Syllabus

Course:	**CLIMATE 414: Weather Systems – Winter 2018**
Web Page:	https://umich.instructure.com/courses/203998
Times:	Monday, Wednesday, Friday 12:30AM-1:30PM – Room 2238
Instructor:	Frank J. Marsik, PhD
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Office Hours:	After class or by appointment
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Course Summary:

The study of meteorology and climate at the University of Michigan dates back to the 1850's. These early studies in meteorology and climate were focused on the application of this knowledge to the areas of agriculture and maritime shipping, both of which were important economic sectors. At that time, weather observations from the University of Michigan's Detroit Observatory (on central campus) were sent to the Smithsonian in Washington, DC. From there, correspondence often lead to an exchange of weather observations on a time-scale of once every other week or so. Today, we have observations from around the world in a matter of minutes of these observations being taken, thus providing us with an incredible tool(s) for studying the changing state of the atmosphere.

The overall goal of this course will be to help you gain an understanding of mid-latitude, synoptic scale weather systems. We will study the structure and the evolution of these weather systems, with the overall goal of obtaining a better understanding of the processes which impact their development. The term "weather systems" need not solely apply to synoptic scale phenomena, thus our goal will be to also look at a number of mesoscale phenomena (eg., supercells, tornadoes and hurricanes). While this course is not listed as a lab course per se, the goal will also be to integrate a fair amount of data analysis, using tools such as the GEMPAK Analysis and Rendering Program (GARP) to obtain a better understanding of these processes.

Course Pre-Requisites:

Students enrolling in this course are expected to have taken the Atmospheric Physics I (AOSS 350) and Geophysical Fluid Dynamics (AOSS 401) courses concurrent with, or prior to taking, this course. If you have not taken these courses, please see me!

Course Materials:

This course does not have a required textbook. Most textbooks are written by senior professors who structure their books along the lines of their home institution's

curriculum. For this reason, no individual textbook ever seems appropriate and thus I don't want to "require" people to purchase a given textbook. The materials for this course will be drawn from a variety of textbooks, peer-reviewed literature and technical training documents available through the National Oceanic and Atmospheric Administration (NOAA) and the Air Weather Service. I will hand out pertinent material as needed. If you really like textbooks, here are the prominent ones that I tend to migrate to and will be drawing from:

- *Midlatitude Synoptic Metorology: Dynamics, Analysis & Forecasting* by Gary Lackmann
- *Atmospheric Science: An Introductory Science* by J. Wallace and P. Hobbs
- *Weather Analysis* by Dušan Djurić
- *Mid-Latitude Weather Systems* by Toby N. Carlson
- *Mid-Latitude Atmospheric Dynamics* by Jonathan E. Martin
- *An Introduction to Dynamic Meteorology* by James R. Holton
- *Synoptic-Dynamic Meteorology in Mid-latitudes* by Howard B. Bluestein

Note: If you have not taken CLIMATE 440 (Meteorological Analysis Laboratory), you may want to consider purchasing the "Weather Map Handbook" by Tim Vasquez (~$30).

Grading and Exam Details:

The final course grades will be determined using the following guidelines:

Homework	35%
Hourly Exam #1	20%
Hourly Exam #2	20%
Group Term Project	25% (20% for paper; 5% for presentation)

HOMEWORK: There will be a number of homework assignments that help to underscore the material covered in class. These assignments will be due in class on the assigned due date. Assignments may be turned in late with prior permission only. Assignments turned in late without permission will have one point deducted for each day that assignments are late. If assignments are not turned in within one week of the assigned due date, the student will receive no credit for the assignment. You will receive an incomplete for the term until all assignments have been completed.

EXAMS: There will be two hourly exams, tentatively set for February 23rd and April 11th. These two exams may end up being take home exams, but that will be determined following a discussion with class members.

GROUP TERM PROJECT: In an effort to pull together the material covered in class, we will be performing a class-wide, group term project. This project will involve a detailed

analysis of a mid-latitude winter storm. The class will be divided into five groups, each with the responsibility to focus their analysis on a particular time period in the storm's life cycle. Each group will them be responsible for putting together a 20 minute presentation at the end of the term on their segment of this storm's life cycle. These presentations will be given on April 16th. Each group will submit a final term paper (8 to 10 pages, plus figures). The due date for the term papers will be Friday, April 20th.
IMPORTANT DATES: We will **not** have class on the following days:

- January 8th and 10th (AMS Annual Meeting)
- January 15th (Martin Luther King Day)
- February 26th – March 2nd (Spring Break)

HONOR CODE: In general, you are expected to following the College of Engineering Honor Code Guidelines (https://ossa.engin.umich.edu/). With respect to homework assignments, while you are allowed to work on homework assignments together, the assignment that you turn in must represent your own work.

IMPORTANT NOTE: If the due date for any assignment or exam conflicts with a religious holiday that you observe, please see me at least one week in advance to make alternate arrangements.

Course Outline[(1)]

I. Introduction

   a. Energetics and the General Circulation (Jet Streams)
   b. Review of The Norwegian Cyclone Model and Modern Approaches to Cyclogenesis
   c. Analysis Tools (GARP, GR2Analyst, Skew-T Log P Diagrams)

II. Characteristics of Synoptic Wave Cyclones (i.e., Mid-Latitude Cyclones)

   a. Air Mass Origins and Characteristics
   b. Fronts and Frontogenesis
   c. Airflow within Mid-Latitude Cyclones (Conveyor Belts)
   d. Quasi-Geostrophic Influences on Life Cycle of Mid-Latitude Cyclones:
      i. The Q-G Vorticity Equation
      ii. The Q-G Height Tendency Equation
      iii. The Q-G Omega Equation

III. Mesoscale Phenomena

   a. Convective Cell Types
   b. Convective Precipitation
   c. Tornadoes
   d. Hurricanes
   e. Lake and Sea Breezes
   f. Mountain flows

(1) This outline is a starting point. There may be need to add or subtract certain topics, or perhaps swap locations. Time will tell……

Poetry

Pablo Neruda

And it was at that age ... Poetry arrived in search of me.
I don't know, I don't know where
it came from, from winter or a river.
I don't know how or when,
no they were not voices, they were not words, nor silence,
but from a street I was summoned,
from the branches of night,
abruptly from the others,
among violent fires
or returning alone,
there I was without a face
and it touched me.

I did not know what to say,
my mouth had no way with names,
my eyes were blind,
and something started in my soul,
fever or forgotten wings,
and I made my own way,
deciphering that fire,
and I wrote the first faint line,
faint, without substance,
pure nonsense, pure wisdom
of someone who knows nothing,
and suddenly I saw
the heavens unfastened and open,
planets, palpitating plantations,
shadow perforated,
riddled with arrows, fire and flowers,
the winding night, the universe.

And I, infinitesimal being,
drunk with the great starry void,
likeness, image of mystery,
felt myself a pure part of the abyss,
I wheeled with the stars,
my heart broke loose on the wind.