Comprehensive Course Syllabus

Mathematical Investigations III

Course Description:
The Mathematical Investigations courses integrate topics from all areas of pre-calculus mathematics. In these courses, students will be expected to explore mathematical concepts, make conjectures and present logical, valid arguments for mathematical assertions. Both written and oral forms of communication are emphasized. MI-3 is the third course in this sequence and will concentrate on the study of exponential and logarithmic functions, polynomial and rational functions, and trigonometry.

INSTRUCTOR(S):

- Name(s): *Every member of the mathematics department teaches this course at some time, so students should feel comfortable asking any of them for help as needed.*

Current teachers (Spring, 2018):

Ms. Ruth Dover	Dr. Janice Krouse	Mr. Matt McCutcheon	Mrs. Valentina Sorescu
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Office Hrs: By Appointment	Office Hrs: By Appointment	Office Hrs: By Appointment	Office Hrs: By Appointment

- Office Number: A-157 (all math teachers)

Meeting Days, Time and Room(s)

Section 1: (Dover)	8:00 – 8:55 Room A151
Section 2: (McCutcheon)	9:00 – 9:55 Room A-148
Section 3: (Sorescu)	10:00 – 10:55 Room A-150
Section 4: (Krouse)	12:20 – 1:15 Room A-152
Section 5: (McCutcheon	2:20 – 3:15 Room A-148
Section 6: (Krouse)	3:20 – 4:15 Room A-152

Text(s) / Materials:
No text required. Students will receive daily handouts written by the IMSA Math Team. Students are expected to maintain a notebook containing class notes, homework assignments, problem sets, and other handouts. Students are also expected to have a graphing calculator (TI-89 Titanium recommended) daily.

Essential Content:
Students studying Mathematical Investigations will:

A. demonstrate a disposition and propensity to use mathematics, a variety of problem solving strategies, and creative thought to solve problems.
B. reason logically in mathematical situations and understand the nature, role, and necessity of proof and counterexample in mathematical reasoning.
C. communicate clearly and accurately about mathematical relationships and results.
D. demonstrate awareness of the interconnectedness of mathematical thought in inter- and intra-disciplinary settings.
E. understand and employ the power, economy, clarity, and elegance of mathematical representations.
F. use and interpret appropriate mathematical models to represent real-world situations.
G. understand the underlying concepts and characteristics of mathematical functions and relations.
H. identify, understand, and apply the concepts of change and invariance under change.
I. understand and apply geometric relationships.
J. use data to research questions, make conjectures, inform decisions, and evaluate assertions.
K. understand and apply discrete mathematical models.
L. use technology to gain insight and obtain different perspectives on problems.examine the parameters of citizenship, ethical behavior, and human rights in a democracy.

These standards will be addressed in *Mathematical Investigations 3* through the study of:

Logarithms
- Conceptual understanding of logarithms
- Understanding the relationship between exponential and logarithmic functions
- Demonstrating facility in translating from exponential to logarithmic form of an expression or equation and vice versa
- Applying the laws of exponents to simplify or solve as required
- Using logarithms to answer questions about real-world phenomena
- Knowing, understanding, and proving the properties of logarithmic functions
- Applying the properties of logarithms to solve logarithmic and certain types of exponential equations
- Graphical representation of logarithms

Polynomials
- Understanding relationship between roots/zeros and factors of polynomials
- Using graphical representation to draw conclusions about the behavior of polynomial functions using technology
- Identifying end behavior of a polynomial function and relating it to the concept of a limit as x increases without bound

- Solving polynomial equations using multiple methods
- Introduction to complex numbers
- Introduction to Fundamental Theorem of Algebra
- Regression strand continues

Rational Functions

- Applying knowledge about the behavior of numeric reciprocals to the reciprocals of polynomials
- Using relationship between factored form of numerators and denominators of rational functions and graph
- Using graphical representation to draw conclusions about the behavior of rational functions using technology
- Analyzing rational functions and their key characteristics
- Identifying key characteristics of functions and their reciprocals
- Identifying end behavior of a rational function and relating it to the concept of a limit as *x* increases without bound

Trigonometric Functions

- Understanding concept of trigonometric functions from a circular perspective
- Understanding periodicity as a pattern of change
- Modeling real-world periodic behavior using trigonometric functions and interpreting the results in terms of the application
- Applying knowledge about the behavior of polynomial reciprocals to the reciprocals of trigonometric functions
- Applying knowledge about inverse functions to determine the graphs and characteristics of inverse trigonometric functions
- Solving elementary trigonometric equations
- Developing an understanding of basic trigonometric identities
- Using transformation to analyze phase shift, vertical shift, amplitude, and period of a trigonometric function
- Using graphical representation with appropriate technology, knowing its limitations, and assessing the reasonableness of answers given by technology
- Studying trig values of special angles
- Regression strand continues

SSLs and Outcomes (FA=formally assessed, IA=informally assessed, NA=not assessed):

IA. Students expected to demonstrate automaticity in skills, concepts, and processes that enable complex thought by

- completing weekly problem sets **FA**
- completing daily worksheets **IA**
- engaging in daily collaboration to complete work **IA**

- completing quizzes and tests **FA**

IB. Students expected to construct questions, forge connections and deepen meaning by

- completing daily worksheets **IA**
- completing problem sets **IA**
- completing writing assignments **IA**
- conversing and collaborating with peers **IA**
- contributing to large group conversation **IA**
- solving problems that require a novel compilation of knowledge and skills on quizzes/tests **FA**

IC. Students expected to precisely observe phenomena and accurately record findings

- through data-based/real-world explorations and projects (this is an area that we are currently committed to increasing) **FA**
- by recognizing patterns within mathematical situations and problems

