STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

COURSE OUTLINE

ESCI 320

WEATHER, CLIMATE, and CLIMATE CHANGE

Prepared By: Dr. David C. Bradford

CANINO SCHOOL OF ENGINEERING TECHNOLOGY
PHYSICS
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A. **TITLE**: WEATHER, CLIMATE, and CLIMATE CHANGE

B. **COURSE NUMBER:** ESCI 320

C. **CREDIT HOURS:** 3

D. **WRITING INTENSIVE COURSE**: Yes

E. **COURSE LENGTH:** 15 weeks

F. **SEMESTER(S) OFFERED:** Spring

G. **HOURS OF LECTURE:** 3 hours lecture per week

H. **CATALOG DESCRIPTION:** This course is an introduction to the science behind weather and climate. It will focus on the composition, structure, and disturbances of the atmosphere. The energy balance and role of water will necessarily include discussions of solar radiation and the water cycle. The difference between weather and climate will be illustrated with a discussion of global climate change. The most current reports from the UN Intergovernmental Panel on Climate Change (IPCC) and the US Global Change Research Program (USGCRP – National Climate Assessment) will be reviewed.

I. **PRE-REQUISITE:** One semester college level science

J. **GOALS (STUDENT LEARNING OUTCOMES):**
By the end of this course, the student will be able to:

1. Explain the pattern of seasons around the world in context of where the energy is received from the sun.
2. Describe the composition and structure of the atmosphere.
3. Explain the connections between the energy balance; temperature; and how and why energy is transported around the globe
4. Describe the role of atmospheric pressure and pressure gradients behind atmospheric circulation and winds.
5. Outline the connection between the special properties of water and their implications in cloud development and precipitation.
6. Understand the competing interactions behind local weather phenomena and larger scale disturbances such as a middle latitude cyclone.
7. Define the difference between weather and climate.
8. Discuss the evidence for unprecedented global climate change and the cause.
9. Review most current state of climate change, projected changes, and mitigation efforts.

Course Objective	***Institutional SLO***
a. Describe the composition and structure of the layers of the earth's atmosphere.	**1. Communication** **2. Crit. Thinking**
b. Understand the methods and role of energy transfer behind seasons, the water cycle and eventually weather.	**1. Communication** **2. Crit. Thinking**
c. Describe the interrelationships between atmospheric pressure gradients, Earth's rotation, and resulting atmospheric circulation.	**1. Communication** **2. Crit. Thinking**
f. Understand the competing interactions behind local weather phenomena and larger scale disturbances such as a middle latitude cyclone.	**1. Communication** **2. Crit. Thinking**
h. Discuss climate and evidence of climate change; past, present, and future in the Anthropocene epoch	**1. Communication** **2. Crit. Thinking**

K. **TEXTS:** Aguado & Burt, 2012. *Understanding Weather & Climate, 6/E,* Prentice Hall, Upper Saddle River, NJ 07548

L. **REFERENCES:** Evolving on-line material including extensive materials maintained by the USGCRP.

M. **EQUIPMENT:** Technology Enhanced Classroom

N. **GRADING METHOD:** A-F

O. **MEASUREMENT CRITERIA/METHODS:**

- Exams
- Quizzes
- In-class computer based activities
- Short answer homework
- Term paper

P. **DETAILED COURSE OUTLINE:**

I. Composition and structure of the Atmosphere
   A. Thickness of the atmosphere and changing density
   B. The vertical profile based on temperature
   C. Permanent gases, variable gases, and aerosols
   D. Evolution of the atmosphere; historical and daily
   E. Weather basics: pressure, wind, temperature, and humidity

II. Solar Insolation and the Seasons
   A. Why we have seasons
   B. Kinds of energy and energy transfer mechanisms
   C. Measuring temperature
   D. The wave and particle models of light; both transmit energy

III. Energy Balance and Temperature
   A. Absorption, reflection, scattering, and transmission of electromagnetic radiation (light).
   B. Energy transfer between the surface and the atmosphere

C. Greenhouse effect (Venus as an example of a runaway Greenhouse effect)
D. Global temperature distributions
E. Influences on temperature by land, water, latitude, altitude, and circulation
F. Change of state of H_2O and temperature

IV. Atmospheric pressure and wind
A. What is pressure
B. Vertical and horizontal pressure changes
C. Equation of state
D. Measurement of pressure
E. Pressure gradients and hydrostatic equilibrium
F. Forces affecting the speed and direction of the wind
G. Surface winds, upper atmosphere winds, and large air mass winds
H. Measuring wind speeds

V. Atmospheric moisture
A. Evaporation and condensation
B. Indices of water vapor content
C. Distribution of water vapor
D. Measuring humidity

VI. Cloud Formation and Precipitation
A. Mechanisms that lift air
B. Static stability and the environmental lapse rate
C. Inversions
D. Cloud types and what they tell you about the atmosphere
E. Growth of cloud droplets
F. Forms of precipitation

VII. Modeling Atmospheric Circulation and Pressure Distributions
A. The three cell model
B. Winds in the upper troposphere
C. Wind/ocean interactions
D. Major wind systems
E. Air masses and fronts

VIII. Disturbances
A. Mid-latitude cyclones
B. Lightning, thunder, and tornadoes
C. Tropical storms and hurricanes

IX. Human Effects on Weather
A. Atmospheric pollutants
B. Heat islands

X. Earth's Climates
A. Defining climate
B. Parameters used to classify different climates
C. Different climates around the world

XI. Climate change: past, present, future
A. The time scales of climate change
B. Past climates and correlations with their atmospheres
C. Factors that can force climate change
D. Feedback mechanisms and tipping points
E. Environmental impact

XII. Most authoritative sources for current state of the Earth's Climate
A. Review of UN- IPCC working group reports
B. USGRP National Climate Assessment

Q. <u>LABORATORY OUTLINE</u>: N/A