FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOGRAPHY

FIRST SEMESTER 2015/2016 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 that

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

$$u_g = -\frac{1}{\rho f}\frac{\partial p}{\partial y} \text{ ...and... } v_g = \frac{1}{\rho f}\frac{\partial p}{\partial x}$$

Derive the expression for Geostropic Vorticity ($\zeta_g$) and explain where the two versions of vorticity equations are generally used.

2. (a) Discuss the Lagrangian and Eulerian derivatives and their relationships in the field of weather forecast.
(b) Explain, giving reasons, which, between the Lagrangian and Eulerian derivatives is more useful in short period weather forecasts.

3. Given a gridded field (as shown in the sketch below) and the values of temperature at the grid intersections:
$T(i,j)$=35, $T(i+1, j)$=38, $T(i, j+1)$=37, $T(i-1, j)$=37, $T(i, j-1)$=39


A wind of 30ms$^{-1}$ blows from 60° bearing direction.
Use Centred-Finite Differencing method in calculating the value of $T(i,j)$ after one hour
(*Taking* $dx=dy=2.22 \times 10^5 m$)

4. Explain how the *Duct, Bridge and Drift* pressure-wind patterns are used in forecasting of weather in East Africa.

5. Explain the Convective Non-Hydrostatic Model and the conditions which will necessitate its use in forecasting local weather situations.

6. Discuss the advantages and disadvantages of the use of conventional and satellite-derived data for the following variables:
   (a) Horizontal Wind Field component in the middle and upper Troposphere
   (b) Sea Surface Wind
   (c) 3-D Temperature Field
   (d) 3-D Humidity Field