REQUEST FOR GENERAL STUDIES DESIGNATION
NATURAL AND PHYSICAL SCIENCES

Please review the Course Selection Criteria for this category for assistance in completing this form, particularly as it relates to the percentages associated with each Student Learning Outcome.

If this course is also being submitted for the Global Diversity Category, check here , and complete and attach the separate Global Diversity General Studies Designation request.

Date: 10/1/12

School: LAS

Department: EAS

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>MTR</td>
<td>1400</td>
<td>3</td>
</tr>
</tbody>
</table>

Title: Weather and Climate

Prerequisite(s): Minimum performance standard scores on reading, writing, and mathematics preassessment placement tests

Corequisite(s): None

Banner enforced prerequisite(s) and/or corequisite(s): 

Recommended maximum enrollment per section: 35

A. Student Learning Outcomes

Describe the specific ways in which this course addresses each of these Student Learning Outcomes, providing students opportunities to develop the skills and/or acquire the knowledge. Include reference to readings, discussions, lectures, and other pedagogical tools which will be used. See the Criteria Table for examples.

1. Demonstrate effective use of technologies appropriate to the task and discipline. (10%)
   - The internet will be used to locate current weather observations, forecasts, and timely information on inclement weather, as well as the Web of Science to locate journal articles
   - Students will use a thermometer or other instruments to collect data
   - Students may use Microsoft Office to type a written assignment or plot data
   - Students will be expected to access class notes or assignments via the web (a class web page, Blackboard, MetroConnect, etc.)
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)
   • Students will learn how to navigate the web to find reliable weather information and data, particularly when timely information is needed about inclement weather in Denver such as a blizzard warning, red flag warning, severe thunderstorm warning, tornado warning, or flash flood warning.
   • Students will learn how to locate peer reviewed literature and distinguish between primary and secondary sources.

10. Describe how the methods of science are used to generate new knowledge. (30%)
   • The scientific method will be discussed explicitly early on in the course and referred to throughout the course.
   • Newton’s laws and the laws of thermodynamics are covered and a discussion of scientific laws will distinguish them from theories.
   • The historical development of the Norwegian cyclone model and Hadley circulation show the origin and development of theories in meteorology.
   • The current theory on global warming is used as an example of the scientific method at work.
   • The student will develop a scientific hypothesis and perform an experiment, identify relevant variables, then draw conclusions based on resulting data.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)
   • The concepts for the entire course are presented in graphs, quantitative figures, and weather maps. The following are examples where students may actively use graphical and symbolic methods to organize, analyze, and interpret data in this course:
     o The Keeling curve is used to teach students graphing basics such as dependent and independent variables as well as trend lines.
     o Surface station maps are decoded for interpretation of the weather observations.
     o Sounding data is used to find surface temperature inversions and the tropopause.
     o Humidity is calculated using a temperature to saturation vapor pressure chart.
     o Stability is determined from a temperature profile.
     o Wind strength and direction are drawn on sea level pressure maps.
     o Sea level pressure is contoured for a cyclone case.
     o Fronts are identified from surface station maps using temperatures and wind directions.
     o Precipitation types are forecasted based on a temperature profile.
     o Chinook wind event is explained using weather observations.
     o Lake effect snow areas are determined using wind directions.
     o Cyclone forecasts are made using upper level wind speed and direction.
     o Forecast meteograms are deciphered to determine when is the safest time to hike.
     o Conditions indicative of a tornado outbreak are picked out from weather observations.
Wind speeds in different quadrants of a hurricane are calculated to find the strongest and most dangerous locations within a hurricane.

Carbon footprints are calculated using an online tool and several different units of measurement.

Climate indices are used to discuss expected conditions on Greenland.

Statistical data is most commonly used in this course in reference to temperature data. In the air temperature section, we use a graph of temperature data for two cities with the same annual mean temperature, but largely different ranges of temperature throughout the year. Also discussed are the mean daily temperature, normal temperature, record high temperature, record low temperature, record low maximum, record high minimum, monthly average, annual range, and annual average temperatures. Statistics are revisited in the climate and climate change chapters when current and past temperatures and temperature trends are discussed as well as the concept of uncertainty.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)

- This entire survey course explores the foundational concepts necessary for understanding the atmosphere, then applies these concepts to weather phenomena and climate processes.
- Students develop a basic understanding of many tools specific to the field of meteorology by using soundings, surface weather maps, meteograms, radar, and satellite imagery.
- The impact of the weather and climate on people is a theme of the class, particularly when discussing proper responses to weather watches and warnings or lightning safety, for example.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)

- The student will develop a scientific hypothesis and perform an experiment, identify relevant variables, then draw conclusions based on resulting data.

21. Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

- These concepts will be discussed within the context of the scientific method and addressed again while taking measurements. The data taken by the students will be compared among groups in the class.
- Repeatability will be discussed in reference to peer reviewed literature.
B. Assessment of Student Learning

Identify and describe at least one specific form of assessing student achievement of each Student Learning Outcome which will be a regular part of the course. Include attachments as applicable. A single piece of student work may be used to assess student achievement of more than one Student Learning Outcome. See the Criteria Table for potential data for use in assessment.

1. Demonstrate effective use of technologies appropriate to the task and discipline.
   • A homework assignment will teach the student to locate current weather observations, forecasts, or timely information on inclement weather, then assess their ability to do so on their own (see Attachment 4, Homework 5)
   • A homework assignment lets students use the Web of Science to find a journal article. (see attachment Attachment 5, Homework 7)
   • Students will use a weather instrument to take measurements (see Attachment 2, Homework 2)

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.
   • Homework assignment (following a tutorial in class) where students will compare primary and secondary sources of information to each other and also to webpages on the same topic of choice (see Attachment 5, Homework 7). Homework 7 has students start with the Intergovernmental Panel on Climate Change summary report, then prompts them to dig into a portion of the detailed report that is of interest to them. They will be required to use the Auraria Library system to get to the Web of Science where they will search for a specific reference cited in the IPCC report. They will be asked to include the most interesting figure from this paper. Students will then use the web to search for a non-peer-reviewed article or blog post on the same topic and comment on the differences.
   • Homework assignment to locate current weather observations, forecasts, or timely information on inclement weather (see Attachment 4, Homework 5)

10. Describe how the methods of science are used to generate new knowledge.
    • A homework exercise will allow students to use the scientific method. Students will make a forecast, create a hypothesis, identify relevant variables, perform an experiment, and draw conclusions from their results. (see Attachment 3, Homework 4)

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.
    • In-class activities will allow students to assess whether they can apply the lessons learned during lecture to a quantitative task including statistical methods and graph reading (see attachment of Selected Activities)
    • Exams will assess this learning outcome through quantitative applications such as using weather maps (see questions 37, and 51-57 on Attachment 7, Sample Exam)
• Homework assignments ask students to represent weather observations in symbolic format or use weather symbols and mathematics to make a forecast (see Attachments 2 and 3, homework 2, 4)

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.
   • Examinations will assess the students’ understanding of meteorology concepts (see attachment Exam)
   • Homework assignments allow students to apply basic concepts (see Attachments 2 and 3, Homework 2, 4)
   • In-class Activities assess the students’ ability to quantitatively apply meteorology concepts learned in lecture (see Attachment 6, selected Activities)

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.
   • A homework exercise will allow students to use the scientific method. Students will make a forecast, create a hypothesis, identify relevant variables, perform an experiment, and draw conclusions from their results. (see Attachment 3, Homework 4)

   • An activity and homework assignment where measurements are taken with a meteorological instrument and compared to the other groups in the class will assess the students’ knowledge of accuracy and precision in scientific data (see Attachment 2, Homework 2)

C. Conformance with Course Selection Guidelines

Briefly describe how the course meets the course section guidelines

The course must meet the full requirements of the Student Learning Outcomes, or must be paired with a corequisite lab course that, as a pair complete the outcomes.

