**AP Calculus MAT 550**

**Resource(s) used:**

**Primary: Calculus – Larson, Hostetler and Edwards, 6th Edition**

**Secondary: Preparing for the (AB) AP Calculus Examination – Best and Lux 2006**

**Secondary: Teacher made material to supplement textbooks**

The main objective of AP Calculus is to provide students with the opportunity to master college level Calculus through a multi-representative approach with concepts, results and problems expressed graphically, numerically, analytically and verbally. Students will employ a *graphing calculator* to aid in computations and visualizations throughout *all lessons* as well as using graphing calculators to aid in experimenting, interpreting results and supporting conclusions. Students are encouraged to purchase a device, but a classroom set will be available for each student. ***Students will use correct vocabulary and terminology when writing or orally communicating in class. Students will learn to describe concepts verbally and in proper notation.*** Connections between concepts will be emphasized and their representations will be studied and practiced. Students will be provided with rigorous daily lessons and additional assistance during times other than class as needed.

***Students will respond to questions and provide oral and written explanations in complete sentences avoiding the use of pronouns.***

*Lessons, Assignments, Sample Quizzes and Sample Tests can be found at the instructor’s website.*

**Course Syllabus**

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| **Lesson** | **Topic(s)** | **Description** |
| **1** | Graphs, Intercepts, Symmetry and Intersection Points | **Students will us a graphing calculator to investigate and verbally describe the concepts: Intercepts, slope, symmetry and intersection points via graphs and LISTS of coordinates** |
| **2** | Slope, Parallel and Perpendicular Lines | **Students learn to adjust WINDOWS to model business problems, interpret how the previously learned concepts apply (in appropriate units of measure) and how to use the calculator to make predictions.** |
| **3** | Functions: Domain, Range, Notation, Composition, Types of Functions and Transformations of Functions | **Students will investigate the concept of a function using real world relationships, for example: {Mothers} to {Sons} versus {Sons} to {Mothers} and determine if a functional relationship is possible and/or a 1-to-1 functional relationship. The class will also be given numeric data sets via lists, spreadsheets and scatterplots and asked to explain if a functional relationship exists and if the relationship constitutes a 1-to-1 function.**  **Students describe the concept of a function in their own words. Types of functions are graphed by hand and on calculators. Compositions are investigated using VARS menu.** |
| **4** | Even and Odd Functions | **Students utilize the REGRESSION capabilities of a graphing calculator to best represent data and make predictions.**  **Students will be asked to determine if any outliers exist. If so, eliminate and recalculate using the appropriate regression type.** |
| **5** | The Tangent Line, Area | **Computer programs are used to investigate the connection between limits and the slope of a secant line versus the slope of a tangent line. Riemann Sums are introduced intuitively.** |
| **QUIZ** |  |  |
| **6** | Limits | **Limits are studied algebraically and graphically. Discontinuities introduced intuitively.** |
| **7** | Basic Limits |  |
| **8** | Squeeze Theorem and Special Limits |  |
| **9** | Continuity at a Point, One Sided Limits | **“Holes” and asymptotes are investigated on the graphing calculator.** |
| **10** | Continuity on a Closed Interval, Intermediate Value Theorem | **Students describe real life situations for which the Intermediate Value Theorem applies.** |
| **11** | Infinite Limits, Vertical Asymptotes |  |
| **TEST** |  |  |
| **12** | Derivatives |  |
| **13** | Differentiation Rules | **Students estimate derivatives by drawing tangents to a curve.** |
| **14** | Average Rate of Change | **Students estimate average rate of change by drawing secants to a curve.**  **Students verbalize, in written sentences the scenario interpreted from graphs of position and velocity functions.** |
| **15** | Product Rule, Quotient Rule, Derivatives of Trigonometric Functions |  |
| **16** | Higher Order Derivatives | **Students explore the relationship between position, velocity and acceleration.** |
| **QUIZ** |  |  |
| **17** | Chain Rule | **Students explore the chain rule through business and physical models.** |
| **18** | Implicit Differentiation | **Students see the connection between the chain rule and implicit differentiation.** |
| **19** | Related Rates |  |
| **20** | More Related Rates Problems | **Students solve real world problems applying implicit differentiation.**  **Students will translate information given in words to function notation and symbolic form, such as *dx/dt* and translate mathematical notation into words.** |
| **TEST** |  |  |
| **21** | Extrema on an Interval, Critical Numbers | **Students must be able to explain the concept of extrema and utilize the graphing calculator to visualize the concept.** |
| **22** | Mean Value Theorem for Derivatives, Rolle’s Theorem | **Students will create graphs of functions for which the MVTD applies and functions for which it does not.**  **They will explain which of the suppositions are satisfied and which are not. Students will understand Rolle’s Theorem as a corollary to the MVTD.** |
