A ATM 316: Dynamic Meteorology I, Fall 2014

*Section references: **HH** = Holton and Hakim, **MP** = Marshall and Plumb, **M** = Martin*

1) Introduction and motivation *(HH1.1, MP0)*
2) Review of mathematical tools *(M1, HH1.5)*
   a) vectors and vector operations
   b) partial derivatives
   c) Taylor Series approximation
   d) vector derivatives: gradient, divergence and curl
   e) kinematics of flow field: divergence / convergence, vorticity, deformation
   f) the definite integral in one variable
3) Forces in the atmosphere *(HH1.2, MP6.2.1, M2.1)*
   a) Pressure and pressure gradient force
   b) Viscous force
   c) Gravitational force
4) Equation of motion for a non-rotating fluid *(MP6.1-3, HH2.1-2, 2.5, M1.2.4, M3.2.2)*
   a) Differentiation following the motion
   b) Material derivative of a vector field
   c) Momentum equations for non-rotation fluid
   d) Continuity equation
   e) Scale analysis: hydrostatic balance
5) Equation of motion for a rotating fluid *(MP6.6, HH1.3, M2.2)*
   a) Radial inflow lab
   b) force balance in inertial versus rotating reference frame
   c) transformation into rotating coordinates
   d) Solid Body Rotation tank experiment
   e) gravity and geopotential
   f) Coriolis force
   g) Inertial oscillations
6) Equation of motion on the sphere *(HH2.3, MP6.6.5-6, M3.2.1)*
   a) Spherical coordinates
   b) Centrifugal force, geopotential surfaces and modified gravity on a sphere
   c) Components of the Coriolis force on the sphere
   d) Acceleration terms in spherical coordinates
   e) Effects of curvature terms
7) Balanced flow *(HH3.1-2, MP7.1, M4.1, M4.4)*
   a) Governing equations in isobaric (pressure) coordinates
   b) Natural coordinates
   c) Geostrophic balance
   d) Cyclostrophic and gradient wind balances
8) Vertical structure of rotating fluids (MP7.2-3, HH3.4, M4.3)
   a) The Taylor-Proudman theorem, Taylor columns in the tank
   b) Barotropic vs. baroclinic fluids
   c) Thermal Wind equation; Thermal Wind in the tank
   d) Meteorological application of thermal wind concept