**Calculus II**
(Integral Calculus)
**Detailed Syllabus**

**Mathematics**

- Integrals defined as area measurement as done in E. Artin's MAA notes written in the 1950's. Approximations by trapezoids.
- If f[t] is given by f[x] = g[t] dt, then f'[x] = g[x].
- The fundamental formula f[x] - f[a] = f'[t[dt]].
- Measurements based on slicing and accumulating
- Area and volume; density and mass.
- Measurements based on approximating and measuring
- Arc length.
- Measurements based on the fundamental formula:
- Accumulated growth.
- Using the chain rule and the fundamental formula to see why f'[u[x]] u'[x] dx = f'[u] du and using this fact to transform one integral into another.
- Measuring area under curves given parametrically.
- Bell shaped curves and Gauss's normal probability law; mean and standard deviation.

**Science and Math Experience**

- Integrals of functions given by data lists.
- Using known area formulas for triangles, trapezoids and circles to calculate integrals.
- Odd functions.
- Trying to break the code of the integral by taking selected functions g[x], putting f[x] = g[t] dt and plotting (f[x + h] - f[x])/h and g[x] on the same axes for small h's.
- Plotting f[x] = cos[t] dt and guessing a formula for f[x]. Plotting f[x] = sin[t] dt and guessing a formula for f[x].
- Estimating the acreage of farm field bordered by a river.
- Relating distance, velocity and acceleration through the fundamental formula.
- Getting the feel of the fundamental formula by using it to calculate integrals by hand. Relating g[t] dt to the solution of the differential equation y'[x] = g[x] with y[a] = 0.
- Very brief look at the "indefinite integral", g[x] dx.
- Measuring area between curves.
- The error function, erf[x], and other functions defined by integrals.
- Measurements of accumulated growth.
- Coloring ceramic tiles.
- Volumes of solids with no special emphasis on solids of rotation.
- Volume measurements of curved tubes and horns.
- Eyeball and precise estimates of curve lengths.
- Filling water tanks.
- Harvesting corn.
- Voltage drop.
- Another look at linear dimension.
- Work.
- Present value of a profit-making scheme.
- Catfish harvesting.
- Designing an 8 fluid ounce logarithmic champagne glass.
- Study of the error function, erf[x].
- Using transformations to explain Mathematica output.
- Polar plots and area measurements.
- Using transformations to explain the meaning of standard deviation in Gauss's normal law.
- Expected life of light bulbs and how long to set the guarantee on them.
- Using Gauss's normal law to help to program coin-operated coffee machines.
- IQ test results.

- Using Gauss's normal law to organize SAT scores into quartiles and deciles.
- Comparison of 1967 and 1987 SAT scores.
- "Grading on the curve."

### Mathematics

- Meaning of the plot of z = f[x,y].
- The 2D integral f[x,y] dx dy as a volume measurement via slicing and accumulating. Gauss-Green formula (Green's theorem) as a way of calculating a double integral numerically as a single integral.
- Separating the variables and integrating to get formulas for the solutions of some differential equations. Integration by parts.
- Complex numbers and the complex exponential es+it = e s (Cos[t] + i Sin[t]).
- Undetermined coefficients.
- Complex numbers and partial fractions.
- Wild card substitutions with the help of a trigonometric, hyperbolic or ad hoc function.
- Integration by parts.

### Science and Math Experience

- Volume and area measurements with 2D integrals.
- Area and volume measurements via the Gauss-Green formula.
- Average value and centroids. Calculation strategies.
- Plotting and measuring. Gauss's normal law in 2D and using it, as done in the Pentagon, to decide how many bombs to drop on a target.
- Formulas for the solutions of the differential equations involved in the chemical model and the spread of infection model.
- Hyperbolic functions and their relation to trigonometric functions.
- Using the complex exponential to help to understand the Mathematica output from the Solve instruction. Gamma function.
- Integration by parts and integration by iteration.
- Error propagation in forward iteration.
- Error reduction by backwards iteration

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**All Distance Calculus courses are offered via the Computer Science and Mathematics Department**
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