# Math 124: Calculus I - Dr. Andy Loveless

Essential Course Info

| | |
|---|---|
| My Course Website: | math.washington.edu/~aloveles/ |
| Homework Log-In (use UWNetID): | webassign.net/washington/login.html |
| Directions for Webassign code purchase: | math.washington.edu/webassign |
| Math Department 124 Course Page: | math.washington.edu/~m124/ |

First week to do list

1. Read 10.1, 2.1, 2.2, and 2.3 of the book. Start attempting HW.
2. Print off the "worksheets" and bring them to quiz sections.

*Today*

- Syllabus/Intro
- Section 10.1
  - lines/circles
  - parametric motion
  - review

1st HW assignments

Closing time is always 11pm.

- 10.1 closes Oct 2 (Mon)
- 2.1 closes Oct 4 (Wed)
- 2.2, 2.3 close Oct 6 (Fri)

Expect 8-10 hrs of work,
10.1 and 2.1 take longer, start today!

**What we will do in this course**:
We learn the basic tools of differential calculus which provide the essential language for engineering, science and economics. Specifically,

1. **Ch. 2 – Limits and tangents**,
   *Foundation of ALL calc. concepts*
   - $\lim\limits_{h\to 0} ??$, $\lim\limits_{x\to\infty} ??$, $\frac{f(x+h)-f(x)}{h}$

2. **3.1-6, 10.1-2 – Derivative Rules**
   *Key mechanical skills*
   - Product, quotient, chain
   - Implicit, parametric, logarithmic
   - Notation

3. **3.9-10, Ch. 4 – Some Applications**
   - Related Rates
   - Max/Min
   - Curve Sketching

4. **Practicing Algebra, Trig and Precalc**
   Students often say: The hardest part of calculus is you have to know all your precalculus, and they are right.

   Improving your algebra, trig and precalculus skills will be one of the best benefits you will gain from this course (arguably as valuable as the course content itself). You will use these skills often in your other courses at UW.

## Circles/Lines/Tangents and
## 10.1 Parametric Equation Intro

**Circles:** The equation describing the points $(x, y)$ on the edge of a circle with center $(x_c, y_c)$ and radius $r$ is

$$(x - x_c)^2 + (y - y_c)^2 = r^2.$$

*Example* (you do)*:*

Give the equation of the circle centered at (2,0) of radius 5. Then answer these questions:

- Is (-1,4) on this circle?
- Is (4,3) on this circle?

**Lines**: The equation describing the points $(x, y)$ on the line through $(x_0, y_0)$ with slope $m$ is

$$y = m(x - x_0) + y_0$$

*Example* (you do):

Find the equation of the line through (-1,4) and the center of the circle from the previous example.

(we call this a *radial* line for the circle)

**Tangent Lines:** A tangent line to a curve at a point is a line that "just touches" the curve at that point (a more precise definition is coming in chapter 2).

In the case of a circle, the tangent line will always be perpendicular to the radial line at that point.

**Key fact: Perpendicular lines have negative reciprocal slopes.**

*Example* (you do):
Find the equation of the tangent line to the circle of the previous examples at (-1,4).

*An circle/line/tangent application*
(just like HW)
Find points on the *unit* circle at which the tangent line also passes through the point (3, 4).

## *10.1 Parametric Equation Basics*

We often need parametric equations when applying our calculus concepts to motion problems this term. So there are a few introductory exercises mixed into the first two homework sets.

*Parametric Equations* are any set of equation of the form x = x(t), y = y(t).

***Basic Example 1:*** *Linear Motion*

$$x = x_0 + v_x t$$

$$y = y_0 + v_y t$$

$$(x_0, y_0) = \text{initial location}$$

$$v_x = \text{horizontal velocity} = \frac{\Delta x}{\Delta t}$$

$$v_y = \text{vertical velocity} = \frac{\Delta y}{\Delta t}$$

*Example:* The location of a bug on the *xy*-plane after *t* seconds is given by

$$x = 1 + 2t \quad , \quad y = 3t$$

*You do*:

Plug in t = -1, t = 0, t = 1, and t = 2.

Plot these points in the xy-plane

***Basic Example 2:*** *Circular Motion*

$$x = x_c + r\cos(\theta_0 + \omega t)$$
$$y = y_c + r\sin(\theta_0 + \omega t)$$
$$(x_c, y_c) = \text{center of circle}$$
$$r \quad = \text{radius of circle}$$
$$\theta_0 \quad = \text{initial angle}$$
$$\omega \quad = \text{angular speed} = \frac{\Delta\theta}{\Delta \mathrm{t}}$$

*HW Note*: Plot points and use these skills on problems 3, 4, 5 of 10.1 HW and 7,8 of 2.1 HW.

*Example:* The location of an ant on the xy-plane after *t* seconds is given by

$$x = \qquad 2\cos\left(\frac{3\pi}{2} + \frac{\pi}{2}t\right)$$
$$y = 3 + 2\sin\left(\frac{3\pi}{2} + \frac{\pi}{2}t\right)$$

*You do*:

Plug in t = 0, t = 1, t = 2, t = 3, and t = 4.

Plot these points in the xy-plane.