

# NOTES FOR THE FIRST HOUR EXAM

## Spring 2012

The first hour exam will be held in the normal classroom on Monday, 27 Feb starting at the normal time of 9 : 20. The exam will be closed book, closed note, closed laptop, and no electronic devices (calculators, phones, computers) will be allowed during the exam. I will provide a sheet of useful formulae/results (such as the divergence theorem,  $\epsilon$  -  $\delta$  relationship) so that you will not need to memorize equations. I will expect that you will be able to do simple integrals (polynomials, simple trig functions, etc).

On the exam, you will be expected to :

- Prove vector identities using only Einstein summation notation. If I ask a question like this (and I will ask a question like this) you must use only summation notation, and not rely on explicit summation signs or writing out explicit components.
- Use the Levi - Civita permutation tensor and Kronecker delta.
- Calculate gradients, divergence and curls of scalar and vector valued functions in Cartesian and other coordinate systems.
- Apply the theory of functions for conservative fields.
- Find scale factors and unit vectors for a coordinate system given the transformation equations.
- Find the expressions for velocity and acceleration given coordinate vectors.
- Use Newton's Laws and vector calculus to show basic results in celestial mechanics.

There will be a Mathematica based question on the exam. This could involve writing a short program utilizing the Mathematica functions we have studied in lab and you have used on homeworks, or could involve correcting a series of Mathematica statements that I provide.