   • The course is a stand-alone course with no corequisite lab. As documented above, the course addresses each of the student learning outcomes.
Approvals:

Andrew Evans 10/1/12

Department Curriculum Committee / Date

Kenneth Englebert 10/1/12

Department Chair or Program Director / Date

Brian Martin 10/12/12

School Curriculum Committee / Date

Sandra Engstrom-Perrett 10/25/12

Dean or Associate Dean / Date

Richard Wagner

Chair, General Studies Committee / Date

Helen A. Thompson 12/11/12

Associate Vice President, Academic Affairs / Date
School of: Letters, Art Sciences

Department: Earth and Atmospheric Science

Prefix & Course Number: MTR 1400

Course Title: Weather and Climate

Check All That Apply:
- Required for Major: x
- Required for Minor: x
- Specified Elective: x
- Required for Concentration: x
- Elective: x
- Service Course: x

Credit Hours: 3 (3+0)

Total Contact Hours per semester (assuming 15-16 week semester):
- Lecture 45
- Lab 0
- Internship 0
- Practicum 0
- Other (please specify type and hours): 0

Schedule Type(s): L

Grading Mode(s): L

Restrictions (Variable Topics Course): None

Prerequisite(s): Minimum performance standard scores on reading, writing, and mathematics preassessment placement tests

Corequisite(s): None

Catalog Course Description:
This course introduces the fundamental physical processes in the atmosphere—heat and energy, temperature, pressure, wind, clouds, precipitation, and stability. These concepts provide the basis for understanding weather systems such as thunderstorms, tornadoes, and hurricanes. These processes are also applied to climatic patterns and the impacts of human activity on weather and climate, such as air pollution and climate change. An optional 1-credit lab course, MTR 2020 Weather and Climate Lab for Scientists, is available for students interested in additional experience in the measurement and analysis of atmospheric data, and is required for some science programs.

APPROVED:

[Signatures and dates]

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 1400

Required Reading and Other Materials will be equivalent to:

Course Category and Related Student Learning Outcomes:

1. Demonstrate effective use of technologies appropriate to the task and discipline.

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.

10. Describe how the methods of science are used to generate new knowledge.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to

1. Explain how energy is transferred throughout the Earth system (11, 19);
2. Identify forcing mechanisms for upward vertical motions and explain how they can lead to cloud and precipitation formation (11, 19);
3. Utilize basic knowledge of atmospheric processes to dissect and explain weather phenomena or climate systems (10, 11, 19);
4. Use the scientific method to assess atmospheric processes (10, 11, 19, 20, 21);
5. Analyze and interpret data presented in graphs, weather maps, and statistical data (1, 10, 11, 19, 20, 21);
6. Exhibit proficient use of technology by using the internet to locate reliable sources for current weather observations, forecasts, and timely information on inclement weather, while recognizing the limitations or uncertainty in the data (1, 2, 19).

Detailed Outline of Course Content (Major Topics and Subtopics)

I. The Earth and its atmosphere
   a. The Scientific Method (1, 2, 10, 11, 19, 20, 21)
      i. Scientific theories and laws
      ii. Scientific hypothesis
      iii. Peer review process
   b. Composition of the atmosphere
   c. Vertical structure of the atmosphere

II. Warming the Earth and the atmosphere (1, 10, 11, 19)
   a. Solar and terrestrial radiation
   b. Energy transfer
   c. Energy balance and seasons

III. Air temperature (1, 11, 19, 20, 21)
   a. Daily cycle of temperature
   b. Climatic controls of temperature
IV. Humidity and clouds (11, 19)
   a. Hydrologic cycle
   b. Humidity
   c. Cloud types
V. Cloud development and precipitation (11, 19)
   a. Stability
   b. Cloud development
   c. Precipitation processes and types
VI. Air pressure and winds (1, 10, 11, 19)
   a. Cyclones and anticyclones
   b. Forces and winds at the surface and aloft
      i. Newton’s Laws
VII. Atmospheric circulations (10, 11, 19)
   a. Local wind circulations
   b. Global circulation
   c. El Nino/Southern Oscillation
VIII. Air masses, fronts, and mid-latitude cyclones (11, 19)
   a. Air masses
   b. Fronts
   c. Mid-latitude cyclones
IX. Weather Forecasting (1, 2, 11, 19, 20, 21)
X. Thunderstorms and tornadoes (1, 11, 19)
   a. Thunderstorms
   b. Lightning
   c. Tornadoes
XI. Hurricanes (11, 19)
   a. Hurricane development
   b. Hurricane structure
XII. Global Climate (11, 19)
XIII. Climate Change (1, 2, 11, 19, 20, 21)
   a. Climates of the past
   b. Recent climate change
XIV. Air Pollution (11, 19)
   a. Pollutants and their sources
   b. Acid rain
   c. Ozone hole

Evaluation of Student Performance

1. Exams
2. Homework, in-class activities, or labs that focus on analyzing and interpreting scientific data
3. Evaluation may also include written assignments, oral presentations, quizzes, and classroom participation or attendance.
Homework 2-- Measurements

Using instruments to find temperature, pressure, and wind speed

Objectives: Students will take measurements, compare them with measurements taken by their classmates, create a station model, and discuss accuracy and precision.

Pick two places on campus a significant distance apart. Use the instruments given to you and other means available to you to fill in the following table.

<table>
<thead>
<tr>
<th>Description of location</th>
<th>Station 1</th>
<th>Station 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure (hPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloud Cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation type (if relevant)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Draw a station model using the data from one of your stations. Be sure to code your pressure.

Draw this station model on the white-board to share your data with the class.
Compare these to surface observations from Denver at this time, using the internet to find the current official observations. How do your observations compare?

Compare results from your group to the data from other groups in the class. Were there any differences?

Calculate the mean temperature reported by the class.

Calculate the standard deviation of temperature data reported by the class.

What can account for differences in observations among the class and the official observations?

Assuming the official report of temperatures in Denver are the true values, were the classes measurements accurate?

Were they precise?
Sample Homework #4

Scientific Method-- Make a Forecast

Objective: You will use the steering rule to make a weather forecast, then formulate a hypothesis on whether or not the steering rule works and perform an experiment to formulate a conclusion.

Weather map analysis and forecasting

A.) On the next page are surface maps for two consecutive days, Day 1 and Day 2.

This is a fairly typical wave cyclone which illustrates some of the “rules of thumb” used by forecasters. Sadly, there are no isobars or fronts drawn on these maps – so your mission is to locate, draw, and identify the following on EACH surface map:

1. Draw in the isobars for 1000 (000), 1010(100), 1020(200), and 1030(300) millibars (not all of these occur each day). Label each isobar with the pressure. Remember 1027.2 mb on the station plot would show up as a 272 in the upper right hand corner of the plot.

2. Each map will have a Low in the central U.S. and two Highs (one near each coast of the U.S.). Mark these with a big “L” or “H”.

3. For each day, look at the weather reports in the vicinity of the Central U.S. Low and use your understanding of how the weather changes across different kinds of fronts to locate the cold front and warm front (one of each) on each map. Draw the fronts on the maps, using the proper symbol for each kind of front (chapter 8). Over the next two days this storm follows the typical life cycle of a frontal wave cyclone. On Days 1 and 2 the warm front will extend generally east from the Low (to the Atlantic coast), while the cold front will extend west or south from the Low (into Mexico or to the Gulf of Mexico). The cold and warm fronts meet at the center of the Low.

4. Highlight plotted precipitation reports, such as rain, snow, and thunderstorm on the map with a color highlighter (or circle the reports with a colored pen; green is a nice color for this). This will show the pattern of precipitation around the Low and along the cold and warm fronts. Remember the symbols to the left of the surface plot indicate precipitation.
B.) On the back page is a 500 millibar chart (showing the winds 18,000 feet up in the atmosphere).

5. On this 500 mb map, sketch in the locations of the SURFACE Highs and Lows (H’s and L’s) and the warm and cold fronts (from questions 2 and 3 above) on Days 1 and 2. Using Colorado as a 400-mile wide ruler, estimate how far the Central U.S. Low moved in 24 hours, in miles. Divide this distance by 24 to get the average speed (m.p.h.) of the movement of the storm center. What direction did the Low move FROM?

<table>
<thead>
<tr>
<th>Miles:</th>
<th>Speed (m.p.h.) = miles/24hrs:</th>
<th>Direction (FROM):</th>
</tr>
</thead>
<tbody>
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</table>

6. Look at the wind reports at 500 mb in the area above the Day 1 location of the surface Low - what is their average speed (m.p.h., to the nearest 5 m.p.h.) and direction? (multiply knots by 1.15 to get m.p.h.).

<table>
<thead>
<tr>
<th>500 mb wind speed (m.p.h.):</th>
<th>Direction (FROM):</th>
</tr>
</thead>
<tbody>
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</table>

7. Did the storm actually move faster, slower, or about the same as the 500 mb "steering" rule would have predicted, and did it move in the correct direction? **Steering Rule:** for each of the weather systems (the Low and the two Highs), estimate what the 500 mb winds are above the Day 2 positions of each system. Each of these systems should move in the direction of the winds but at half the speed. The distance (in miles) each system moves in 24 hours will be the wind speed (in m.p.h.) divided by two, then times 24 hours.

