FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

SCHOOL OF PHYSICAL SCIENCES

DEPARTMENT OF GEOGRAPHY

SECOND SEMESTER 2015/2016 SESSION UNDERGRADUATE EXAMINATION

COURSE CODE: MET522

COURSE TITLE: Advanced topics in atmospheric Dynamics (3units)

INSTRUCTION: Answer **any four** Questions (Credits will be given for proper usage of relevant illustrations and diagrams)

TIME ALLOWED: 2hrs:30Minutes

Useful Constants: Latent heat of fusion of ice = 2.34 X $10^6 Jkg^{-1}$; Specific heat capacity of water = 4.2 X $10^6 Jkg^{-1}K$; Latent heat of vaporization of water = $2.5X10^6 JKg^{-1}$; g= $9.8ms^{-2}$, R = $287Jdeg^{-1}Kg^{-1}$, C_p=$1004Jdeg^{-1}Kg^{-1}$

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1. (a) Explain briefly the thermal stratification of the atmosphere .
   (b) State the hydrostatic equation and discuss its uses in the study of the atmosphere .
   (c) Suppose at the surface, a 1000m thick layer of air (under standard conditions) has an average density of $1.1Kgm^{-3}$. Compute the change of pressure (.
2. (a) Define (i) Geopotential (ii) Potential temperature (iii) Latent heat of condensation(3mks)
   (b) Derive an expression for the potential temperature of an air parcel in terms of its pressure (P), temperature (T) and the standard pressure (P_0) .
   (c) Calculate the potential temperature of a parcel of air whose temperature is 20^0C and compressed adiabatically from a 500mb pressure level to standard atmospheric pressure .
3. Explain briefly the following:
   (i) A parcel of air cools when it is lifted.
   (ii) When the sun heats the ground wetted by rain, wisps of cloudy air sometimes form above the layer close to the ground.
   (iii) Towering cumulus cloud containing large amounts of super cooled water can Sometimes be induced to grow higher levels by seeding them with artificial ice nuclei.
   (iv) Rain areas tend to be associated with convergence in the lower troposphere and divergence in the upper troposphere.

4. Write short notes on each of the following:
   (i) Dry Adiabatic Lapse Rate
   (ii) Saturated Adiabatic Lapse Rate
   (iii) Diurnal variation of Atmospheric Stability
   (iv) Conditional Instability of the Second Kind (CISK) .

5. (a) Explain the uses of thickness and height of constant pressure surfaces in the monitoring of the dynamics of the atmosphere. .
   (b) Calculate the thickness of the layer between the 1000 and 500 mb pressure surfaces
   (i) At a point in the tropics where the mean virtual temperature of the layer is 9^0C

(ii) At a point in the polar region where the corresponding mean virtual temperature is -40^{0}C .

6. (i) Advance reasons for the reduction of pressure to sea level pressure in meteorology .

(ii) Calculate the geopotential height of the 1000mb pressure surface when the pressure at sea level is 1014mb. The scale height of the atmosphere may be taken as 8km .