Course Syllabus

Course:	CLIMATE/EARTH 414: Weather Systems – Winter 2024
Times:	Monday, Wednesday, Friday 12:30AM-1:20PM
Location:	2238 Climate and Space Research Building
Instructor:	Frank J. Marsik, PhD (He/Him/His)
Office:	2543C Climate and Space Research Building (CSRB)
Office Hours:	Monday, 1:30 to 2:30 PM, 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., thunderstorms, tornadoes). 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 Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Demonstrate a fundamental understanding of the distribution and transformation of energy in the atmosphere and at the Earth's surface, including how these processes influence atmospheric motions at various spatial and temporal scales.
- Explain the life cycle of mid-latitude cyclones, including the application of the quasi-geostrophic equations with respect to the evolution of mid-latitude cyclones, anticyclones.
- Explain the storm-relative atmospheric transport features associated with mid-latitude cyclones.
- Demonstrate a fundamental understanding of the factors influencing the convective environment, including processes which can influence the destabilization of this environment through radiative, dynamic and thermodynamic processes.

Reporting Obligations:

As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. It is my goal that you feel able to share information related to your life experiences in classroom discussions, in your written work, during online discussions, and in one-on-one meetings. When meeting with me, I will seek to keep information you share private to the greatest extent possible. However, due to my role within the University, I am required to share information regarding sexual misconduct or information about a crime that may have occurred on U-M's campus with the University. The purpose of my sharing this information is to ensure that you are aware of your rights, and the resources available to you, under such circumstances. As a student, you may speak to someone confidentially by issues pertaining to sexual assault by contacting the Sexual Assault and Prevention Awareness Center's (SAPAC) Crisis Line at (734) 936-3333.

I am dedicated to providing a harassment-free experience for everyone, regardless of gender, gender identity and expression, age, sexual orientation, disability, physical appearance, body size, race, ethnicity, religion (or lack thereof), or technology choices. I will not tolerate harassment of participants in any form. Sexual language and imagery is not appropriate for any activity associated with this course, whether it be in-person or virtual discussions, during group-work (homework or projects), or references on social media.

Student Personal Health and Wellness:

These past two years have been hard. Period. As students, you may experience stressors that can impact both your academic experience and your personal well-being. These may include academic pressure and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc.

If you are experiencing any of these or other challenges, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact me so that we can find solutions together. For personal concerns, U-M offers many resources, some of which are listed at Resources for Student Well-being on the Well-being for U-M Students website. You can also access this same information using the "Well-Being" tab on the left toolbar of Canvas. Other resources can be accessed through the "Engin Student Support" tab on the left toolbar.

Course Prerequisites:

Students enrolling in this course are expected to have taken the Atmospheric Physics I (CLIMATE 350) and Geophysical Fluid Dynamics (CLIMATE 401) or their equivalent, or prior to taking, this course. If you have not taken these courses, please contact me and we can discuss a plan to help you be successful in the course.

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.

With all of this said, there are two textbooks that contain particular chapters or sections which student may find helpful, particularly if your primary area of study is not atmospheric science. I have provided links to these texts under the "Library Tools" toolbar on the left of this Canvas website. These two books are:

- *Atmospheric Science: An Introductory Science* by J. Wallace and P. Hobbs
- *Global Physical Climatology* by Dennis Hartmann.

If you are into building a resource library, you may want to consider the following additions:

- *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

Grading and Exam Details:

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

Homework (Written and Lecture Reflections)	35%
Take Home Exam #1	20%
Take Home Exam #2	20%
Term Project	20% (15% for paper; 5% for presentation)
Participation/Office Hours	05%

HOMEWORK: There will be a number of homework assignments (written or online Canvas quizzes) that help to underscore the material covered in class. Assignments may be turned in late with prior permission only. Assignments turned in late without permission will have 10% percent of the total available points deducted for each day that assignments are late up to 48 hours, then 50% up to seven days. If assignments are not turned in within one week of the assigned due date, the student will receive no credit for the assignment.

EXAMS: There will be two take home exams, tentatively set for the weekends of **February 16-19 and April 12-15**. I will ask that you allow yourself two semi-continuous hours to complete each exam.

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 two mid-latitude cyclones. The class will be divided into four groups, each with the responsibility to focus their analysis on a particular time period in the storms' 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 storms' life cycle. These presentations will be given on **Friday, April 19 and Monday, April 22**. Each group will submit a final term paper (8 to 10 pages, plus figures). **The due date for the term papers will be 5PM, Friday, April 26. You are welcome to turn in the final papers prior to that date.**

OFFICE HOURS: Office hours are a required element of this class. In short, you will be required to check in with me twice during the term (essentially, once at the start of the term and once in the middle part of the term). I will maintain open office hours during the scheduled time for the other weeks of the semester.

HONOR CODE: In general, you are expected to following the College of Engineering Honor Code Guidelines found **HERE**. 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.

Important Dates:

We will **not** have class on the following days:

Monday, January 15	Martin Luther King, Jr. Day
Monday, January 29 and Wednesday, January 31	Annual Meeting of AMS
February 26, February 28, and March 2nd	Spring Break

Course Outline:(1)

1. Introduction
    - Energetics and the General Circulation (Jet Streams)
    - Review of The Norwegian Cyclone Model and Modern Approaches to Cyclogenesis
2. Characteristics of Synoptic Wave Cyclones (i.e., Mid-Latitude Cyclones)
    - Air Mass Origins and Characteristics
    - Fronts and Frontogenesis
    - Airflow within Mid-Latitude Cyclones (Conveyor Belts)
    - Quasi-Geostrophic Influences on Life Cycle of Mid-Latitude Cyclones:
        - The Q-G Vorticity Equation
        - The Q-G Height Tendency Equation
        - The Q-G Omega Equation
        - The Q-Vector Equation
3. Mesoscale Phenomena
    - Convective Cell Types
    - Convective Precipitation
    - Tornadoes

(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.