Enter your answers in the boxes below:

<table>
<thead>
<tr>
<th>Did the storm move faster or slower or the same as the 500mb steering rule prediction:</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Did it move in the right direction? (yes or no):</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

C.) Now that you’ve analyzed the surface and 500 mb weather maps, it’s forecast time!

8. This is your big chance to combine your understanding of the 500 mb steering rule and the typical life cycle of a cyclone to make your best guess (forecast) of where the Highs, Lows, and the Fronts across the U.S. (and particularly, near the Low) will be on Day 3 (24 hours after the Day 2). Draw your forecast weather map on the U.S. map on the back page. Do NOT draw the isobars, just draw the H’s, L’s, the fronts, and areas that you would expect to receive precipitation, and what type. **Steering Rule:** for each of the weather systems (the Low and the two Highs), estimate what the 500 mb winds are above the Day 2 positions of each system. Each of these systems should move in the direction of the winds but at half the speed. The distance (in miles) each system moves in 24 hours will be the wind speed (in m.p.h.) divided by two, then times 24 hours.
500 millibar chart

Your Forecast Surface Map for Day 3 (17 November)
D) The scientific method

Observations—weather forecasters noticed that surface cyclones moved in the same direction, but at half the speed of the 500mb winds.

Problem—Does the steering rule allow forecasters to create accurate forecasts of cyclone position?

Hypothesis—Fill in your hypothesis here:

Experiment—How will you test your hypothesis using your Day 3 forecast data?

Experimental Variables—What variables are you using in your experiment?

Conclusion—Test your hypothesis using your experiment. What are the results?

Do the results of this experiment hold true for ALL cyclone forecasts?

Websites with archived weather data:
http://weather.unisys.com/archive/sfc_map/
http://vortex.plymouth.edu/u-make.html
Homework #5

Using real-time weather data to take proper precautions during inclement weather

Go to the following webpage www.weather.gov
Click on a region on the map that has a watch or warning, according to the key below the map. This will allow you to zoom in on a certain region. The more severe the weather for your region, the more fun this exercise will be!

The zoomed in map indicates the counties in the region and the watches or warnings for these counties. To the right of the map are a list of all of the watches, warnings, outlooks, and any basic commentary on that specific region. What types of watches or warnings is this region under?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

To the right of the zoomed in map, clicking on a specific warning will give you details on the situation from the National Weather Service forecasters in that area. If you want to read all of the commentary for the region of interest, you can click on “Read watches, warnings, and advisories”. Click there! Explore the text in these messages. Note that they list specific locations, times, and safety precautions that should be taken. If a tornado warning was in your county, you could come here to see where the tornado is expected to be (of course you would only do this from the safety of your basement during a tornado warning using a portable device not plugged into a wall, in case of a power surge).

What do three of these watches or warnings mean for this region? Please refer to your textbook or the text in the watch or warning on your computer. (If there aren’t three, add one from another region.)

1. ___________________________ means ____________________________ 
2. ___________________________ means ____________________________ 
3. ___________________________ means ____________________________

What precautions should people in these regions take?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Let’s make sure you are prepared for your next severe weather outbreak! What county do you live in?

________________________________________________________________________

What are the counties north, south, east, and west of your home county?

________________________________________________________________________
If you were going to drive west on I70 to go skiing, what county would you drive through or to?

Go back to the original webpage: www.weather.gov

Above the map there are several tabs. Click on the “Radar” tab. This brings up a national radar image showing areas currently receiving precipitation. Click on an area receiving precipitation to zoom in on that particular region’s Radar. Once you are there, you can animate this image to get an idea of where the precipitation has been and where it is going. On the left hand side navigation, click on “Loop” next to Composite (under Reflectivity). This should animate a Radar image of precipitation in this region. During a severe weather outbreak, warning boxes will highlight areas under tornado warnings in red, severe thunderstorm warnings in yellow, and flash flood warnings in green. While your Radar is animating, click on the area in on the map with the most intense precipitation. This will zoom you into that area while it is animating. You can un-zoom by holding your “Alt” button and clicking. If things are happening very quickly, maybe a tornado is heading your way, you might hit the “Refresh” button on the bottom right of the map to load the latest Radar imagery and warnings. Maybe the storm you are tracking is heading east and you want to follow it to the neighbor’s Radar image (a Radar can only reach so far). On the top left of the page you can hit one of the nine arrows to navigate to a nearby Radar. You can also use the navigation links on the left to animate the National Radar.

Find the Radar nearest to Denver (FTG, the Front Range Airport in Watkins, CO). Animate this Radar image. Zoom in to identify where you live, noting that the highway system is overlaid on the image.

Let’s look at our local NWS page: http://www.crh.noaa.gov/bou/. You could also get here by typing in weather.gov to your navigation bar, then clicking on Denver.

What is the current temperature at Denver International Airport? 

What is the time and date of this observation?

What is the “Top News of the Day”? 

Click on the “Weather Story” link (bottom left of the icons). Summarize today’s weather for the entire region.
On the left-hand navigation, click on “Forecast Discussion” and skim our discussion for the forcing for our current weather.

At the top of the left-hand navigation, type in your home city and state to get your personalized forecast. What is the forecast for tonight and tomorrow?

Note that our watches, warnings, or outlooks can be found here as well in the bold, red, underlined text. Scroll down to the bottom of the page. Under “Additional Forecasts and Information” click on “Hourly Weather Graph.” This will bring up a forecast meteogram for your region.

What is the forecast for 5:00pm tomorrow?

Temperature
Dewpoint
Wind speed
Wind direction
Is there a chance of precipitation? What type? How much?

The next day, go to this same site to verify the temperature.

What was the actual temperature reported at 5:00?

What is the difference between this and the forecasted temperature?
Locating sources and evaluating their authenticity, validity, and reliability

Go to http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf or type “IPCC summary for policymakers” into your search engine and click on the first link.

Skim this document.
Find a figure or bullet point that is of particular interest to you. Note that each figure and bullet point show in brackets {} the area in the full document where this topic is discussed. Pick the area in the full document that you want to dig into further.
I’d like to dig into this section further ____________.
Go to the contents for the full IPCC AR4 document here:
Find the section you indicated above. Once you are in the section, do some reading about your topic, using the arrows in the upper right to go to the next page. You can always zoom in on a figure by clicking on it. While you are reading, look for a citation to a journal article that you’d like to look up. (Holloway and Sou), 2002, for example.
Go back to the contents for the full report, then click on the chapter you were reading.
Click on “References” so you can get more details about the citation you are interested in. For example: Holloway, G., and T. Sou, 2002: Has Arctic sea ice rapidly thinned? J. Clim., 15, 1691-1701. J.Clim. is the name of the journal, the Journal of Climate, which is put out through the American Meteorological Society.
My full reference is

Let’s go find this paper! Go to our auraria library guide page:
http://guides.auraria.edu/mscdmeteorology1400 and click on “Databases,” then “Web of Science.” If you are doing this from home, you might have to log in with your name and student ID number. Once in the Web of Science, use your reference above to search for your paper. Maybe you want to search by author or title. Get a PDF of this paper.
Skim your peer reviewed journal article PDF file for an interesting figure related to the IPCC report. Print this page of the paper and staple it to this homework packet to hand in.
Let’s find a non-peer-reviewed article on this topic. Summarize your topic into a simple phrase that you can search for. My search phrase is

Let’s use Google to search. Go to www.google.com and type your phrase into the search. Search for it! On the left-hand-side on your list of pages you searched for, Google lets
you choose what type of thing you are searching for. Let's search for a blog that discusses this topic! (Blogs are under "more.") Browse a few of these links. Find one that you’d like to focus on. The blog or article that I’d like to focus on was written by this person or organization:

Please discuss in a well-formulated, typed one page essay, the differences between the three references you looked at (the IPCC AR4, a journal article, a blog post).

- Discuss the authenticity, validity, and reliability of each of these works.
- Where did each author get their information?
- Did the author of the journal article give enough information for another scientist to try to replicate the same experiment to check the results?
- Briefly describe the peer review processes.
- Did any of the three works insert their opinion about the topic or did they only discuss the science?
- Which of the three works was the most recent? The oldest? Why do you think this is?
Homework #7

Locating sources and evaluating their authenticity, validity, and reliability

Go to http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf or type “IPCC summary for policymakers” into your search engine and click on the first link.

Skim this document

Find a figure or bullet point that is of particular interest to you. Note that each figure and bullet point show in brackets{} the area in the full document where this topic is discussed. Pick the area in the full document that you want to dig into further.

