Math 252: Integral Calculus **(4-0-4)** 05/14/18

Catalog Description: Computational techniques for and applications of the definite and indefinite integrals.

Course Objectives: After completing this course, students will be able to

1. Evaluate indefinite and definite integrals.
2. Use definite integrals to solve application problems.
3. Use various integration techniques to evaluate integrals.
4. Communicate mathematical ideas using correct and appropriate notation.

Learning Outcomes and Performance Criteria

1. Apply mathematical concepts and principles to perform computations.
   Core Criteria:
   (a) Compute the anti-derivative of a basic form (linear combinations of x^n for any rational n, $\sin(kx)$, $\cos(kx)$ and e^{kx}) without use of formulas.
   (b) Compute an anti-derivative like those in (a) but which requires a step of algebraic manipulation prior to integration.
   (c) Compute an anti-derivative using u-substitution.
   (d) Compute an anti-derivative using integration by parts.
   (e) Compute an anti-derivative using partial fractions, for a quadratic denominator without repeated linear factors.
   (f) Compute an anti-derivative requiring one substitution with a trigonometric identity.
   (g) Using trigonometric substitution, evaluate an integral containing one of the forms $a^2 + x^2$, $a^2 - x^2$, $x^2 - a^2$.
   (h) Given an integral, determine an appropriate method of integration.
   (i) Use a given initial value to find the constant of integration.
2. Understand the theory of definite integrals.
   Core Criteria:
   (a) Approximate a definite integral using a finite sum of areas of rectangles.
   (b) Use a graph of a function $y = f(x)$ to determine the value of a definite integral, $\int_a^b f(x)\,dx$.
   (c) Use the Fundamental Theorem of Calculus to differentiate an integral of the form $\int_a^x f(t)\,dt$.

Additional Criteria:

(d) Apply properties of definite integrals to evaluate integrals of arbitrary functions with given definite integrals.

(e) Express a definite integral as a limit of sums or vice-versa.

(f) Compute a definite integral using a limit of sums.

(g) Use the Fundamental Theorem of Calculus to differentiate an integral of the form $\int_{g(x)}^{h(x)} f(t)\,dt$.

3. Compute definite integrals; use definite integrals to solve applied problems.

Core Criteria:

(a) Use the Fundamental Theorem of Calculus to evaluate a definite integral.

(b) Use a definite integral to find the area between two curves.

(c) Set up an integral representing the volume of a solid of revolution about a coordinate axis, using both the washer and shell methods.

(d) Set up an integral representing the length of a curve.

(e) Set up an integral representing an amount of work or a hydrostatic pressure.

(f) Use u-substitution to compute a definite integral, including changing the limits of integration.

Additional Criteria:

(g) Evaluate an improper integral of the form $\int_a^\infty f(x)\,dx$

(h) Approximate the solution of an applied problem from given data values using some sort of numerical integration.

(i) For an integral expression representing a physical quantity, give the units of any part of the expression, including the entire integral.

(j) Set up an integral representing the area of a surface of revolution.

(k) Find the average value of a function in the context of an application.

(l) Compute the distance traveled and displacement from a velocity function.