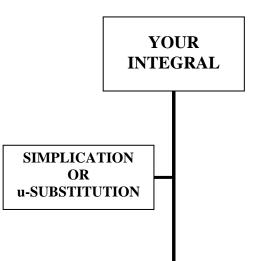# INTEGRATION TECHNIQUES

This review of integration techniques is in no way complete. It is vital for your success that you attempt a large number of problems from the text (even more than are assigned). There is no substitute for practice and experience. I hope that this guide helps you organize your studying.

We have 20 integrals we can do in one step (see page 484 of the text). If your integral is not on this list, then you need to some simplifying method. The first thing you should do is look for any possible substitutions or algebraic simplifications. Then you should try one of our four new methods. These methods, and when to choose them, are illustrated below:

```
              ┌─────────────────┐
              │      YOUR       │
              │    INTEGRAL     │
              └─────────────────┘
                       │
       ┌──────────────────────────┐
       │      SIMPLICATION        │
       │           OR             │
       │     u-SUBSTITUTION       │
       └──────────────────────────┘
                       │
   ┌───────────┬───────────────┬───────────┐
```

Products, log's, inverse trig	sin's, cos's, tan's, sec's	$a^2 - x^2$, $x^2 + a^2$, $x^2 - a^2$ or if quadratic doesn't factor	rational functions where the bottom factors
INTEGRATION BY PARTS	**TRIG. INTEGRALS**	**TRIG. SUBSTITUTION**	**PARTIAL FRACTIONS**
u = dv = du = v = If you're stuck on choosing u remember LIPET. (But after you get comfortable with this method, you shouldn't need LIPET anymore)	1. Odd cos → u = sin(x) 2. Odd sin → u = cos(x) 3. Even sec → u = tan(x) 4. Odd tan → u = sec(x) 5. Even sin & cos → Half Angle Identities In the first 4 cases you need the identities: $\sin^2(x) = 1 - \cos^2(x)$ $\cos^2(x) = 1 - \sin^2(x)$ $\tan^2(x) = \sec^2(x) - 1$ $\sec^2(x) = \tan^2(x) + 1$ For the 5th case, you need the half angle identities: $\sin^2(x) = (1 - \cos(2x))/2$ $\cos^2(x) = (1 + \cos(2x))/2$ $\sin(x)\cos(x) = \sin(2x)/2$	If the quadratic has a linear term (`middle term') and it doesn't factor, then you need to complete the square. (1/2 of middle term, square, add and subtract value) The rest of the method follows by making the correct substitution. $x = a \sin(\theta)$ $x = a \tan(\theta)$ $x = a \sec(\theta)$ At the end, draw and label the TRIANGLE to get back to x's.	Divide if the power of top is bigger than power on bottom. Then factor the bottom and set up and solve the partial fraction decomposition. Distinct Linear Factors → Determine a constant for each factor. Non-Distinct Linear Factors → Determine a constant for each factor, along with each power from 1 up to the number of times repeated. Irreducible Quadratic Factor → Complete the square, the numerator of the factor is Ax+B.