I’d like to dig into this section further ________.

Go to the contents for the full IPCC AR4 document here:

Find the section you indicated above. Once you are in the section, do some reading about your topic, using the arrows in the upper right to go to the next page. You can always zoom in on a figure by clicking on it. While you are reading, look for a citation to a journal article that you’d like to look up. (Holloway and Sou), 2002, for example.

Go back to the contents for the full report, then click on the chapter you were reading. Click on “References” so you can get more details about the citation you are interested in. For example: Holloway, G., and T. Sou, 2002: Has Arctic sea ice rapidly thinned? J. Clim., 15, 1691–1701. J.Clim. is the name of the journal, the Journal of Climate, which is put out through the American Meteorological Society.

My full reference is

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Let’s go find this paper! Go to our auraria library guide page:
http://guides.auraria.edu/mscdmeteorology.1400 and click on “Databases,” then “Web of Science.” If you are doing this from home, you might have to log in with your name and student ID number. Once in the Web of Science, use your reference above to search for your paper. Maybe you want to search by author or title. Get a PDF of this paper.

Skim your peer reviewed journal article PDF file for an interesting figure related to the IPCC report. Print this page of the paper and staple it to this homework packet to hand in.

Let’s find a non-peer-reviewed article on this topic. Summarize your topic into a simple phrase that you can search for. My search phrase is

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Let’s use Google to search. Go to www.google.com and type your phrase into the search. Search for it! On the left-hand-side on your list of pages you searched for, Google lets
you choose what type of thing you are searching for. Let’s search for a blog that discusses this topic! (Blogs are under “more.”) Browse a few of these links. Find one that you’d like to focus on.
The blog or article that I’d like to focus on was written by this person or organization:

Please discuss in a well-formulated, typed one page essay, the differences between the three references you looked at (the IPCC AR4, a journal article, a blog post).

- Discuss the authenticity, validity, and reliability of each of these works.
- Where did each author get their information?
- Did the author of the journal article give enough information for another scientist to try to replicate the same experiment to check the results?
- Briefly describe the peer review processes.
- Did any of the three works insert their opinion about the topic or did they only discuss the science?
- Which of the three works was the most recent? The oldest? Why do you think this is?
The graph above shows the concentrations of carbon dioxide (in parts per million by volume, ppmv) measured in the atmosphere at Mauna Loa, Hawaii. These concentrations are representative of the lower atmosphere in most of the world.

1. Approximately what was the average concentration of CO₂ in 1960?

2. Approximately what was the average concentration of CO₂ in 2007?

3. By about what percent did CO₂ concentrations increase between 1960 and 2007?

4. Prior to the industrial revolution in the 1800s, the average concentration of CO₂ was about 280 ppmv. By approximately what percent have CO₂ concentrations increased from their pre-industrial value?

5. Using your answers to the preceding questions, when do you expect CO₂ concentrations to reach values that are double their pre-industrial value?

6. By about how many ppmv do CO₂ concentrations decrease from May to September (and increase from October to May)?

7. Provide a reason why CO₂ concentrations decrease from May to September.
Solar Heating and Temperature

The following are the average monthly temperatures (°F) for San Francisco, CA and Chicago, IL. Use this information to answer the questions below.

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco</td>
<td>58.7</td>
<td>52.2</td>
<td>53.3</td>
<td>55.6</td>
<td>58.1</td>
<td>61.5</td>
<td>62.7</td>
<td>63.7</td>
<td>64.5</td>
<td>61.0</td>
<td>54.8</td>
<td>49.4</td>
</tr>
<tr>
<td>Chicago</td>
<td>21.0</td>
<td>25.4</td>
<td>37.2</td>
<td>48.6</td>
<td>58.9</td>
<td>68.6</td>
<td>73.2</td>
<td>71.7</td>
<td>64.4</td>
<td>52.0</td>
<td>40.0</td>
<td>26.6</td>
</tr>
</tbody>
</table>

(a)  

<table>
<thead>
<tr>
<th></th>
<th>Month with most sunlight</th>
<th>Month with least sunlight</th>
<th>Warmest month</th>
<th>Coldest month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago</td>
<td>____________</td>
<td>____________</td>
<td>____________</td>
<td>____________</td>
</tr>
<tr>
<td>San Francisco</td>
<td>____________</td>
<td>____________</td>
<td>____________</td>
<td>____________</td>
</tr>
</tbody>
</table>

(b) One might expect that the warmest month would be the month with the most solar heating, and the coldest month would be the month with the least solar heating. Does your answer to (a) confirm this? Explain why or why not.

(c) Perth is on the west coast of Australia in the Southern Hemisphere, at about the same latitude (°S) as Chicago and San Francisco. Based on your answers to (a) and (b), what are likely to be the warmest and coldest months at Perth?

warmest: ____________  coldest: ____________
From the maps of average January and July global temperatures, estimate the average seasonal temperature change in degrees Fahrenheit at the following locations:

1. Northern Siberia
2. The Aleutian Islands
3. Regina, Canada
4. Los Angeles, CA
5. Miami, Florida
6. Amazon River Delta

7. Over the globe, at what latitudes are the smallest seasonal temperature changes found?

8. Where are large seasonal temperature changes found?
Interpreting a Sounding

Use the data from the sounding to answer the questions. Include units when appropriate.

1. Identify and label the temperature line and dewpoint line on the sounding.
2. What is the surface air temperature?
3. What is the surface pressure?
4. What is the surface dewpoint temperature?
5. What is the 850 mb dewpoint depression?
6. At what pressure level is the tropopause?
7. What is the speed of the strongest wind?
8. Which layer is a cloud layer above Green Bay? (Identify the layer by the pressures at the top and bottom.)
9. What is the wind speed and direction at 500 mb?
10. Carefully circle the inversion layer in the lower atmosphere.
Environmental Lapse Rates

The sounding below shows the temperature measured over a single location. Compute the environmental lapse rate for each layer of the atmosphere listed below. Use the standard atmosphere altitudes on the bar on the left to determine altitudes. Identify inversion layers (they will have a positive lapse rate).

\[
\text{Lapse Rate} = \frac{\text{change in temperature (°C)}}{\text{change in height (km)}} = -\frac{(T_2 - T_1)}{(H_2 - H_1)}
\]

<table>
<thead>
<tr>
<th>Layer</th>
<th>Change in Temperature</th>
<th>Lapse Rate (°C/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface to 1 km</td>
<td>(25°C – 20°C) / (1 km – 0 km)</td>
<td>+5°C/km</td>
</tr>
<tr>
<td>1 to 3 km</td>
<td></td>
<td></td>
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<tr>
<td>3 to 5 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 7 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 to 8 km</td>
<td></td>
<td></td>
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<tr>
<td>8 to 10 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 to 12 km</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Diagram showing temperature variations with altitude]
Activity #14 Find the Front

Find the front!

Each pair of station models below shows data from the same station six hours apart. During that time, a front passed the station. Based on the station models, determine what type of front passed by choosing from the list. Use each selection only once. Draw in the front symbol as it would appear on a weather map.

| C Cold Front | D Dry Line |
| W Warm Front | U Upper Level Front |
| O Occluded Front |

<table>
<thead>
<tr>
<th>BEFORE</th>
<th>AFTER</th>
<th>FRONT</th>
<th>MAP SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 29</td>
<td>54 42</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>85 74</td>
<td>83 37</td>
<td></td>
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</tr>
<tr>
<td>73 65</td>
<td>56 38</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>33 29</td>
<td>24 21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using the map below:

a. Draw isobars at 4-mb intervals (e.g., 1004 mb, 1008 mb, 1012 mb).
b. Label the low pressure center with an "L."
c. Draw the warm and cold fronts.
d. Label a maritime tropical (mT) and continental polar air mass (cP).
e. Outline the area where cloud cover exceeds 75%.
f. Shade the areas receiving precipitation.
Activity # 21

Name__________________

Hurricanes

Information about the rotational wind speeds and forward movement of four hurricanes is provided in the sketches below. Four quadrants in each storm are defined relative to the direction the storm is moving. Use the information to evaluate the winds in the eyewall in the four quadrants of the storm (right, left, front and back). In addition, use the information provided to determine the Saffir-Simpson rating of each hurricane.