| **23** | Increasing and Decreasing Functions, First Derivative Test | **Students will explain how to determine when a function is increasing or decreasing analytically and verify with a graphing calculator. Students will explain orally why the First Derivative Test can be used to determine relative min or max.** |
| **24** | Concavity, Inflection Points and the Second Derivative Test | **Students will utilize the *graphing calculator* to graph functions and their 1st and 2nd derivatives. They will observe when a function is increasing or decreasing and when it is concave up or down and how this is related to the derivatives.** |
| **25** | More with Inflection Points and Concavity |  |
| **QUIZ** |  |  |
| **26** | Limits at Infinity, Horizontal Asymptotes | **Students will evaluate limits at infinity and verify with a graphing calculator.** |
| **27** | Curve Sketching |  |
| **28** | Optimization | **Students will apply the concepts learned to solve business and real world problems.** |
| **29** | Differentials | **Students will use differentials to estimate calculations and propagation of errors.** |
| **30** | Business Applications of Optimization |  |
| **TEST** |  |  |
| **31** | Antiderivatives, Integration | **Students will see how integration is the inverse of differentiation and use the graphing calculator to visualize a “family of functions”.** |
| **32** | Finding Particular Solutions | **Students will use integration to determine how far a car will travel after braking (decelerating at a constant rate.) Students learn how far a car travels per second at different rates in mph.** |
| **33** | Area, Summation Formula | **Students use mathematical induction to probe summation formulas. Students utilize SUMMATION feature of graphing calculator.** |
| **34** | Estimating Area with Rectangles |  |
| **QUIZ** |  |  |
| **35** | Riemann Sums |  |
| **36** | Fundamental Theorems of Calculus  Mean Value Theorem for Integrals  Average Value of a Function | **Students will compute *F’(x)* with and without FTC for given examples.**  **Students will graph *F’ (x)* on a graphing calculator employing the derivative capabilities.**  **Students must explain the connection between the MVTI and the formula for Average Value of a Function**  **Students work collaboratively in small groups to determine the initial velocity of rockets launched from the ground (by the Physics class) using only a stopwatch.** |
| **37** | Integration by Substitution |  |
| **38** | u-Substitution, Change in Variables, Trapezoidal Rule |  |
| **TEST** |  |  |
| **39** | The Natural Logarithmic Function | **Students solve interest problems and utilize the graphing calculator to discover properties of base *e*.** |
| **40** | Logarithmic Differentiation and L’Hopital’s Rule |  |
| **41** | ln x and Integration |  |
| **QUIZ** |  |  |
| **42** | Inverse Functions | **Students utilize the DRAW feature of the graphing calculator.** |
| **43** | Derivatives of Inverse Function |  |
| **44** | Exponential Functions, Derivatives and Integration | **Students use the CALC and DERIV features of the graphing calculator and compare results.** |
| **45** | Derivatives Base a | **Students use the change of base formula for log’s and derive derivative formulas for any base.** |
| **46** | Integration Base a | **Students use the change of base formula for log’s and derive integration formulas for any base.** |
| **47** | Differential Equations, Exponential Growth and Decay | **Students use exponential models to solve real-world problems. Students will work collaboratively to find the time of death in a murder investigation utilizing Newton’s Law of Cooling.** |
| **48** | Differential Equations, Separation of Variables |  |
| **49** | Inverse Trigonometric Functions | **Students will graph inverse trig functions by hand and with the graphing calculator.** |
| **50** | Derivatives of Inverse Trigonometric Functions |  |
| **51** | Inverse Trig and Integration |  |
| **TEST** |  |  |
| **52** | Area Between Curves | **Students will utilize the graphing calculator to find intersection points and area between curves.** |
| **53** | Volume by Discs and Washers | **Students use folding party decorations to aid in visualizing how volumes by rotations are formed from revolving areas under a curve about an axis.** |
| **54** | Volume by Cylindrical Shells |  |
| **54b** | Volume by Cross-Section | **Students will explain derivation of volume formulas.** |
| **QUIZ** |  |  |
| **55** | Arc Length |  |
| **56** | Surface Area | **Students will explain derivation of surface area formula using arc length formula.** |
| **57** | Work |  |
| **58** | Work, Gravity and the Inverse Square Law | **Students will compute work necessary to propel objects off the surface of earth and the moon.** |
| **59** | Work Done by Pumps |  |
| **60** | Basic Integration Rules |  |
| **61** | Integration by Parts |  |
| **----------** | **-------------- AP EXAM ------------** | **--------------------------------------------------------------------------------------------------** |
| **62** | Review of Trigonometry and Power Reducing Formulas |  |
| **63** | Trigonometric Integrals, Powers of Sine and Cosine |  |
| **64** | Trigonometric Integrals, Powers of Secant and Tangent Quiz |  |
| **65** | Trigonometric Substitution |  |
| **66** | Partial Fraction Decomposition |  |
| **67** | Improper Integrals |  |
| **TEST** |  |  |
| **68** | Sequences |  |
| **69** | Bounded Sequences |  |
| **70** | Series and Convergence |  |
| **71** | Geometric Series, Integral Test |  |
| **72** | p-Series, Harmonic Series, Direct Comparison Test |  |
| **QUIZ** |  |  |
| **73** | Limit Comparison Test |  |
| **74** | Ratio Test, Root Test |  |
| **75** | Power Series and Taylor Series |  |