To Whom It May Concern:

Advanced Topics in Mathematics II* is a math class that was started in the 2006 – 2007 school year at Torrey Pines High School in the San Dieguito Union High School District. The course was created to give advanced students with an interest in math and science an opportunity to take more classes in mathematics and work on independent projects. The majority of the students in the class have completed Calculus III (SDSU Math 252) and Introduction to Linear Algebra (SDSU Math 254) in the previous year as juniors. All of the students in the class have had at least one year of Calculus, many having completed Advanced Placement Calculus BC or Calculus II (SDSU Math 151). The SDSU courses are semester-long classes that I teach in conjunction with San Diego State University.

In Advanced Topics in Mathematics II students complete projects in four categories: advanced math topics, interdisciplinary, community service, and reading and research. Most of the work in this class is done on computers. We primarily use the computer program *Mathematica*. Students work independently or in small groups on projects of their own choosing. Every day several students present their work to the class. Throughout the year students have the opportunity to attend and/or present at local conferences to share the work we are doing with other educators in our community.

The students' projects cover a wide range of interests and ability levels. Some students create projects designed to teach or practice math concepts for students in lower-level classes. For example, some projects review the basics of graphing equations or factoring expressions. Other projects demonstrate math concepts at higher levels such as using three-dimensional graphics to illustrate directional derivatives or the use of matrices for geometric transformations. Many students enjoy using the logic and mathematics of programming in *Mathematica* to design projects that involve music or art while others build modules to model the concepts they are studying in their physics, chemistry, statistics, economics, and social studies classes. Some projects combine mathematics and games.

This class has given students the opportunity to explore a variety of mathematical concepts and applications not traditionally included in the high school curriculum. Through our partnership with San Diego State University, the students in Advanced Topics in Mathematics II have the option to take the class for college credits. In the fall they may enroll in Mathematics Software Workshop (SDSU Math 241) and in the spring it becomes Topics in Mathematics (SDSU Math 118). The following two pages is the course profile written to provide students and their parents a brief outline of what to expect in the class. If you would like more information, please contact me as listed below.

Sincerely,

Abigail S. Brown
Advanced Topics in Mathematics II Teacher
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*Advanced Topics in Mathematics (I) is an older, projects-based course in our records designed for students at a pre-calculus level. We are not currently offering this course on our campus.

Advanced Topics in Mathematics II
Readiness Profile & Course Expectations

Prerequisites: Successful completion of or concurrent enrollment in Calculus AB or BC. Students should *not* take this course instead of Calculus. (Note: Students may take this course without taking Advanced Topics in Mathematics I.)

Below are some guidelines for choosing the best course for an individual student. This is *not* a placement test and it should *not* be used as the only criteria for making placement decisions.

Student Background
Students entering **Advanced Topics in Mathematics II** should *already* have a good understanding of the following concepts:

- Functions (including composite functions, inverse functions, domain, range, etc.)
- Graphing all types of functions in two dimensions. Basic graphing in three dimensions.
- Trigonometry (functions, inverse functions, identities, graphing, unit circle values, etc.)
- Parametric Equations (graphing, converting to and from familiar algebraic forms)
- Basic Calculus (at least an introduction to limits, derivatives, and integrals)
- Vectors (notation, arithmetic, graphing, applications)

Students entering **Advanced Topics in Math II** should also be able to solve problems such as

<u>Example Function Problem</u>: What is the domain of $f(x(t), y(t))$ given $f(x, y) = \dfrac{x^2}{y}, \ x(t) = \ln t, \ \text{and} \ y(t) = \tan t$.	<u>Calculus Problem</u>: Find the derivative of $f(x) = (x-1)^2(x+2)^2$ and use your result to find the equation of the line tangent to $f(x)$ at $x = -1$. Graph the curve and line together.
<u>Graphing Problem</u>: Sketch the graph for each set of parametric equations. Indicate the orientation and state an appropriate domain. $\begin{cases} x(t) = 3t - 4 \\ y(t) = -2t + 5 \end{cases} \quad \begin{cases} x(t) = 3\cos t \\ y(t) = 4\sin t \end{cases}$	<u>Vector Problem</u>: Draw a sketch of an object being pulled by the forces $\mathbf{F}_1 = <1, 5>$ and $\mathbf{F}_2 = <-4, 1>$. Draw the single vector that represents the total force acting on the object? What is the magnitude of this force?

Students entering **Advanced Topics in Mathematics II** are expected to do the following things:

- Keep up with assignments without a daily check from the teacher.
- Work independently and with classmates to solve problems and understand concepts.
- Read mathematical arguments, proofs, and examples.
- Prepare projects inside and outside of class and give presentations in front of peers.
- Solve complex and open-ended problems.
- Develop proofs and write out mathematical arguments for solving problems.
- Connect mathematics to other disciplines (such as physics, economics, or music).
- Think creatively from the perspective of a student and a teacher.
- Participate in community service through project design, testing, and implementation.

Course Content and Expectations
In **Advanced Topics in Mathematics II**, students will learn concepts such as:

- Differential equations, dynamical systems, complex analysis, and discrete math topics.
- Real-world applications of math in science, business, social sciences, and the arts.
- Selecting and using technology for doing and presenting mathematical work.
- Review and study in more depth mathematics concepts covered in prior courses.
- Additional topics and research in modern mathematics.

Textbook: Students will use a variety of materials including books, journals, computer programs, professional connections, and Internet resources.

Students will be expected to spend an average of approximately 1 to 2 hours outside of class on homework, reading, and preparation for each class period. Students will complete approximately six to eight projects each semester. There may be a few traditional tests or quizzes. Grades will be calculated within the following guidelines:
- Projects: 75 – 90%
- Other (Participation, Journal, Quizzes, Small Assignments): 25 – 10%

There may also be activities and assignments such as
- Keeping a learning journal and portfolio throughout the semester.
- Reading books and articles that relate to math and writing reports to share.
- Connecting with professionals in the community.
- Sharing projects and activities with other students, teachers, schools, districts, and community members.

Test Scores
Other indicators of potential success in **Advanced Topics in Mathematics II** include test scores near or above the following values:

- California Standards Tests (CST) for Summative Mathematics: Proficient or better
- Advanced Placement Calculus AB or BC Exam: A score of at least 3 or higher

Other Comments

Advanced Topics in Mathematics II is a projects-based math course where students explore new areas of mathematics as well as reviewing concepts studied in previous courses. Students will also design, research, create, and present interdisciplinary projects using mathematics as it is applied to other fields. Community service will be a significant portion of the course since students will develop projects and activities to be used by other students and teachers in lower-level math classes. Students in Advanced Topics in Mathematics II will learn material specific to their own interests and will be exposed to the concepts their classmates are studying through ongoing class presentations. This course provides students the opportunity to experience mathematics from the perspective of a student, teacher, researcher, scientist, and artist.