<table>
<thead>
<tr>
<th>Hurricane</th>
<th>Wind in each quadrant</th>
<th>Saffir-Simpson rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby</td>
<td>N: _______ S: _______ E: _______ W: _______</td>
<td></td>
</tr>
</tbody>
</table>
The top diagram below is a cross-section of the clouds and circulations within a strong hurricane. The shaded areas represent the eyewall and spiral rainbands. In the lower portions of the diagram, show schematically how the surface pressure, surface wind speed, rainfall rate, 700 mb temperature and storm surge height vary across the storm. Also, use the graph to the right of the cross-section to show how the wind speed varies with altitude in the eyewall. (Assume the hurricane is not stationary.)
Choose the BEST answer and be sure to read ALL of the answers before choosing the best one.

1. You buy a bag of chips in Denver and then drive to higher elevations to go skiing. The volume of the bag of chips is _______________ at the top of the mountain. (Hint: use the ideal gas law.)
   a. bigger
   b. smaller
   c. the same, volume does not change if pressure changes

2. The jet stream in the northern hemisphere comes FROM the _______. The jet stream in the southern hemisphere comes FROM the _______.
   a. east, east
   b. west, west
   c. east, west
   d. west, east

3. What is a haboob?
   a. a scale of atmospheric motion
   b. a sea breeze
   c. a dust or sandstorm that forms from a downdraft of a thunderstorm
   d. a willy-willy
   e. a tornado

4. To measure pressure, we use a ____________.
   a. anemometer
   b. barometer
   c. thermometer
   d. sling psychrometer

5. If city 1 and city 2 are at the same elevation and have the same air pressure at the surface, then what could cause the height of an air column above city 1 to be smaller than the height of an air column above city 2?
   a) The Coriolis force
   b) The pressure gradient force
   c) The air above city 1 is cooler than the air above city 2
   d) The air above city 1 is warmer than the air above city 2
   e) This scenario is physically impossible

6. Using the same picture, at letter B, the pressure would be _______ than the pressure at letter A. (Note that A and B represent upper levels, not the surface.)
   a. higher
   b. lower
   c. the same
   d. colder

7. As you move 1 km in the horizontal direction the air pressure will vary ______ than when you move 1 km in the vertical direction. [Think: walking across Denver (horizontal) versus climbing a mountain (vertical).]
   a) at the same rate
   b) more quickly
   c) more slowly
8. A line connecting points of equal pressure is called _______.
   a) an isotherm
   b) an isobar
   c) sea level pressure
   d) a low pressure system

9. An area of high pressure is called a(an) _______ and an area of low pressure is called a(an) _______.
   a) cyclone, anticyclone
   b) cyclone, depression
   c) anticyclone, cyclone
   d) cold front, tornado

10. At the surface in the Northern Hemisphere winds blow _____ and _______ an area of low pressure.
    a) clockwise, in towards
    b) clockwise, out from
    c) counterclockwise, in towards
    d) counterclockwise, out from

11. The amount of pressure change that occurs over a given horizontal distance is called the ________.
    a) pressure tendency
    b) coriolis parameter
    c) pressure gradient
    d) potential gradient

12. The Coriolis force is caused by _______.
    a) wind motions only
    b) day / night temperature differences
    c) the rotation of the earth
    d) the fact that the poles are colder than the equator

13. At point A the pressure gradient force is _______ than at point B. The pressure gradient force (PGF arrow) at point A would be directed from _______.
    a) larger, right to left
    b) larger, left to right
    c) smaller, right to left
    d) smaller, left to right

14. For a wind speed of 10 mph the maximum deflection due to the Coriolis force (the strongest Coriolis force) would occur at ________.
    a) the equator
    b) the North Pole
    c) 45 degrees south latitude
    d) 45 degrees north latitude
15. When Bart Simpson visited Australia in the Southern Hemisphere, he flushed the toilet at the American Embassy, which was equipped with a huge mechanical contraption that changes the direction of the water so that it flushes “the American way”. In reality, does the Coriolis force cause toilets in the southern hemisphere to flush in the opposite direction as toilets in the northern hemisphere?
   a. yes, the Coriolis force acts to the right in the northern hemisphere and to the left in the southern hemisphere
   b. no, the Coriolis force acts to the left in the northern hemisphere and to the right in the southern hemisphere
   c. yes, the Coriolis force acts on all scales of fluid motion
   d. no, the Coriolis force only acts on large scales of fluid motion

16. Using the upper level weather map at the left, answer the following question. In the Northern hemisphere the geostrophic wind at point X would blow from ________.
   a) the bottom towards the top of the page (to the north)
   b) the top towards the bottom of the page (to the south)
   c) left to right (from the west, towards the east)
   d) right to left (from the east, towards the west)

17. At upper levels, the wind tends to blow ________.
   a) at right angles to the isobars or contour lines
   b) parallel to the isobars or contour lines
   c) at an angle between 10 and 30 degrees to the isobars and towards lower pressure
   d) at an angle between 10 and 30 degrees to the isobars and towards higher pressure

18. Why does the wind blow?
   a) the Coriolis force
   b) the pressure gradient force
   c) the centripetal force
   d) the friction force

19. At the surface, wind tends to blow ________.
   a) at right angles to the isobars or contour lines
   b) parallel to the isobars or contour lines
   c) at an angle between 10 and 30 degrees to the isobars and towards lower pressure
   d) at an angle between 10 and 30 degrees to the isobars and towards higher pressure

20. Put the scales of atmospheric motion in order from smallest scale to largest scale:
   a) microscale, synoptic scale, global scale, mesoscale
   b) mesoscale, microscale, synoptic scale, global scale
   c) microscale, synoptic scale, mesoscale, global scale
   d) microscale, mesoscale, synoptic scale, global scale

21. Put the weather phenomena in order from smallest scale to largest scale:
   a) high pressure system, small turbulent eddies, land-sea breeze, longwaves in the westerlies
   b) small turbulent eddies, land-sea breeze, high pressure system, longwaves in the westerlies
   c) land-sea breeze, high pressure system, small turbulent eddies, longwaves in the westerlies
   d) land-sea breeze, small turbulent eddies, high pressure system, longwaves in the westerlies
22. In order to find cyclones and anticyclones, one uses a map of
   a) station pressure readings from around the country
   b) pressures adjusted to sea level (sea level pressure)

23. In Florida, a sea breeze circulation will reverse direction and become a land breeze
   a) once a year
   b) at the beginning and the end of the summer
   c) only when a front is approaching
   d) usually once per day

24. The land-sea breeze is a thermal circulation that initially starts because
   a) water heats and cools more slowly than land
   b) land heats and cools more slowly than water
   c) clouds shade the land
   d) low pressure always develops over water

25. If the weather forecast for Denver predicts a Bora for tomorrow you would expect
   a) a cool, rainy day
   b) heavy snow
   c) a warm, dry, windy day
   d) a cold, dry, windy day

26. What natural hazard is associated with Santa Ana winds in southern California?
   a) wildfires
   b) mudslides
   c) floods
   d) tornadoes
   d) hurricanes

27. In the Hadley cell __________.
   a) warm air rises near the equator
   b) air moves from the poles towards the equator in the upper atmosphere
   c) air moves towards the poles at the surface
   d) all of the above
   e) none of the above

28. Large deserts of the world are found near __________ due to _______ motion.
   a) 60 degrees latitude, sinking
   b) 60 degrees latitude, rising
   c) 30 degrees latitude, sinking
   d) 30 degrees latitude, rising

29. The intertropical convergence zone (ITCZ) is found near __________ and is associated with
    __________.
   a) at the poles, Santa
   b) 60 degrees latitude, the polar front
   c) 30 degrees latitude, doldrums
   d) the equator, thunderstorms
30. This ocean current is responsible for warm waters off the U.S. east coast:
   a. Kuroshio
   b. Canary
   c. Labrador
   d. Gulf Stream
   e. Australia

31. The California current is a _______ current.
   a. warm
   b. cold

32. El Nino is ____________.
   a) an anomalous warming of water in the eastern equatorial Atlantic ocean
   b) an anomalous cooling of water in the eastern equatorial Atlantic ocean
   c) an anomalous warming of water in the eastern equatorial Pacific ocean
   d) an anomalous cooling of water in the eastern equatorial Pacific ocean

33. During an El Nino, one would expect thunderstorms and flooding near
   a. Australia
   b. Japan
   c. New Zealand
   d. Peru

34. An air mass is characterized by similar properties of _____ and _____ in any horizontal direction.
   a) temperature, pressure
   b) pressure, winds
   c) pressure, moisture
   d) temperature, moisture

35. cP air masses that affect the weather in the continental United States can originate over
   a) the North Atlantic ocean
   b) the Gulf of Mexico
   c) the deserts of Mexico
   d) northern Canada

