

## MATHEMATICS

### General Major

Upon successful completion of a mathematics major at Redeemer, a successful student will be able to:

- I. Depth and Breadth of Knowledge
  - A. possess a broad training in the liberal arts and sciences
  - B. describe the historical context and development of mathematics
  - C. describe philosophical frameworks for understanding mathematics (and science)
  - D. provide examples of how mathematics has shaped (and shapes) society
  - E. describe mathematics through the lens of faith, noting Reformed emphases
  - F. draw connections between different areas of mathematics
  - G. recognize a breadth of applications of mathematics
  - H. possess a broad understanding of four of the following major fields in mathematics: calculus,
  - I. linear algebra, statistics, differential equations, and discrete mathematics
  - J. justify a small sampling of techniques used in mathematics
  - K. possess a detailed understanding of at least four of the following major fields of study: linear algebra,
  - L. Euclidean and non-Euclidean geometry, abstract algebra, real analysis, numerical analysis,
  - M. graph theory, and others
  - N. solve mathematical problems in pure and applied settings
  - O. describe mathematical models in physics
- II. Knowledge of Methodologies
  - A. recognize and employ different proof techniques
  - B. explain the importance of definitions, axioms and theorems
  - C. describe key techniques in multiple subject areas in mathematics
  - D. develop results within an axiomatic system
  - E. describe uses and limitations of methodological reductionism
  - F. justify results and provide proofs
- III. Application of Knowledge
  - A. develop proofs for theorems; construct and reconstruct arguments
  - B. use theoretical knowledge in applied problems
  - C. explore multiple approaches to solve a problem
  - D. apply techniques and key results in multiple subject areas of mathematics
  - E. discern and select appropriate mathematical tools for a given context
  - F. make appropriate approximations, including in modeling
  - G. reason with abstract concepts
  - H. manipulate concepts geometrically and algebraically
  - I. model practical and theoretical problems, and judge the reasonableness of solutions
  - J. employ appropriate software tools and technological aids
  - K. design, code, debug, and test well-structured computer programs at an introductory level
  - L. explore open-ended questions
  - M. read mathematical notation
  - N. use primary sources to develop an understanding of the context of mathematics
- IV. Communication Skills
  - A. write a careful proof of a theorem
  - B. provide careful justification with a solution to an exercise

- C. use correct mathematical notation
  - D. orally present a mathematical argument or concept
  - E. document simple computer programs
- V. Awareness of Limits of Knowledge
- A. articulate limits of mathematics and statistics as a tool
  - B. cite particular results which demonstrate the limits of mathematics
  - C. cite mathematical results which demonstrate the limits of knowledge in general
  - D. recognize that mathematics is a human activity
  - E. recognize that mathematics is merely one aspect of the created order
- VI. Maturity and Professional Capacity
- F. model and solve practical problems with mathematical tools
  - G. develop logical arguments for careful thinking
  - H. read mathematics and mathematical arguments
  - I. work collaboratively to frame and solve a problem
  - J. teach oneself by asking appropriate questions and exploring possible answers
  - K. consider how mathematics shapes career choices
  - L. subscribe to an academic integrity policy

#### **Four-Year Major**

The Learning Outcomes for the Four-Year Major are the same as those for the General Major, except where noted below:

- I. Depth and Breadth of Knowledge
  - H. possess a broad understanding of the following major fields in mathematics: calculus, linear algebra, statistics, differential equations, discrete mathematics
  - I. justify techniques used in mathematics
  - J. possess a detailed understanding of at least five of the following major fields of study: linear algebra, Euclidean and non-Euclidean geometry, abstract algebra, real analysis, numerical analysis and graph theory
  - M. explore extensions of known results
- II. Knowledge of Methodologies
  - G. employ strong induction as a proof technique
- III. Application of Knowledge
- IV. Communication Skills
  - A. orally present a variety of mathematical arguments or concepts
  - B. document well-structured computer programs
- V. Awareness of Limits of Knowledge
- VI. Maturity and Professional Capacity
  - A. work collaboratively to frame and solve complex problems

#### **Honours Major**

The Learning Outcomes for the Honours Major are the same as those for the Four-Year Major, except where noted below:

- I. Depth and Breadth of Knowledge
  - J. possess a detailed understanding of the following major fields of study: linear algebra, Euclidean and non-Euclidean geometry, abstract algebra, real analysis, numerical analysis and graph theory
  - N. contrast historical and philosophical developments in mathematics versus science
  - O. highlight the history of applied mathematics in the development of physics
  - P. explore extensions of known results in a variety of mathematical fields
  - Q. possess a detailed understanding of additional fields or sub-fields of mathematics
- II. Knowledge of Methodologies
- III. Application of Knowledge
  - L. explore open-ended questions in a variety of subject areas
  - O. develop concepts in mathematics
  - P. read unfamiliar mathematical notation
- IV. Communication Skills
  - C. write a research paper on a mathematical topic using primary source material
  - D. write a report using LATEX documentation software
- V. Awareness of Limits of Knowledge
- VI. Maturity and Professional Capacity
  - E. contextualize advanced mathematics and present to a broader audience

### **Minor**

Upon successful completion of a mathematics minor at Redeemer, a successful student will be able to:

- I. Depth and Breadth of Knowledge
  - A. possess a broad training in the liberal arts and sciences
  - B. describe the historical context and development of mathematics
  - C. provide examples of how mathematics has shaped (and shapes) society
  - D. describe mathematics through the lens of faith, noting Reformed emphases
  - E. draw connections between different areas of mathematics
  - F. recognize a breadth of applications of mathematics
  - G. possess a broad understanding of two or more of some major fields in mathematics: calculus, linear algebra, statistics, differential equations, discrete mathematics
  - H. justify simple techniques used in mathematics
  - I. possess a detailed understanding of one or two of the following major fields of study: linear algebra, Euclidean and non-Euclidean geometry,
  - J. solve mathematical problems in pure and applied settings
  - K. describe mathematical models in physics
- II. Knowledge of Methodologies
  - A. explain the importance of definitions, axioms and theorems

- B. describe key techniques in multiple subject areas in mathematics
  - C. justify results and provide proofs
- III. Application of Knowledge
- A. develop proofs for theorems; construct and reconstruct arguments
  - B. use theoretical knowledge in applied problems
  - C. explore multiple approaches to solve a problem
  - D. apply techniques and key results in multiple subject areas of mathematics
  - E. discern and select appropriate mathematical tools for a given context
  - F. make appropriate approximations, including in modeling
  - G. reason with abstract concepts
  - H. manipulate concepts geometrically and algebraically
  - I. model practical and theoretical problems, and judge the reasonableness of solutions
  - J. employ appropriate software tools and technological aids
  - K. read mathematical notation
- IV. Communication Skills
- A. write a careful proof of a theorem
  - B. provide careful justification with a solution to an exercise
  - C. use correct mathematical notation
- V. Awareness of Limits of Knowledge
- A. articulate limits of mathematics
  - B. use mathematics and statistics as a tool
  - C. recognize that mathematics is a human activity
  - D. recognize that mathematics is merely one aspect of the created order
- VI. Maturity and Professional Capacity
- A. model and solve practical problems with mathematical tools
  - B. develop logical arguments for careful thinking
  - C. work collaboratively to frame and solve a problem
  - D. subscribe to an academic integrity policy