ID. Students expected to evaluate the soundness and relevance of information and reasoning through

- experiments and data analysis (such as light intensity lab or some other similar experience) **FA**
- focused inquiries on weekly Problem Sets which require brief written responses **FA**

IIIA. Students use appropriate technologies as extensions of the mind by

- computing linear regressions of log-log and semi-log situations or generating sinusoidal models and using these models to make predictions **FA**
- exploring mathematical ideas and problem solving using tools such as graphing calculators, Desmos, Mathematica, Excel, etc. **IA**
- producing a technology-generated product, including mathematical equations, graphs and text **FA**
- complete a portion of each week's problem set via WebWorK
- use of web-based resources **IA**

IIIB. Students recognize, pursue, and explain substantive connections within and among areas of knowledge through

- regular participation in both small and large group discussions **IA**
- focused inquiries on weekly Problem Sets which require brief written responses **FA**
- extended expository writing assignments **FA**

IVA. Students construct and support judgments based on evidence by

- making connections and mastering new mathematical ideas via developed concept strands in problem sets **FA**
- completing the light intensity lab **FA**
- exploring mathematical relationships (e.g. factors of polynomials and the behavior of the graph, polynomial and reciprocal functions, trigonometric functions and relationships, etc.), from which they make conjectures, test their hypothesis, and justify mathematically **FA**

IVB. Students will be challenged to write and speak with economy, power, and elegance through

- regular participation in both small and large group discussions **IA**

- focused inquiries on weekly Problem Sets which require brief written responses **FA**
- short answer responses to justify reasoning on quizzes and/or tests **FA**
- writing projects (usually paired activity) in which students explore, explain and formally present a problem and its solution or thorough explanation of an applied concept. **FA**

VA. Students will identify, understand and accept the rights and responsibilities of belonging to a diverse community by

- working collaboratively in groups on a daily basis to explore, discuss, and solve problems, utilizing each others' various strengths **IA**
- engaging in a formally assessed writing project(s) with a partner, which requires a team dynamic for successful completion **IA**

VB. In order for students to make reasoned decisions which reflect ethical standards, and act in accordance with those decisions, students Medium Target

- learn to collaborate in class to learn and solve problems, but produce their own work for assessment **IA**
- collaborate outside of class on assignments in an appropriate manner, modeling their in-class behavior **IA**
- submit written projects via turnitin.com **IA**

Instructional Design and Approach:

The instructional design of *Mathematical Investigations* provides opportunities for students to work collaboratively on a regular basis both in and out of class. Collaboration encourages oral communication, multiple perspectives in problem solving, and self regulation. Carefully crafted and sequenced questions, problems, and applications comprise our problem-centered curriculum, which enables learning through guided discovery. This process requires pattern recognition, mathematical reasoning and visualization, critical thinking, appropriate use of technology and use of multiple representations in building connections within and between mathematical concepts. Regular teacher feedback and ongoing assessment shapes the learning experience for each individual student. The teacher's informal assessment of each student and the class as a whole tailors instruction to immediate need, generates enthusiasm, and insures intended connections. In addition, students are expected to communicate their understandings in writing with clarity, coherence, and mathematical accuracy.
Also integral to the core experience are unique classroom projects that are intermittently incorporated to introduce students to mathematical inquiry, stretching their understandings in new directions and possibly beyond core content. As a result of this carefully structured learning experience, students' abilities to engage in mathematical inquiry, pose questions, and communicate mathematical concepts evolve, inviting creativity in problem solving, application, and further collaboration.

Student Expectations:

All students are expected to

- be involved in class discussions and explorations.
- maintain a notebook containing class notes, homework assignments, Cycle Problem Sets, and other handouts.
- complete all assignments, problems sets and writing assignment(s) in a timely manner.
- take responsibility for learning certain basic skills and relationships.
- take responsibility for seeking additional help as it is needed.
- have a graphing calculator and computer with them during each class.

Assessment Practices, Procedures, and Processes:

- ***Daily worksheets***. Must be completed on a timely basis, usually by the beginning of the next class period.
- ***Problem Sets.*** You are responsible for completing one set per week. The problem sets will be handed out each Tuesday (**B** day) and will be collected the following Tuesday (**B** day), at the beginning of class. Most weeks, a portion of the problem set will be completed via WebWorK, which is due by 5:00 pm on **B** day. If the (paper) problem sets are late the following penalties apply:

Not turned in by class time, but turned in by 4:00 p.m. of the same day	-20%
Not turned in on time, but turned in by noon the following class day	-50%
Turned in later than noon the following class day	-100%

Note: WebWorK does not accept late submissions.

- ***Projects.*** These may be varied in length, and are often designed to be done with a partner. Writing in mathematics is a focus, along with the mathematics involved. A project will replace the problem set 1-2 times per semester for that given week(s). The grade will count in the problem set category.
- ***Quizzes.*** These will usually be short (few problems), and occur 1-2 times per unit. Students may also be quizzed on problem set content.
- ***Exams.*** These will be announced well ahead of time and will be at the end of a unit. There will also be a mid-unit test for Trigonometry. Exams may consist of a calculator-use section, as well as a no-calculator-use section.

Weights of components of the quarter grade:

Notebook	15%
Problem Sets:	20%
Quizzes/Exams:	65%

Weights of components of the semester grade:

1st and 2nd Quarter	80%
Semester Exam	20%

Grading scale:

A = 90% - 100%
B = 80% - 89%
C = 70% - 79%
D = 0 - 69%

Sequence of Topics and Activities

1. Logarithms (*12-14 teaching days*)
2. Polynomials (*16-18 teaching days*)
3. Rational Functions (*9-11 teaching days*)
4. Trigonometry (primarily right triangle) (*24-26 teaching days*)