Mathematics
Department Faculty
Heunggi Park

Department Goals
Mathematics is a discipline with ancient origins in early Greek thought, and has been the indispensable language and tool of science. In our major program and in our service to other departments, the Mathematics Department at Covenant College seeks to provide solid grounding in the discipline of mathematics as well as providing a greater appreciation for logic and precise language. In our major program we seek to prepare students for graduate school, technical jobs or for teaching in secondary school. In our service programs we aim to prepare pre-engineering students for the dual degree program and to prepare students majoring in other disciplines which require mathematics. We also hope to impart:

1. an appreciation for the wisdom of God as it is manifested in the logic and orderliness of His creation,
2. an appreciation for the goodness of God in both structuring much of creation to be amenable to mathematical description and in structuring our thought processes to be able to understand the mathematics that describe the creation,
3. an appreciation of absolute truth in the limited context of a mathematical system and at the limited understanding of fallen man.

Teacher Certification
Students who desire teacher certification in Mathematics should complete a BA degree with a major in Mathematics, then enroll in the one-year Master of Arts in Teaching program at Covenant College. To ensure eligibility for entry to the MAT program, it is recommended that you complete the Education Minor. (See page 79.) Two of the courses in the minor, EDU 222 Educational Psychology and EDU 361 Education of Exceptional Children, are required for admission to the program. This program leads to grades 6-12 teacher certification through the state of Georgia and through the Association of Christian Schools International (ACSI).

Additionally, pre-MAT mathematics majors must take the following specific courses as part of their mathematics major:

- MAT 270 Discrete Math
- MAT 360 Geometry I OR MAT 361 Geometry II

See Dr. Jim Drexler in Brock Hall 303 (jdrexler@covenant.edu) for more information.

Requirements for a Major in Mathematics
The core requirements are the same as those listed for baccalaureate degrees (see page 24) with the exception that a course other than PHI 357 Formal Logic must be completed to fulfill the humanities distribution requirement. Mathematics courses required for the major will also satisfy the mathematics core requirement.

Core requirements .................................................. 55
Electives ............................................................... 22

Major and Supporting Course Requirements
<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>COS 130 Computer Programming Methodology</td>
<td>4</td>
</tr>
<tr>
<td>MAT 145-146 Calculus I, II</td>
<td>8</td>
</tr>
<tr>
<td>MAT 247 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MAT 250 Probability</td>
<td>3</td>
</tr>
<tr>
<td>MAT 258 Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>MAT 290 Proofs and Exposition “W”</td>
<td>3</td>
</tr>
<tr>
<td>MAT 310 Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MAT 350 Modern Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MAT 460 Real Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MAT 492 Senior Integration Paper “S”</td>
<td>2</td>
</tr>
</tbody>
</table>

Mathematics electives:
- MAT 270 Discrete Math, or
- MAT 360 Modern Geometry I, or
- MAT 361 Modern Geometry II, or
- MAT 470 Topology, or
- MAT 480 Advanced Topics in Mathematics

PHI 357 Formal Logic or
- MAT 410 Mathematical Logic

Total hours for the major .................................. 49
Total degree hours .......................................... 126

Requirements for Minor in Mathematics
MAT 145-146 Calculus I, II .................................. 8
MAT 247 Calculus III ......................................... 8
MAT 258 Differential Equations .................... 4
Any course offered by the Mathematics Department that is from either the core electives of the mathematics major, or STA 253 ......................................................... 3-4

Total hours for the minor .................................. 19-20

Mathematics Placement Process
Placement in mathematics courses for those with no previous college mathematics credit is determined on the basis of mathematics scores on the SAT or ACT with the following scale:

Minimum Subscore
<table>
<thead>
<tr>
<th>Placement Level</th>
<th>SAT Math</th>
<th>ACT Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Below 540</td>
<td>Below 21</td>
</tr>
<tr>
<td>Level 2</td>
<td>540</td>
<td>21</td>
</tr>
<tr>
<td>Level 3</td>
<td>570</td>
<td>23</td>
</tr>
<tr>
<td>Level 4</td>
<td>600</td>
<td>25</td>
</tr>
<tr>
<td>Level 5 – Score of 4 or higher on AP Calc AB or higher Test</td>
<td></td>
<td></td>
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</tbody>
</table>

If a student wishes to attempt to achieve a higher placement level than originally assigned based on test scores, there will be a mathematics placement test offered during New Student Orientation. Scores on the mathematics placement test may increase a student’s math placement level, but will not decrease that original placement.

Math Placement Level 1: Students majoring in Art, Bible, English, Foreign Language, History, IDS (if concentrations do not require math), Music, Philosophy, Psychology, Sociology or Theatre may take MAT 122 Concepts in Mathematics to fulfill the core mathematics requirement. Students in majors that require additional math or statistics that includes Business, Community Development, Economics, Elementary Education, IDS (if concentrations require additional math), International Studies, Mathematics or any of the science majors, must take MAT 040 Intermediate Algebra before proceeding with other required math or statistics courses.

