SMR 307: THERMODYNAMICS AND CLOUD PHYSICS

STUDY GUIDE

1. Course Unit Summary

This study unit is level 3 Course in Thermodynamics and cloud physics for learners taking undergraduate program in any science-based fields such as B.Ed Science, B.Sc. Meteorology and B.Sc. Physics.

In this couse unit, the basic concept of thermodynamics is introduced by giving a fundamental definition to the subject. Statement of some perfect gas laws and hypotheses and how they can be used to derive the equation of state for dry and moist air has also been given in this lecture.

2. General Course Unit Objectives

Thermodynamics is the empirical science which is based upon the *mechanics* of a *system* and its interaction with the environment. The *system* in this case is the atmosphere or part of it and the *mechanics* refers to changes in pressure, temperature, internal energy etc. The interaction *mechanics* of *the system* is the basis of all the process that leads to the formation of clouds.

The aim of this course unit, therefore, is to equip students with knowledge and skills of the thermodynamics of the atmospheric system, its interaction with the environment and the physics of cloud formation process.

3. Course Unit Outcomes

At the end of this unit, the student should be able to:

- Define thermodynamics
- Derive the equation of state for perfect gases and their mixtures applied to dry air and water vapour.
- List and define different concepts for specification of water vapour content.
- State the Laws of thermodynamics processes, and explain the concept of heat, work, internal energy and entropy.
- Discuss reversible/irreversible, adiabatic and pseudo-adiabatic processes
- Describe the thermodynamic phase changes of water
- Discuss thermodynamic diagrams and their uses.
- Derive Hydrostatic equation,and apply in geopotential, Altimetry, hydrostatics of special atmospheres, standard atmosphere.
- Explain the concept of Atmospheric stability with respect to dry and saturated adiabatic lapse rates, static stability.
- Exlain the stability criteria for dry and moist air parcels and slice methods, entrainment and buoyancy in cumulus clouds, and top mixing.
- Describe the diurnal variation of stability changes. Radiative cooling; subsidence; formation of fog.

4. Resources & references

- Hess, S. L., (1959): *Introduction to theoretical Meteorology*. FSU, Tallahassee, Fla.

- McIntosh, D. H. and A.S. Thom, A. S, (1972): *Essentials of Meteorology*. The Wykeham Science series;Compedium of Meteorology
- Haltiner: Dynamic and Physical Meteorology
- Level 3 ODeL module: Thermodynamics and cloud physics by Alfred Opere

5. Lecturers

Prof. F.M. Mutua, Prof. J.N. Muthama, Dr. Alfred Opere, Dr.W Gitau