategies
  - (i) Strategy of contraposition
  - (ii) Indirect proof
  - (iii) Rules of logical inference
    - (a.) detachment (inference)
    - (b.) negative inference (principle of contraposition)
    - (c.) disjunctive inference
    - (d.) Principle of the syllogism
    - (e.) substitution principles
    - (f.) principle of equivalent inference
  - (iv) Axiomatic proofs
- (C.) Common Errors
  - (i) Asserting conclusion
  - (ii) Denying premise
  - (iii) Others

(3) Formal Mathematical systems

(A.) Components of mathematical system
    (i) Undefined objects
    (ii) Definitions
    (iii) Axioms
    (iv) Theorems
(B.) Equivalence Relations and Associated Properties
(C.) Mathematical Operations and their Associated Properties

(4) Number Theory
(A.) Prime and Composite numbers
(B.) Fundamental Theorem of Arithmetic
(C.) GCD
    (i) Find using F.T.A.
    (ii) Find using Division Algorithm
(D.) Divisibility tests for 2,3,4,5,7,9,11
(E.) The principle of Mathematical Induction

(5) Relations with Functions
(A.) Representation using sets of ordered pairs
(B.) Comparing relations and functions analytically and graphically
(C.) The difference quotient
(D.) Algebra of functions (sum, difference, product, quotient, and composition of functions)
(E.) 1-1 functions
(F.) Inverses

(6) Sequences
(A.) Arithmetic and geometric sequences
(B.) Recursive and explicit formulae/pattern recognition

REVISED COURSES:

(Formerly, MATH 2216-Introduction to Discrete Mathematics)

MATH 2562 Introduction to Discrete Mathematics

(1) Solving congruences
(2) Induction and recursion
    (A.) Math induction
    (B.) Strong induction
    (C.) Recursive definitions and structural induction
    (D.) Recursive algorithms
(3) Discrete Probability
    (A.) Intro to discrete probability
    (B.) Counting
        (i) Fundamental counting principle
        (ii) Combinatorics (permutations and combinations)
        (iii) Pigeonhole principle
    (C.) Probability Theory
    (D.) Bayes' Theorem
    (E.) Expected Value and Variance
(4) Relations
    (A.) Relations and their properties
    (B.) Representing relations
    (C.) Closure of relations
    (D.) Equivalence relations
    (E.) Partial orderings
(5) Graphs
    (A.) Graphs and graph models
    (B.) Graph terminology and special types of graphs
    (C.) Representing graphs and graph isomorphism
    (D.) Connectivity
    (E.) Euler and Hamilton paths
    (F.) Shortest path problems
    (G.) Planar graphs (optional)
    (H.) Graph coloring (optional)
(6) Trees
    (A.) Intro to trees
    (B.) Applications of trees
    (C.) Tree traversal
    (D.) Spanning trees
    (E.) Minimum spanning trees (optional)

(Formerly, MATH 2212-Sets, Relations, and Functions)

MATH 2563 Transition to Higher Mathematics

1) Basic Types of Proof
    1. Statements, Implications, and Negation
    2. Direct Proofs
    3. Indirect Proofs
    4. Proofs Involving Quantifiers
2) Number Theory
    1. Properties of the Integers
    2. Greatest Common Divisor
    3. Primes and Composites
3) Induction
    1. Principle of Mathematical Induction
    2. Other Forms of Induction
        a. Generalized
        b. Complete
    3. Well-ordering Principle
4) Relations and Partitions
    1. Cartesian Products and Relations
    2. Equivalence Relations
    3. Partitions
5) Functions
    1. Functions as Relations
    2. Constructions of Functions
    3. Functions That Are Onto
    4. Functions That Are One-to-one
    5. One-to-One Correspondences and Inverse Functions
    6. Images of Sets

APPENDIX D
Course Outcomes and Assessments

NEW COURSE:

MATH 1561 **Introduction to Mathematical Reasoning**

Outcome	**Direct Assessment**	**Rubric/satisfactory performance standard**
1. Analyze, apply, and compose rigorous definitions of mathematical concepts.	Exam/quiz question(s)	Class average will be greater than or equal to 70% of the possible points on questions associated with this outcome on the midterm and final exam.
2. Read, analyze, and design proofs at a level below Calculus I. **(This course outcome maps to math program outcome 2)**	Exam/quiz/homework proof(s)	Class average will be 12 or better, out of 20, on the proof rubric.
3. Apply principles of logic by analyzing arguments and statements, including quantified statements.	Exam/quiz question(s)	Class average will be greater than or equal to 70% of the possible points on questions associated with this outcome on the midterm and final exam.
4. Demonstrate the ability to identify the structural parts of a mathematical proof (hypotheses, conclusions, undefined terms, defined terms, axioms, theorems, and the use of logic) and recognize the importance of each component.	CONCEPT MAP Activity	Class average score of greater than 2.5 on the Arizona Math Rubric.
5. Explain and apply the basics of set theory.	Exam/quiz question(s)	Class average will be greater than or equal to 70% of the possible points on questions associated with this outcome on the midterm and final exam.

MATH 2562 Introduction to Discrete Mathematics

Outcome	**Direct Assessment**	**Rubric/satisfactory performance standard**
1. Make conjectures and solve counting problems using permutations, combinations, and the Fundamental Counting Principle.	Quiz/Test problem(s)	Average of 2.5 or better on the Arizona Math Rubric
2. Use the language of Mathematics to explain the terms and concepts of elementary graphs.	Quiz/Test problem(s)	Average of 2.5 or better on the Arizona Math Rubric
3. Apply fundamental ideas of discrete mathematics such as the algorithms of graph theory to solve a variety of "real world" problems.	Quiz/Test problem(s)	Average of 2.5 or better on the Arizona Math Rubric
4. Model problems using recursive relationships.	Quiz/Test problem(s)	Average of 2.5 or better on the Arizona Math Rubric

MATH 2563 Transition to Higher Mathematics

Outcome	**Direct Assessment**	**Rubric/satisfactory performance standard**
1. Apply a variety of techniques to prove theorems.	Quiz or Exam question	Average of 13 or better on the Proof Rubric
2. Investigate and solve unfamiliar math problems.	Quiz or Exam question	Average of 2.5 or better on the Arizona Math Rubric
3. Organize and communicate mathematics effectively in writing to faculty using the language of mathematics to express ideas precisely.	Quiz or Exam question	Average of 13 or better on the Proof Rubric
4. Organize and communicate mathematics effectively to peers using the language of mathematics to express ideas precisely.	Presentation of problem solution or proof to the class	Average of 15 or better on the Presentation Rubric