Math Placement Level 2: Students should enroll in MAT 111 Math for Educators if majoring in Elementary Education; MAT141 College Algebra if majoring in Business, Community Development, IDS (with math concentration), Mathematics or any of the sciences; or MAT 122 Concept in Mathematics for all other majors to fulfill the core mathematics requirement.

Math Placement Levels 3, 4 and 5 who have no specific math requirements for their major have fulfilled the core mathematics requirements and are not required to take an additional math course.

Math Placement Level 3: Students may take MAT 142 Pre-Calculus, MAT 144 Finite Mathematics, or STA 253 Statistics for Decision Makers.

Math Placement Level 4: Students may take MAT 145 Calculus I.

Math Placement Level 5: Students have credit for MAT145 Calculus I and may take MAT146 Calculus II.

### Mathematics Courses (MAT)

**040 Intermediate Algebra**

A review of elementary and intermediate algebra designed to assist students in developing the skills necessary for taking MAT 141 College Algebra. Prerequisite: Placement level 1. Four hours institutional credit (institutional credit is not applicable to the 126 hours required for graduation). Only offered on a Credit (CR) / No Credit (NC) basis.

**111-112 Mathematics for Educators I, II**

These courses are a two-course sequence of mathematics content course (not method course) designed to prepare students to teach elementary and middle school mathematics for understanding, as envisioned by the National Council of Teachers of Mathematics, and as described in their document Principles and Standards for School Mathematics. The courses will examine deeply those topics in mathematics which are relevant for elementary and middle school teaching. MAT 111 focuses on the problem solving and arithmetic including why standard algorithms work, properties of arithmetic, and applications of elementary mathematics. MAT 112 focuses on the problem solving and geometry including why various standard formulas and properties in geometry are valid. Prerequisite: MAT 040 or placement level 2 for MAT 111; MAT 111 for MAT 112. These courses only fulfill the core mathematics requirement for an elementary education major. These courses are not equivalent to either MAT 122 or MAT 141. Three hours each.

**122 Concepts in Mathematics**

This course will introduce a variety of topics chosen from the following: Number systems, finite and infinite sets, geometry, topology, chaos theory, probability, and game theory. This course aims to help students to develop an appreciation for the beauty of mathematics, and for the usefulness of mathematical thinking, by examining particularly surprising results in classical and contemporary mathematics. Prerequisite: Placement level 1. This course fulfills the core mathematics requirement for non-science majors, but does not serve as a prerequisite for any other course. Three hours.

**141 College Algebra**

The course will cover complex numbers, solution of equations and inequalities, techniques of graphing, and the study of various functions: linear, quadratic, polynomial, rational, exponential, and logarithmic. Designed for those who have had two years of high school algebra, but need more depth in algebraic topics to prepare for enrollment in MAT 142, 144 or STA 253. Prerequisite: MAT 040 or placement level 2. This course fulfills the core mathematics requirement; not open to students with credit for any mathematics course (or equivalent) numbered 142 or higher unless special permission is granted by the instructor. Four hours.

**142 Precalculus Mathematics**

The course will cover analytical trigonometry, systems of equations, matrices and determinants, linear programming, solution of polynomial equations, conic sections, mathematical induction, the binomial theorem, permutations and combinations, and introductory probability. Designed to
meet the requirements of various major programs (including biology, business and elementary education/middle grades certification), and to provide preparation for the calculus sequence. Prerequisite: MAT 141 or placement level 3; not open to students with credit for any mathematics course (or equivalent) numbered 145 or higher unless special permission is granted by the instructor. Four hours.

144 Finite Mathematics and Brief Calculus for Business Majors
The course will cover systems of linear equations, linear programming, mathematics of finance, and elementary differential and integral calculus. Emphasis placed on applications to finance and management problems. Prerequisite: MAT 141 or placement level 3. Four hours.

145-146 Calculus I, II
The course will cover analytic geometry, functions and limits, the derivative and its applications, antiderivatives, indefinite integrals, transcendental functions, the definite integral and its application, methods of integration, polar coordinates and infinite series. These courses are prerequisites to all courses numbered above 200. Prerequisite: MAT 142 or placement level 4 for MAT 145; MAT 145 or placement level 5 for MAT 146. Four hours each.

247 Calculus III
A continuation of MAT 145-146. The course will cover vectors, parametric equations, solid analytic geometry, partial differentiation, multiple integration, line and surface integrals. Prerequisite: MAT 146. Four hours.

