Queen Creek High School – AP Calculus AB
Dual Credit Course (CGCC) – Mat 221

Syllabus

Instructor Fred Clare
Phone 480-987-5900 ext 5551
e-mail fclare@qcusd.org
Materials TI-83 or TI-84 graphing calculator or equivalent, 3-ring 1" Notebook, pencil, paper, graph paper

Link to online Help http://www.coolmath.com

Course Outline
By successfully completing this course, you will be able to:

- Work with functions represented in a variety of ways and understand the connections among these representations.
- Understand the meaning of the derivative in terms of rate of change and local linear approximation, and use derivatives to solve a variety of problems.
- Understand the relationship between the derivative and the definite integral.
- Communicate mathematics both orally and in well-written sentences to explain solutions to problems.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Use technology to help solve problems, experiment, interpret results, and verify conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Technology Requirement
I will use a Texas Instrument 83 Plus graphing calculator in class regularly. You will want to have a graphing calculator as well. I recommend the TI-83, TI-84 and the TI-89.
We will use the calculator in a variety of ways including:

- Explorations.
- Graphing functions within arbitrary windows.
- Solve equations numerically.
- Analyze and interpret results.
- Justify and explain results of graphs and equations.

A Balanced Approach
Current mathematical education emphasizes a "Rule of Four." There are a variety of ways to approach and solve problems. The four Branches of the problem-solving tree of mathematics are:

- Numerical analysis (where data points are known, but not an equation)
- Graphical analysis (where a graph is known, but again, not an equation)
- Analytic/algebraic analysis (traditional equation and variable manipulation)
- Verbal/written methods of representing problems (classic story problems as well as written justification of one's thinking in solving a problem-such as on our state assessment)

Below is an outline of topics along with a tentative timeline. Assessments are given at the end of each unit as well as intermittently during each unit. Semester finals are also given.

Unit P: Preparation for Calculus (2 weeks)

A. Graphs and models
B. Linear models and rates of change
C. Functions and Their Graphs
D. Fitting linear models to data

Unit 1: Limits and Continuity (3-4 weeks)

E. Rates of Change
    1. Average Speed
    2. Instantaneous Speed
F. Limits at a Point
    1. 1-sided Limits

2. 2-sided Limits
3. Sandwich Theorem

**A Graphical Exploration is used to investigate the Sandwich Theorem. Students graph $y_1 = x^2$, $y_2 = -x^2$, $y_3 = \sin\frac{1}{x}$ in radian mode on graphing calculators. The limit as x approaches 0 of each function is explored in an attempt to "see" the limit as x approaches 0 of $x^2 \sin\frac{1}{x}$. This helps tie the graphical implications of the Sandwich Theorem to the analytical applications of it.

G. Limits involving infinity
   1. Asymptotic behavior (horizontal and vertical)
   2. End behavior models
   3. Properties of limits (algebraic analysis)
   4. Visualizing limits (graphical analysis)

H. Continuity
   1. Continuity at a point
   2. Continuous functions
   3. Discontinuous functions
      a. Removable discontinuity (0/0 form)

** A tabular investigation of the limit as x approaches 1 of $f(x) = \left(x^2 - 7x - 6\right)/\left(x - 1\right)$ is conducted in groups of 3 or 4. Next, an analytic investigation of the same function is conducted in the groups. Students discuss with their group members any conclusions they can draw. Finally, a graphical investigation (using the graphing calculators) is conducted in the groups, and then we discuss, as a class, whether the group conclusions are verified or contradicted.

      b. Jump discontinuity (We look at y = int (x).)
      c. Infinite discontinuity

I. Rates of Change and Tangent Lines
   1. Average rate of change
   2. Tangent line to a curve
   3. Slope of a curve (algebraically and graphically)
   4. Normal line to a curve (algebraically and graphically)
   5. Instantaneous rate of change
   6.

Unit 2: The Derivative (5-6 weeks)

A. Derivative of a function
   1. Definition of the derivative (difference quotient)
   2. Derivative at a point
   3. Relationships between the graphs of f and f'
   4. Graphing a derivative from data

** A CBL experiment is conducted with students tossing a large ball into the air. Students graph the height of the ball versus the time the ball is in the air. The calculator is used to find a quadratic equation to model the motion of the ball over time. Average velocities are calculated over different time intervals and students are asked to approximate instantaneous velocity. The tabular data and the regression equation are both used in these calculators. These velocities are graphed versus time on the same graph as the height versus time graph.

   5. One-sided derivatives

B. Differentiability
   1. Case where f'(x) might fail to exist
   2. Local linearity

** An exploration is conducted with the calculator in groups. Students graph yl = absolute value of(x) + 1 and y2 = sqrt (x^2 + 0.0001) + 0.99. They investigate the graphs near x = 0 by zooming in repeatedly. The students discuss the local linearity of each graph and whether each function appears to be differentiable at x = 0.

