**Colorado Technical University**

**Course:** MATH205 – Differential Calculus

## Unit 10 Parts 19, 20 Readings – Applications of Integration

## Applications of Integration

## Trick 0: come up with an equation involving dy/dx (y and x will be the variables you are

## interested in)

## Trick 1: split the dy and dx into two sides of the equation

## Trick 2: integrate both sides

## Trick 3: combine the “c”s

Trick 4: use any known values (like at t=0) to find a value for c

## Useful EE Formulas

(thank you, Stephen Yim!)

|  |  |
| --- | --- |
| v(t) = dw/dq v(t) is the voltage (volts) w is the energy (joules) q is the charge (coulombs)i(t) = dq/dt i(t) is the current (amps) t is the time (sec)ic = C dv/dt  ic is instantaneous capacitor  current in amps C is capacitance in farads (F) | p(t) = dw/dt  = (dw/dq)(dq/dt) = v(t)×i(t)p(t) is the power in joules/sec or wattsvcoil = N dw/dt  vcoil is the instantaneous coil voltage (in volts) N is the number of primary turnsVL = L di/dt  VL is the instantaneous inductor voltage L is the inductance in henrys (H) |

#### Average Value of a Function

yavg = *∫ab*ƒ(x)dx/(b  a) WolframAlpha: average (your function) over x= (your limits)

**Arc (Curve) Length**

S = *∫ab* $\sqrt{1+(dy/dx)^{2}}$ dx WolframAlpha: length of (your function) over x= (your limits)

**Probability**

Every continuous random variable has a probability density function (pdf)

Probability density functions satisfy these 2 conditions:

1) f(x)≥0 for all x (no negative probabilities)

2) The integral over the entire domain is 1 (the sum of probabilities for all possible

 values of x is 100%)

To evaluate the probability over an interval, integrate the pdf over that interval

Note: for a continuous distribution, the probability of any specific single value is 0

**Hydrostatic Force**

Submerge a vertical plate in water

How much force is exerted on the plate by the pressure of the water?

This force is called the hydrostatic force (F)

The hydrostatic force is: w*∫cd* h(y)L(y) dy

where w is the weight density of the fluid (for water: 9800 N/m3 or 62.4 lbs/ft3)

h(y) is the depth of the plate

L(y) is the width of the plate

This is one of those horizontal integrations - that’s because the variation is in depth (vertical)

**Center of Mass (Centroid)**

The center of mass or centroid of a region is the point in which the region will be perfectly

balanced if suspended from that point

The center of mass of a thin plate with uniform density ρ will be a pair of (x,y) coordinates

designated x̅ and y̅

Suppose that the plate is the region bounded by the two curves f(x) and g(x) on the

interval [a,b]

We want to find the center of mass of the region

First, we need the mass of this plate: M = ρ(Area of plate) = ρ *∫ab*ƒ(x) – g(x) dx

Next, we need “moments”

There are two moments, denoted by Mx and My

The moments measure the tendency of the region to rotate about the x and y-axis

respectively

The moments are given by:

 Mx = ρ *∫ab* ½ (ƒ(x)2 – g(x)2) dx

 My = ρ *∫ab* x(ƒ(x) – g(x)) dx

The coordinates of the center of mass are given by:

x̅ = My/M = *∫ab* x(ƒ(x) – g(x)) dx /*∫ab*ƒ(x) – g(x) dx

y̅ = Mx/M = *∫ab* ½ (ƒ(x)2 – g(x)2) dx /*∫ab*ƒ(x) – g(x) dx

WolframAlpha widgets for these calculations:

x̅: https://www.wolframalpha.com/widgets/view.jsp?id=801ca6de07ccb371bb5cba5619d3af67

y̅: https://www.wolframalpha.com/widgets/view.jsp?id=a081ff8464e718bda98f82a9793f93ba