250 Probability
An introduction to the theory of probability. The course will cover combinatorics, laws of probability, discrete and continuous random variables and distributions, expectation, variance, and if time permits, other topics. Prerequisite: MAT 247. Three hours.

258 Differential Equations
The course will cover first order differential equations, second and higher order linear equations, series solutions, the Laplace transform, systems of first order equations, linear second order boundary value problems. Both analytic and numerical techniques are studied. Prerequisite: MAT 146. Four hours.

270 Discrete Mathematics
The course will cover counting, permutations, combinations, discrete probability distributions, generating functions, Ramsey Theory, the pigeonhole principle, induction, various algorithms, topics in graph theory including: connectivity, trees, Euler tours, Hamilton cycles, edge and vertex coloring, planar graphs and graph algorithms. Prerequisite: MAT 145. Three hours.

290 Proofs and Exposition
Proofs in mathematics are both intimidating and mysterious to most people. This course hopes to dispel some of that mystery as well as equip students to both read and write mathematical proofs. Besides a review of logic and mathematical nomenclature, students will be required to tackle proofs from a variety of different fields of mathematics. Prerequisite: MAT 146. Three hours. “S” “W”

310 Linear Algebra
This course will develop the algebra of vectors and matrices, including finding the inverse of a matrix, subspaces, basis and dimension of vector spaces, linear transformations, isomorphisms. Inner and cross products will be treated. Special types of matrices will be discussed, such as the Jordan Normal form. Eigenvalues and eigenvectors will be treated. Prerequisite: MAT 146. Three hours.

350 Modern Algebra
The course will cover integral domains, rings, fields, groups, elementary number theory, and other selected topics. Prerequisite: MAT 290 or permission of instructor for Math Edu majors. Three hours.

360-361 Modern Geometry I, II
The objective of this course is to teach students axiomatic reasoning without the aid of diagrams, explore what can be deduced from neutral geometry (without the Euclidean Fifth Postulate, or, equivalently, the Hilbert Parallel Axiom for Euclidean Geometry), explore aspects of Euclidean Geometry, then, replace the Euclidean Fifth Postulate with the Hyperbolic Parallel Postulate, and show that Hyperbolic Geometry is as self-consistent as Euclidean Geometry. The historical developments, philosophical implications and Hyperbolic Trigonometry should be of particular use to future secondary education mathematics instructors. Prerequisite: MAT 290 or permission of instructor for Math Edu majors for MAT 360; MAT 360 for MAT 361. Three hours each.

410 Mathematical Logic
The course will cover truth functions and tables, rules of logic, predicate calculus, first order arithmetic, formal set theory, consistency, completeness, recursive functions, and if time permits, Godel Numbers, Godel’s Incompleteness Theorem, algorithms, computability, Church’s Thesis, Turing machines, undecidability of formal systems and the halting problem. Prerequisite: MAT 290. Three hours.

460 Real Analysis
The course will cover set theory, the real number system, functions, sequences, limits, convergence, uniform convergence, Bolzano-Wierstrass Theorem, functions of a real variable, open and closed sets, continuity, uniform continuity, connectivity of the real numbers, the intermediate value theorem, completeness, compactness, the mean value theorem, differentiation, Riemann integration, and if time
permits, other topics. Prerequisite: MAT 290 and 258. Three hours.

470 Topology
Review of set theory and logic, defining axioms of topological spaces, bases for topological spaces, order, product and subspace topology, closed sets and limit points, continuous functions, metric topology, connectivity, compactness, the Tychonoff Theorem, and if time permits, other topics. Prerequisite: MAT 290. Three hours.

480 Advanced Topics in Mathematics
Topics are considered in number theory, operations research, mathematical statistics, or advanced calculus, depending on student demand. Prerequisite: MAT 290. Three hours per semester.

492 Senior Integration Paper
See page 27. “S”

Quantitative Methods Course (STA)

STA 252 Elementary Statistic: Concepts and Methods
An introductory course in statistical science used in scientific research investigations. Topics considered include the nature and importance of statistics, quantification, measurement, probability, elementary research design, the collection and scoring of research results, measures of central tendency, the normal distribution, correlational analysis, statistical inference, analysis of variance and the analysis of categories and ranks. Computer applications will be stressed. Prerequisite: MAT 040 or higher-level mathematics course, or placement level 2 or higher. Four hours.

STA 253 Statistics for Decision Making
This course explores methods of data collection and analysis for making decisions related to business, economics, and other organizational issues. Topics include descriptive statistics, correlation, the Normal distribution, sampling, surveys, statistical inference, hypothesis testing, and regression. Applications focus on real data analyzed with statistical software. Students learn to think critically about conclusions drawn from data and to apply statistical methods in their own studies. Prerequisite: MAT 141 or higher-level mathematics course, or placement level 3 or higher. Four hours.