   3. Derivatives on the calculator (Numerical derivatives using NDERIV)
   4. Symmetric difference quotient

5. Relationship between differentiability and continuity
6. Intermediate Value Theorem for Derivatives

C. Rules for Differentiation
   1. Constant, Power, Sum, Difference, Product, Quotient Rules
   2. Higher order derivatives

D. Applications of the Derivative
   1. Position, velocity, acceleration, and jerk
   2. Particle motion.
   3. Economics
      a. Marginal cost
      b. Marginal revenue
      c. Marginal profit

E. Derivatives of trigonometric functions
F. Chain Rule
G. Implicit Differentiation
   1. Differentiation method
   2. y' method

H. Derivatives of inverse trigonometric functions
I. Derivatives of Exponential and Logarithmic Functions

Unit 3: Applications of the Derivative (5-6 weeks)

A. Extreme Values
   1. Relative Extrema
   2. Absolute Extrema
   3. Extreme Value Theorem
   4. Definition of a critical point

B. Implications of the Derivative
   1. Rolle's Theorem
   2. Mean Value Theorem
   3. Increasing and decreasing functions

C. Connecting f' and f'' with the graph of f(x)
   1. First derivative test for relative max/min
   2. Second derivative
      a. Concavity
      b. Inflection points
      c. Second derivative test for relative max/min

A matching game is played with laminated cards that represent functions in four ways: a graph of the function; a graph of the derivative of the function; a written description of the function; and a written description of the derivative of the function.

D. Optimization problems
E. Linearization models
   1. Local linearization

** An exploration using the graphical calculator is conducted in table groups where students graph f(x) = (x^2 + 0.0001)^0.25 + 0.9 around x = 0. Students algebraically find the equation of the line tangent to f(x) at x = 0. Students then repeatedly zoom in on the graph of f(x) at x = 0. Students are then asked to approximate f(0.1) using the tangent line and then calculate f(0.1) using the calculator. This is repeated for the same function, but different x values further and further away from x = 0. Students then individually write about and then discuss with their tablemates the use of the tangent line in approximating the value of the function near (and not so near) x = 0.

   2. Tangent line approximation
   3. Differentials

F. Related Rates

Queen Creek High School – AP Calculus AB
Dual Credit Course (CGCC) – Mat 221

Unit 4: The Definite Integral (3-4 weeks)

A. Approximating areas
   1. Riemann sums
      a. Left sums
      b. Right sums
      c. Midpoint sums
      d. Trapezoidal sums

** Here students are asked to input a program that will calculate trapezoidal sums for trapezoids of equal width. They are given this program. They are encouraged to think about altering it to be able to calculate sums as well.

   2. Definite integrals

** Students are asked to graph, by hand, a constant function of their choosing. Then they are asked to calculate a definite integral from x = -3 to x = 5 using known geometric methods. Students then share their work with their tablemates and are asked to come up with a table observation. Those observations are shared with other tables and a formula is discovered.

B. Properties of Definite Integrals
   1. Power rule
   2. Mean value theorem for definite integrals

** An exploration is conducted to show students the geometry of the mean value theorem for definite integrals and how it is connected to the algebra of the theorem.

C. The Fundamental Theorem of Calculus
   1. Part 1
   2. Part 2

Unit 5: Differential Equations and Mathematical Modeling (4 weeks)

A. Slope Fields
B. Antiderivatives
   1. Indefinite integrals
   2. Power formulas
   3. Trigonometric formulas
   4. Exponential and Logarithmic formulas
C. Separable Differential Equations
   1. Growth and decay
   2. Slope fields (Resources from the AP Calculus website are liberally used.)
   3. General differential equations
   4. Newton's law of cooling
D. logistic Growth

Unit 6: Applications of Definite Integrals (3 weeks)

A. Integrals as net change
   1. Calculating distance traveled (particle motion)
   2. Consumption over time
   3. Net change from data
B. Area between curves
   1. Area between a curve and an axis
      a. Integrating with respect to x
      b. Integrating with respect to y
   2. Area between intersecting curves
      a. Integrating with respect to x
      b. Integrating with respect to y
C. Calculating volume
   1. Cross sections

2. Disc method
3. Shell method

** An exploration is conducted using play-doh to help students visualize solids and made by different cross sections as well as the use of the definite integral to find the volume of these solids.

Unit 7: Review/Test Preparation (time varies, generally 3-5 weeks)

A. Multiple-Choice practice
   1. Test taking strategies
   2. Individual and group practice are both used
B. Free- response practice
   1. Rubrics are reviewed so students see the need for complete answers
   2. Students collaborate to formulate team responses
   3. Individually written responses are crafted. Attention to full explanations is emphasized

Unit 8: After the exam…

A. Projects designed to incorporate this year's learning in applied ways
B. Research projects on historical development of mathematics with a focus on calculus
C. Advanced integration techniques
D. A look at college math requirements and expectations including placement exams

Textbook

Larson, Hostetler, and Edwards. *Calculus of a Single Variable*. Eighth edition. Houghton Mifflin Company, 2006.

