Course Number ATOC-315 – Thermodynamics and Convection

FALL 2020 Instructor: EVANGELIA IOANNIDOU

COURSE OUTLINE

- **UNIT I** INTRODUCTION

    - Thermal Equilibrium
      Lapse Rates – Vertical Exchange of Air Masses –
      Entrainment Mixing – The Role of Moisture

    - Measuring Convection
    - Convection in Extratropical Latitudes
    - Convection in the Tropics

- **UNIT II** ATMOSPHERIC THERMODYNAMICS

    - Application of the Gas Laws to the Atmosphere
      Molecular Weight – Virtual Temperature –
      Saturation Vapour Pressure – Moisture Variables
    - Fundamental Quantities
      Enthalpy – Static Energy – Moist Static Energy
    - Adiabatic Transformations
      'Dry' and 'Moist' Adiabatic Motion
      Potential Temperature – Equivalent Potential Temperature
      Thermodynamic Diagrams

- **UNIT III** CONVECTIVE DEVELOPMENT

    III.1 Unstable Convective Growth

    - Static Instability
      Conditional Instability – Convective Available Potential Energy
      Potential Instability

    - Brunt-Vaisala Frequency
    - Gravity Waves

    III.2 Convective Circulations

    - Upwards Energy Transfer in the Atmospheric Boundary Layer (ABL)
      ABL Structure – Heat and Momentum Fluxes –
      Inversion Layers

- Convective Elements
  Updrafts – Downdrafts – Wind Shear – Gust fronts

- Convective Circulation Dynamics
  Governing Equations – The Rossby number –
  Divergence – Generation of Vorticity

- Convective Phenomena: Organisation and Development
  Cumuliform Clouds – Air-Mass Thunderstorms –
  Squall Lines – Multi-Cell Storms –
  Mesocyclones – Tornadoes

METHOD of EVALUATION

Assignments: 2 or 3, will count for **30%** of final grade
Class Participation: 0%
Class Tests/Quizzes: 0%
Essays/Papers: 0%
Lab Reports: 0%
Labs: 0%
1st Mid-term Exam (late September) take-home, 24-hour availability window, **18%**
2nd Mid-term Exam (mid-November) take-home, 24-hour availability window, **18%**
Projects: 0%
Oral Presentation: 0%
Final assessment (December exam period) take-home, 72+-hour availability window, **34%**

COMMENTS

1. Bi-weekly classes : Tuesday and Thursday **(TR) 10:00-11:30am**

2. Two delivery modes: some classes will be delivered through the Zoom platform, other classes will be based on a pre-recorded audio containing the commentary that accompanies a power-point presentation.

3. All Zoom sessions will be recorded automatically and made available through MyCourses for listening to at a later time, if desired. The audio and the power-point files will be posted on MyCourses at the earliest possible time, after class.

2. Class attendance is strongly encouraged. To accommodate for the eventualities of weak internet connections, technological limitations and breach of privacy students will not be required to have their video cameras turned ‘on’ during Zoom sessions.

4. Assignments will be given at a 3 to 4 -week frequency. There will be 2 or 3 assignments. The **30%** total weight will be distributed equally among the assignments.

5. The mid-term exams will consist of a) multiple choice questions and b) questions that ask the student to elaborate on taught concepts, or provide explanations, or solve problems that lead to quantitative estimates of physical variables.

6. Oral and written feedback will be given to students regularly on their performance in the assignments and the mid-term exams.

6. The instructor may be reached for questions and comments at: Evangelia.Ioannidou@mcgill.ca