36. Lake effect snow, such as the 22 inches that fell on Friday the 13th (October 2006) in Buffalo, New York, knocking out electricity to thousands of residents, occurs when ______ ______ air blows over relatively _________ water.
   a. continental polar; warm
   b. continental tropical; cold
   c. maritime tropical, warm
   d. maritime tropical, cold
37. The following four panels all have the same weather observations plotted on them. Which panel shows the correct position of the warm front?

a) panel A  b) panel B  c) panel C  d) panel D
38. A front drawn on a weather map with alternating triangle and semi-circle symbols on opposite sides of the front is a ________ and we often find these backed up against the Rocky Mountains, not going anywhere.

a) cold front  
b) warm front  
c) stationary front  
d) occluded front

39. When a ______ passes over a city, cold, dry air replaces warm, moist air and thunderstorms and other violent precipitation events are associated with this frontal passage.

a) cold front  
b) warm front  
c) stationary front  
d) occluded front

40. To locate a front on a weather map you would look for ________.

a) a large change in temperature over a short distance  
b) a large change in moisture over a short distance  
c) a shift in wind direction  
d) all of the above

41. Between the cold and warm front (the southeast quadrant) in a well-developed mid-latitude cyclone in the U.S., one often finds a ________ air mass.

a) cP  
b) mT  
c) cT  
d) mP

42. For a surface low pressure center to intensify, the upper level trough should be located to the ________ of the surface low.

a) north  
b) south  
c) east  
d) west

43. Developing mid-latitude cyclones generally have ______ air near the surface and ______ air aloft.

a) converging, diverging  
b) diverging, converging  
c) converging, converging  
d) diverging, diverging

44. The strongest rising motion (upward vertical motion) would be found above ______ at the surface.

a) high pressure  
b) low pressure  
c) divergence  
d) cold air
45. A ________ develops in the later stages of cyclone development
   a. cold front
   b. warm front
   c. dry line
   d. occluded front

46. When looking for a place to drive to for a great day of storm chasing (and by great, I mean lots of tornadoes and large thunderstorms), I would look for a _________ on a surface observation map by looking at the different values of _________.
   a. Warm front, temperature
   b. Stationary front, pressure
   c. Dry line, dew point temperature
   d. Occluded front, temperature

47. If a cyclone gets really strong, we might say it has deepened. How does its pressure change?
   a. the central pressure gets lower
   b. the central pressure gets higher
   c. the central pressure stays the same

48. A monsoon is
   a) a heavy rainfall
   b) a seasonal change in wind direction
   c) a hurricane
   d) a flood
   e) a tornado or cyclone

49. Knowing the common placement of a surface cyclone with respect to an upper level trough, the surface cyclone will be steered _________.
   a. towards the west (from the east)
   b. towards the north (from the south)
   c. towards the northeast (from the southwest)
   d. towards the southeast (from the northwest)

50. The forecast calls for the center of a Nor’Easter to be located directly over New Jersey. What weather should they expect in New Jersey?
   a. a sunny day
   b. clouds, wind, rain or snow
   c. land breeze
   d. Santa Ana winds

Please see the next page for the graphical/symbolic/short answer portion of the exam.
51. Label the low pressure system with an 'L'.
52. Contour a cyclone by drawing several isobars and labeling them.
53. Sketch in the position of the cold and warm fronts.
54. Label the air masses that the fronts separate.
55. Given the 500mb map on the next page, draw an L where you think the low center will be in 24 hours. (Remember, Colorado is about 400 miles long.)
56. Using the wind barb in eastern Kansas as a basis for the geostrophic wind in the above 500mb map, draw a force balance diagram below indicating the pressure gradient force, Coriolis force, and wind vector for the station in eastern Kansas.

57. How would this wind in Kansas be different if it were located at the surface?
Sample Syllabus-- MTR 1400 – Weather and Climate

Text Book: The textbook for the class is the sixth edition of Essentials of Meteorology: An Invitation to the Atmosphere by C. Donald Ahrens.

Credits: 3 (3 + 0)

Prerequisite: Minimum performance standard scores on reading, writing, and mathematics pre-assessment placement tests

Description: This course introduces the fundamental physical processes in the atmosphere-- heat and energy, temperature, pressure, wind, clouds, precipitation, and stability. These concepts provide the basis for understanding weather systems such as thunderstorms, tornadoes, and hurricanes. These processes are also applied to climatic patterns and the impacts of human activity on weather and climate, such as air pollution and climate change. This course does not apply toward a meteorology major or minor.

Instructor Goals for students: The atmosphere is a complex and exciting subject! You will take away basic knowledge about how the weather works and the skills to begin to dissect phenomena in the physical world on your own. Carl Sagan, a famous astrophysicist, author, and popularizer of science once said, “Science is a way of thinking much more than it is a body of knowledge.” Although we will cover a large body of knowledge of basic meteorology and climate in this class, most importantly, you will learn science skills and a “way of thinking.” These skills will help you use the basic knowledge you learn here to continue to understand and discover the physical world long after this class! You will also successfully pass assessments on each of the learning objectives below throughout the course.

Learning objectives for Natural and Physical Sciences General Studies courses

1. Demonstrate effective use of technologies appropriate to the task and discipline
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose
10. Describe how the methods of science are used to generate new knowledge
11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.
19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.
20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.

Learning objectives specific to this course (numbers in parenthesis refer to general studies objectives above)

1. Explain how energy is transferred throughout the Earth system (11, 19);
2. Identify forcing mechanisms for upward vertical motions and explain how they can lead to cloud and precipitation formation (11, 19);
3. Utilize basic knowledge of atmospheric processes to dissect and explain weather phenomenon or climate systems (10, 11, 19);
4. Use the scientific method to assess atmospheric processes (10, 11, 19, 20, 21);
5. Analyze and interpret data presented in graphs, weather maps, and statistical data (1, 10, 11, 19, 20, 21);
6. Exhibit proficient use of technology by using the internet to locate reliable sources for current weather observations, forecasts, and timely information on inclement weather, while recognizing the limitations or uncertainty in the data (1, 2, 19).
Schedule: this is subject to changes/adjustments

