Name : ______________________________

# Homework #3 (in-class)

## Math 566, Spring 2014

Wednesday April 9, 2014

You may use your course notes, and books, and discuss problems with each other. But please, no help from the internet, or anyone outside of class. Each of you should turn in your own work.

Please turn in your completed assignment to the math office by 5PM, Wednesday 4/9. If you have questions during the assignment, you can text me at (208) 297-8862.

1. Show that that region of absolute stability for the trapezoidal method is the half plane Re $z < 0$. **Hint:** Use the Euler formula, $e^{i\theta} = \cos(\theta) + i\sin(\theta)$

2. Formulate a linear difference equation based on the second order BDF method (page 175 in the coarse textbook) for the initial value problem

$$u'(t) = 0, \qquad u(0) = 1.$$

   Use as your initial conditions $U^0 = 1$ and $U^1 = 1 + k$, where $k$ is the time step. Solve this linear difference equation and show that the solution converges to the true solution $u(t) = 1$ as $k \to 0$.

3. Show that for a first order LMM,

$$\pi(e^z; z) = O(z^2). \tag{1}$$

4. Generliazing (1) to $p^{th}$ order accurate LMMs, we have

$$\pi(e^z; z) = O(z^{p+1}). \tag{2}$$

   How does this result help determine the stability region for an LMM, if we only know the boundary of the region?

5. Show how you might go about demonstrating the more general result in (2). You do not have to work through the details, but you should be able to easily write down what you *would* do.