MET 4400 -- Meteorological Instrumentation and Observations (Credits: 3)

Justification:
This course primarily supports the Atmospheric Science Track, B.S. Major in the Department of Earth and Environment. It provides essential content in Meteorological Instrumentation and Observations to students who have an academic focus on atmospheric sciences or wish to pursue a specific career path in meteorology. This is a required course for B.S. degree in Atmospheric Sciences recommended by the American Meteorological Society (AMS). This course also covers satellite and radar meteorology and introduces basic knowledge and skills in data analyses. There is no similar course at FIU.

Course description:
This course introduces theory and practice of calibration and operation of basic meteorological sensors, which are used to measure temperature, atmospheric flow, pressure, and moisture. Specific topics include barometry, thermometry, hygrometry (atmospheric water), precipitation, anemometry (winds), radiation and visibility and cloud height. The course will focus primarily on in-situ measurement techniques but will also cover some aspects of remote sensing measurements such as satellite and radar observations of clouds and precipitation for purposes of inter-comparison. The course includes in-class demonstrations and laboratory projects designed to illustrate applications of meteorological instruments through hands-on experiences.

Course objectives:
The main goal of this course is to introduce students the basic atmospheric measurement methodology and the fundamental physics behind the measurements. The course focuses on the basic physical principles of measurements while providing examples of actual instrumentation. It discusses sources and mitigation of measurement errors, how to represent and analyze both static and dynamic errors, and how to analyze and interpret the measurement results and characterize the measurement results statistically.

Time and location: 9:30 AM – 10:45 AM  Tuesday/Thursday (Aug. 20 – Dec. 1, 2018) at AHC5-357

Instructor: Dr. Ping Zhu

Office: AHC5-234

Office hours: Tuesday/Thursday: 12:30 PM – 1:30 PM or by appointment

Office Tel: (305) 348-7096
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Prerequisites: PHY2048C and MET3003

Textbook:

Online class notes (can be downloaded in FIU Canvas)
Reference:

Course Grading:
60% Homework and Projects
20% Midterm
20% Final

Grade Scale:  A = 93-100%, A- = 90-92%, B+ = 87-89%, B = 83-86%, B- = 80-82%, C+ = 77-79%, C = 70-76%, D = 60-69%, F = 0-59%.

Final Exam Schedule: 12/04/2018 (Tuesday) 9:45AM – 11:45AM at AHC5-357

Lecture and Experiment Outline:
Schedule Subject
Week 1 (Aug. 21 & 23):
  Introduction
  General concepts of measurement systems
  Temperature measurement
    a) Basic principles
    b) Sensor types

Week 2 (Aug. 28 & 30):
  Temperature measurement - continuing
    c) How to measure atmospheric temperature (experiment)

  Basic data processing methods
    a) Significant figures

Week 3 (Sept. 04 & 06):
  Basic data processing methods – continuing
    b) Simple Statistics
    c) Signal processing
    d) Least square fitting

Week 4 (Sept. 11 & 13):
  Pressure measurement
    a) Basic principles
    b) Sensor types
    c) How to measure atmospheric temperature (experiment)
Week 5 (Sept. 18 & 20):
  Moisture measurement
  a) Moisture Variables and Basic Principles
  b) Sensors
  c) How to measure relative humidity (experiment)

Week 6 (Sept. 25 & 27):
  Moisture measurement - continuing
  d) Moist virtual effect
  e) Determining air density
  f) How to estimate air density (experiment)
  g) Propagation of measurement errors

Week 7 (Oct. 02 & 04):
  Precipitation measurement
  a) Rain gauges
  b) Remote sensing measurement of precipitation
  c) How to measure rainfall (experiment)

  Mid-Review

Week 8 (Oct. 09 & 11):
  Mid-terms

  Data processing - Fourier Transform

Week 9 (Oct. 16 & 18):
  Wind measurement
  a) Dynamic force anemometers
  b) Measuring wind speed (experiment)
  c) Pressure pulse frequency anemometers (sonic anemometer)
  d) Thermal anemometers
  e) Wind profilers

Week 10 (Oct. 23 & 25):
  Radiation measurement
  a) Basic principles
  b) Sensors
  c) Simple experiment on radiation measurement

Week 11 (Oct. 30 & Nov. 01):
  Cloud measurement
  a) Cloud properties and types
  b) Cloud formation and precipitation
  c) Sensors
  d) Cloud-radiation-climate feedback
Week 12 (Nov. 06 & 08):
  Upper atmosphere measurement
  a) Radiosonde
  b) GPS deopsonde
  c) Driftsonde

Week 13 (Nov. 13 & 15):
  Weather radar
  a) Radars in meteorology
  b) Radar bands and moments
  c) Doppler effect
  d) Dual Doppler radar

Week 14 (Nov. 20):
  Satellite observations
  a) Satellite basics

Week 15 (Nov. 27 and 29)
  Satellite observations – continuing
  b) Polar orbit satellite
  c) Geostationary satellite
  Final Review

Course Learning Outcomes:

- Understand the basic mechanisms underlying various instruments for measuring meteorological properties such as atmospheric temperature, pressure, moisture, precipitation, and winds.
- Be able to measure meteorological properties using conventional meteorological instruments.
- Possess the basic knowledge of radar and satellite meteorology.
- Be able to process and analyze meteorological observational data.
- Be able to present data analysis results using graphics.