<table>
<thead>
<tr>
<th>Week</th>
<th>Subject</th>
<th>Read</th>
<th>HW due</th>
<th>In-class activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Syllabus, The Earth's Atmosphere</td>
<td>Ch 1</td>
<td></td>
<td>#0 The Keeling Curve</td>
</tr>
<tr>
<td></td>
<td>Scientific Method</td>
<td>handout</td>
<td></td>
<td>#1 Surface Stations</td>
</tr>
<tr>
<td>2</td>
<td>Warming the Earth and the Atmosphere</td>
<td>Ch 2</td>
<td></td>
<td>#2 Temp scales, latent heat</td>
</tr>
<tr>
<td></td>
<td>Air Temperature</td>
<td>Ch 3</td>
<td></td>
<td>#3 Seasons</td>
</tr>
<tr>
<td>3</td>
<td>Take Measurements outside</td>
<td>Ch 4</td>
<td>1 (Ch 1-2)</td>
<td>#4 Soundings</td>
</tr>
<tr>
<td></td>
<td>Humidity, Condensation</td>
<td></td>
<td></td>
<td>#5 Humidity</td>
</tr>
<tr>
<td>4</td>
<td>Fog, Clouds</td>
<td>Ch 5</td>
<td></td>
<td>#6 Naming Clouds</td>
</tr>
<tr>
<td></td>
<td>Cloud Development and precipitation</td>
<td></td>
<td></td>
<td>#7 Stability</td>
</tr>
<tr>
<td>5</td>
<td>Precipitation processes and types</td>
<td>Ch 6</td>
<td>2 (Measurements)</td>
<td>#8 Precipitation types, sleet</td>
</tr>
<tr>
<td></td>
<td>Exam 1 over Chapters 1-5</td>
<td></td>
<td></td>
<td>ACTIVITIES DUE!</td>
</tr>
<tr>
<td>6</td>
<td>Air pressure and winds</td>
<td>Ch 7</td>
<td></td>
<td>#9 Cyclones vs Anticyclones</td>
</tr>
<tr>
<td></td>
<td>Surface Winds</td>
<td></td>
<td></td>
<td>#10 Pressure contouring</td>
</tr>
<tr>
<td>7</td>
<td>Atmospheric Circulation</td>
<td>Ch 8</td>
<td>3 (Ch 6-7)</td>
<td>#11 Chinooks</td>
</tr>
<tr>
<td></td>
<td>Global Winds</td>
<td></td>
<td></td>
<td>#12 El Nino Conditions, NAO</td>
</tr>
<tr>
<td>8</td>
<td>Air masses</td>
<td>Ch 9</td>
<td>4 (Scientific Method)</td>
<td>#13 Air Masses, Lake effect snow</td>
</tr>
<tr>
<td></td>
<td>fronts</td>
<td></td>
<td></td>
<td>#14 Find the front</td>
</tr>
<tr>
<td>9</td>
<td>Mid-latitude Cyclones</td>
<td>Ch 10</td>
<td></td>
<td>#15 Contour a cyclone</td>
</tr>
<tr>
<td></td>
<td>Exam 2 over Chapters 6-8</td>
<td></td>
<td></td>
<td>ACTIVITIES DUE!</td>
</tr>
<tr>
<td>10</td>
<td>Forecasting</td>
<td>Ch 11</td>
<td></td>
<td>#16 Forecasting the cyclone</td>
</tr>
<tr>
<td></td>
<td>Forecasting</td>
<td></td>
<td></td>
<td>#17 Analyzing instrument data</td>
</tr>
<tr>
<td>11</td>
<td>Thunderstorms</td>
<td>Ch 12</td>
<td>5 (Weather Online)</td>
<td>#18 T-storm structure</td>
</tr>
<tr>
<td></td>
<td>Thunderstorms and Lightning</td>
<td></td>
<td></td>
<td>#19 Lightning</td>
</tr>
<tr>
<td>12</td>
<td>Tornadoes</td>
<td>Ch 13</td>
<td></td>
<td>#20 Tornado Forecast</td>
</tr>
<tr>
<td></td>
<td>Hurricanes</td>
<td></td>
<td></td>
<td>#21 Hurricane winds and movement</td>
</tr>
<tr>
<td>13</td>
<td>Air Pollution and Ozone depletion</td>
<td>Ch 14</td>
<td></td>
<td>#22 Climate preconceptions</td>
</tr>
<tr>
<td></td>
<td>Climate</td>
<td>Ch 15</td>
<td>6 (Ch 11, 14)</td>
<td>#23 Vostok Ice Core</td>
</tr>
<tr>
<td>14</td>
<td>Climate Change</td>
<td>Ch 16</td>
<td></td>
<td>#24 Arctic Sea Ice</td>
</tr>
<tr>
<td></td>
<td>Climate Change</td>
<td></td>
<td></td>
<td>#25 Carbon footprint</td>
</tr>
<tr>
<td>15</td>
<td>Atmospheric Optics</td>
<td>Ch 17</td>
<td>7 (Sources)</td>
<td>#26 Name that optical phenomena</td>
</tr>
<tr>
<td>16</td>
<td>Review</td>
<td></td>
<td>None</td>
<td>ACTIVITIES DUE!</td>
</tr>
<tr>
<td></td>
<td>Final Exam is cumulative, with a focus on chapters 9-15</td>
<td></td>
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</tr>
</tbody>
</table>
Grading:
Your final grade in this course will be made up of:

- **Three in-class exams:**
  - Exam 1: 20%
  - Exam 2: 20%
  - Final Cumulative Exam: 25%

- **In-class activities (11%)**—Hand me a packet of your in-class activities on exam days for a complete or not-complete grade on each worksheet, which we will correct together in class.

- **Homeworks/Lab writeups (24%)**—7 homeworks or lab writeups, drop the lowest score, each homework is worth 4% of final grade

Your final letter grade in this class will be determined from your final grade (as calculated above) and the following letter grade divisions:

- 90-100% = A
- 80-89.99% = B
- 70-79.99% = C
- 65-69.99% = D
- 0-64.999% = F

**Exams:** Please put the exam dates into your calendar and plan accordingly. If you miss an exam for a legitimate emergency, written proof will be required before arrangements can be made. Arrangements may include an essay exam taken the next class period after the missed exam. Two or more missed exams will not be accommodated.

**Homework:** Some homework assignments will act as study guides for the exams. Other homework assignments will give you a chance to use the internet to find weather observations and forecasts as well as scientific sources. At least one homework will be a lab writeup based on a lab experiment conducted during class. The lowest homework grade of the seven homeworks will be dropped because I will not accept late homework or e-mailed homework! If you are not in class, you must put the homework under my door or in my mailbox before the due date.

**In-class activities:** There are 26 total in class activities, one for each non-exam day. I will allow you to miss four classes without penalty or the need to tell me your reason for missing, and only count your activities out of 22. If you have more than 22 activities by the end of the course, you will receive bonus points for these, worth as much as any of the other activities. Each class period we will take a break from lecturing for a chance to do an activity (usually a worksheet done in groups that involves quantitatively applying lessons learned during lecture or readings from the textbook). You will complete each activity and keep them as study materials until exam day, when you will staple all of the activities together and turn them in for a complete/incomplete grade for each activity. These will make up 5% of your grade. In-class activities cannot be made up, even for excused absences. I cannot replicate the unique classroom experience that attendees will experience, and therefore, I cannot give credit to people not in attendance. If you would like a copy of an old activity for the sake of study material, you will have to attend my office hours and I will give you a copy marked "Missed Class" at the top so you cannot receive credit. I rarely bring copies of old in-class activities to class with me. You may not collect in-class activities for your classmates who do not attend class.

**Academic Dishonesty**
Students are encouraged to work in groups on the homework assignments and in-class activities, but copying any part of an assignment (or exam) from another person is unacceptable. Make sure that you answer the homework questions in your own words, even if you work with a group of people. Two homework assignments with the same sentences, word for word, will be considered copied and both parties will be equally punished. Cheated work will receive no credit and I will submit an accusation or violation report to the appropriate authorities.

Cheating on an exam is very serious. To avoid any confusion, always keep your eyes on your own paper, do not touch your cell phone or other electronic devices during an exam. Do not talk, do not wear headphones, and do not look at materials other than your exam. I will not hesitate to take away your exam if I suspect you of being dishonest. To avoid the consequences of having a violation report filled out against you, and to avoid the consequences of receiving a zero on an exam, please be conscious of everything you do on exam days to avoid incident.

Do not make photocopies of your in-class activities for your classmates who were not in class. These are meant as a means of taking attendance. Students not in attendance should not get credit for being in attendance, no matter the excuse.
Academic dishonesty is a serious offense because it diminishes the quality of scholarship and the learning experience for everyone on campus. An act of academic dishonesty may lead to such penalties as reduction of grade, probation, suspension, or expulsion.

**Classroom behavior**
Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities.

**Class Attendance on Religious Holidays**
Students at Metro State who, because of their sincerely held religious beliefs, are unable to attend classes, take examinations, participate in graded activities or submit graded assignments on particular days shall without penalty be excused from such classes and be given a meaningful opportunity to make up such examinations and graded activities or assignments provided that advance written notice that the student will be absent for religious reasons is given to the faculty members during the first two weeks of the semester.

Nothing in paragraph one of this policy shall require Metro State faculty members to reschedule classes, repeat lectures or other ungraded activities or provide ungraded individualized instruction solely for the benefit of students who, for religious reasons, are unable to attend regularly scheduled classes or activities. However, presentations, critiques, conferences and similar activities involving individual students shall be scheduled to avoid conflicts with such students’ religious observances or holidays provided that reasonable advance notice of scheduling conflicts is given to faculty members. Because classroom attendance and participation is an important aspect of learning, Metro State students should not register for courses if regularly scheduled classes or activities routinely conflict with their religious observances or holidays (e.g., conflicts resulting in weekly absences for an entire semester).

Any Metro State student who believes that an Metro State faculty member has violated this policy is entitled to seek relief under Section V of the Metro State Equal Opportunity Grievance Procedure.

**ADA Disability Syllabus Statement**
The Metropolitan State College of Denver is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this class and are requesting accommodations, then you must first register with the Access Center, located in the Auraria Library, Suite 116, 303-556-8387.

The Access Center is the designated department responsible for coordinating accommodations and services for students with disabilities. Accommodations will not be granted prior to my receipt of your faculty notification letter from the Access Center. Please note that accommodations are never provided retroactively (i.e., prior to the receipt of your faculty notification letter.) Once I am in receipt of your official Access Center faculty notification letter, I would be happy to meet with you to discuss your accommodations. All discussions will remain confidential. Further information is available by visiting the Access center website www.mscd.edu/-.access.

**NC/Withdrawal (No Credit)**
The No Credit (NC) notation is not a grade. It may indicate withdrawal from the course or course repetition. (The NC should not be confused with a schedule change during the first 12 days of the fall or spring term [8 days for the summer term]. During this period a student may drop a course, and it will not appear on the student’s academic record.)

