FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF GEOGRAPHY

FIRST SEMESTER 2013/2014 SESSION UNDERGRADUATE EXAMINATION

COURSE CODE: MET 515 (3 Units)
COURSE TITLE: Numerical Models in Weather Prediction
INSTRUCTIONS: Answer any 4 questions

TIME ALLOWED: 2½ Hours

1. Given the Hydrostatic Equation

$$\frac{\partial p}{\partial z} = -\rho g$$

and the Equation of State

$$PV = RT$$

Derive the equation for the geopotential height and explain how the equation is used in the determination of constant pressure levels in the atmosphere.

2. Given that

$$\nabla = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z} \right) and$$

$$\vec{V} = (u, v, w)$$

Derive the expression for:
i. The Curl of rotation
ii. The Divergence of fluids

3. Describe the practical steps for the graphical computation of kinematic vorticity.

4. Given that

$$\zeta_r = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}, and$$

for geostropic wind approximation

$$u_g = -\frac{1}{\rho f} \frac{\partial p}{\partial y}; and$$

$$v_g = \frac{1}{\rho f} \frac{\partial p}{\partial x}$$

i. Derive the equation for Geostropic Vorticity (ζ_g)
ii. Name the zone of the earth it is used and why it is peculiar to that zone.

5.   Explain the steps for the graphical estimation of Geostropic Vorticity.

6.   Describe and discuss the Baroclinic Model of the atmosphere and explain how it is used in determining the strength of circulation in bad weather system