This textbook will be our primary resource. You will benefit from reading it. It contains a number of interesting explorations that we will conduct with the goal that you discover fundamental calculus concepts. I will also explain topics in a way that students have found helpful over the years. I encourage cooperative learning, and I believe our entire class benefits from us all working together to help one another construct understanding.

My hope is that you want to learn as much as you can about calculus. Mathematicians have been responsible for many great developments throughout history. Much of our understanding of the universe is a direct result of the contributions of mathematicians. Who knows, I hope you learn to view math as more than just numbers, variable, processes, and algorithms. I hope you learn to apply your mathematical understanding to help create a better understanding of the mathematical nature of our lives.

Grading

Homework, warm-ups	15%
Tests, Quizzes, Projects	65%
Final Exam	20%
	100%

Grading scale		
	89.5%-100%	A
	79.5%-89.4%	B
	69.5%-79.4%	C
	59.5%-69.4%	D
	0%-59.4%	F

Accelerated Math

Accelerated math is a program that I use occasionally to help with the mastery of some of the essential mathematical skills we are learning. In this program if the student does not meet the mastery criteria of 80% or better, he or she must redo the assignment until this criteria is met. When given as a homework assignment there is no penalty for having to redo the assignment but no credit is given until the criteria is met. When given as a quiz there may be a penalty for having to redo the assignment.

Homework

Homework is an important part of any math class and is a determining factor in how well a student performs on tests. Homework will be assigned on a nightly basis and is expected to be turned in the next day. Late work **will not** be accepted and partially completed assignments will not receive full credit.

Queen Creek High School – AP Calculus AB
Dual Credit Course (CGCC) – Mat 221

Attendance

Regular attendance is expected. If you know you will be absent (including school related absences), the work is due prior to the absence. Absences are not a valid reason for being unprepared for class, not turning in assignments on time or for missing a test or quiz. If a student has missed class from an excused absence then they will have two days to turn in any missing work and make-up any missed tests or quizzes. A student may not make up any work resulting from an unexcused absence, please refer to the student handbook for the definition of an excused and unexcused absence.

Tests and Quizzes

There will be a cumulative test at the end of each unit. If a student does not receive a minimum satisfactory grade of a 70% on an exam they are given the option to come in for tutoring and a retake exam before/after school or at lunch. The retake exam will replace the previous exam grade with a 10 % penalty (for example if a student receives a 95% on the retake exam then it will be entered as a 85% in the grade book). A student may only retake a unit test one time.

Cumulative Final

A cumulative final exam will be administered at the end of each semester (see QCHS handbook for final exam schedule). The final exam is worth 20% of the students' final grade.

Cumulative Final for Mat 221

The comprehensive common final exam must be taken. As per Chandler Gilbert Community College, students who score less than 60% on the final exam will receive a grade no higher than a "D" no matter what their grade is going into the final..

Tutoring

Help is available on Tuesday and Thursday from 2:00 – 3:00 as well as other days by appointment.

Math Department Policies

Mission Statement:

The mission of the QCHS mathematics department is to facilitate the growth and development of each student as an actively engaged, responsible, independent learner of mathematics, and the applications thereof.

Instructor Expectations:

- I will do my best to make the course meaningful for every student.
- I will try hard to plan interesting and useful activities and assignments.
- I will strive to provide valuable feedback to you on your work.
- I will be fair in evaluating your work.
- I promise to maintain a positive attitude at all times.
- I will have excellent attendance and begin and end class on time.
- I will be available for individual help.

Student Expectations:

- I expect you to attend every class on time.
- I expect you to be prepared for every class by doing the homework assignments and bringing the required materials.
- I expect you to participate in class activities and discussions
- I expect you to contact the teacher or another student when you are absent to find out your assignments.
- I expect you to be courteous and respectful to the teacher and your classmates and to not distract the educational environment in any way.
- I expect you to maintain a positive attitude.
- I expect you to follow all school rules.

Consequences

1st Offense:	Warning/Conference with student - Documented in student record
2nd Offense:	Parents/Guardian notified
3rd Offense:	Conference/ Meeting with Parent or Guardian
4th Offense:	Written referral/ Parent contact
Severe offence:	Security will remove student immediately. Administrator Conference

Queen Creek High School – AP Calculus AB
Dual Credit Course (CGCC) – Mat 221

Students:
I have read the syllabus and student expectation plan for Mr. Clare's Precalculus Class.
I understand it and will honor it.

_____	_____	_____	_____
Student Name	Student Signature	Date	Hour

Parents:
My Child has discussed the syllabus and student expectation plan with me. I understand it and will support it.

_____	_____
Parent/Guardian Name	Parent/Guardian Signature

_____
Parent/Guardian e-mail

_____
Parent/Guardian e-mail

_____
Parents/ Gaurdian phone

_____
Parents/ Gaurdian phone

_____
Parents/ Gaurdian phone