The “NC” notation may be used in self-paced courses to indicate that the student has not completed the self-paced course(s) and requires additional time to increase the student’s proficiency. In this case, to earn credit the student must re-register for and pay tuition and fees for the course in a subsequent term. Deadlines as described in this section apply.

- The following minimal standards shall be required throughout the College and shall be a part of all school, department, and individual faculty policies. The following is for full term classes for fall and spring semesters. Specific NC deadlines for full term classes for fall, spring, and summer semesters are published in that term’s class schedule. Prorated deadlines are available from the Office of the Registrar and the Student Accounts Office for “part-of-term” classes. “Part-of-term” classes are those classes which have start and/or end dates different from those of full-term classes. The “NC” notation is available to students for full term classes in all instances from the
12th day of the term through the fourth week of classes for fall and spring semesters. The period during which students may request an NC without the faculty member’s signature will be established for summer part-of-term and weekend courses based on percentages of the term. Deadlines for weekend and “part-of-term” classes are available from the Office of the Registrar and from the Student Accounts Office. The deadline for requesting an NC without faculty approval for full-term classes is published in the class schedule for each term. Students are expected to attend all sessions of courses for which they are registered. Each instructor determines when a student’s absences have reached a point at which they jeopardize the student’s success in a course. When absences become excessive, the student may receive a failing grade for the course. If attendance is a part of the grading criteria, that policy should be included in the individual faculty member’s class policies and outline and distributed to students on the first day of class.

- During this period, students may request an NC ONLY online at MetroConnect.
- Students reducing their course load between the beginning of the fifth and the end of the tenth week of full term classes during fall and spring semesters may receive an “NC” notation for each course provided faculty approval is granted and indicated on the request form by the faculty member’s signature or the department chair’s signature in the case of the absence of the faculty member who is the instructor of record. NC request forms with the instructor’s signature for full term classes are due to the Office of the Registrar by the deadline noted in the class schedule for any given term. Part-of-term NC deadlines are available from the Office of the Registrar or the Office of Student Accounts.
- Additional restrictions regarding assigning the “NC” notation may be set by each school, department, and/or faculty member for the period between the beginning of the fifth and the end of the tenth week of the semester (or proportional time frame). Such additional restrictions should be included in the instructor’s class outline and policies which are distributed to all students on the first day of class.
- Student requests for an “NC” notation in a given course will not be granted after the tenth week of the fall and spring semester or after the published date for summer term for full-term classes (or after the part-of-term deadlines for requesting an NC with the signature of the faculty member) unless the request is approved by the faculty member, the department chair and the dean. The “I” notation may be used during this period, provided the conditions specified in the “I” explanation above apply.
- Proportional time frames are applied for part-of-term courses, weekend courses, workshops and summer terms. These deadlines are available from the Office of the Registrar or the Office of Student Accounts. Deadlines for full-term summer classes are published in the class schedule.
- A written policy statement describing the use of the “NC” notation will be given to each student for each class in which the student enrolls.

Students are expected to attend all sessions of courses for which they are registered. Each instructor determines when a student’s absences have reached a point at which they jeopardize the student’s success in a course. When absences become excessive, the student may receive a failing grade for the course. If attendance is a part of the grading criteria, that policy should be included in the individual faculty member’s class policies and outline and distributed to students on the first day of class. Students who withdraw from a course or courses because of the death of an immediate family member, serious illness or medical emergency, or employment changes beyond the control of the student may file a Tuition and Fees Appeal Form through the Office of Student Accounts.
REGULAR COURSE SYLLABUS

School of:  Letters, Art Sciences
Department:  Earth and Atmospheric Science
Prefix & Course Number:  MTR 1600  Crosslisted With*:  
Course Title:  Global Climate Change
Check All That Apply:  Required for Major:  Required for Minor:  Specified Elective:  
Required for Concentration:  Elective:  Service Course:  
Credit Hours:  3 (3+0)
Total Contact Hours per semester (assuming 15-16 week semester):
  Lecture 45  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0
Schedule Type(s):  L  Grading Mode(s):  L
Restrictions (Variable Topics Course):  None
Prerequisite(s):  Minimum performance standard scores on reading, writing, and mathematics preassessment placement tests
Banner Enforced:  
Corequisite(s):  None

Catalog Course Description:
This course presents the science behind global climate change from an Earth systems and atmospheric science perspective. These concepts then provide the basis to explore the effect of global warming on regions throughout the world. This leads to the analysis of the observed and predicted impacts of climate change on these regions; the effect of these changes on each region’s society, culture, and economy; and the efforts of these regions to mitigate or adapt to climate change. The interdependence of all nations will be discussed in regards to fossil fuel-rich regions, regions responsible for greenhouse gas emissions, and regions most vulnerable to the impacts of climate change.

APPROVED:  
Department Chair OR Program Director  3/3/11
Dean OR Associate Dean  3/4/11
Associate VP, Academic Affairs  5/17/11

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 1600

**Required Reading and Other Materials will be equivalent to:**

Readings will also be taken from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, which is freely available online. These will be updated as future assessment reports become available. Supplementary materials may also include journal articles, news clips, climate data available online, figures and readings from other textbooks or books, and other readings relevant to the topic.

**Specific, Measurable Student Behavioral Learning Objectives:**
Upon completion of this course the student should be able to
1. Define climate and distinguish it from weather (11, 19)
2. Describe how the scientific method has led to the evolving scientific consensus and noted uncertainties on the magnitude and cause of the current global warming (10, 19, 20, 21)
3. Identify and explain positive and negative feedback systems in the Earth system and differentiate between the various time scales of these climate processes (10, 11, 19)
4. Describe the carbon cycle and its relationship to the natural and enhanced greenhouse effect (10, 11, 19)
5. Distinguish between natural and anthropogenic forcings of climate change (10, 19)
6. Analyze numerical data presented in graphs and maps and interpret means, medians, and trendlines in climate data. (1, 10, 11, 19, 20, 21)
7. Exhibit knowledge of a region or country’s climate (outside the U.S.) and the societal and cultural manifestations of that climate (19, 22, 23)
8. Describe ways in which a changing climate impacts a region’s society, culture, and economy. (1, 2, 19, 22, 23)
9. Explain where fossil fuels come from scientifically and geographically and how the locations of these resources affect the interdependence of regions and their economies (1, 2, 19, 22, 23)
10. Give examples of ways in which regions are mitigating climate change through the use of alternative energy and geoengineering and explain the motivation for this (1, 2, 19, 22, 23)
11. Explain national or international policies (implemented or proposed) aimed to reduce carbon dioxide emissions (22, 23)
12. Describe ways in which regions will adapt (by force or voluntarily) to climate change in the future (1, 2, 19, 22, 23)
13. Give examples of global conflicts that may arise due to climate change (22, 23)

**Detailed Outline of Course Content (Major Topics and Subtopics)**
I. Climate and Climate Change Basics
   a. Scientific Method
      i. Problem solving using the scientific method and importance of repeatability
      ii. Publishing scientific results in journal articles
         (Journal article setup—what we know, methods, what we have figured out, and where to advance from here)
      iii. Forming a scientific consensus (IPCC)
   b. Climate defined
      i. Climate affects people, society, culture
      ii. Historical perspective on climate change and past civilizations
   c. Global Energy Balance and the Greenhouse effect
   d. Positive and Negative feedback systems
   e. The atmospheric circulation system
      i. Relationship between atmospheric circulation and regional climates
   f. The Circulation of the Oceans
      i. Surface ocean circulation
Prefix and Course Number: MTR 1600

ii. Thermohaline circulation (deep ocean)

g. The Cryosphere and recent changes
   i. Rising sea levels
   ii. Thawing permafrost and the affect on infrastructure

h. The Carbon cycle
   i. Photosynthesis
   ii. Respiration
   iii. Decomposition
   iv. Carbon reservoirs
   v. Carbon cycle feedbacks

i. Paleoclimate Perspective on Climate Change
   i. History of glaciations and their proposed causes
   ii. Origin of fossil fuels (oil and coal specifically)

II. Contemporary Climate Change—Global Warming (Last 150 years)

a. Basics of Global Warming
   i. Observed Temperatures
   ii. Greenhouse gases: past, present, future
      1. Regional emissions (Carbon footprints)
      2. Fuel sources for regions
      3. Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES)
   iii. Climate Modeling--Climate projections
      1. Future temperatures
      2. Future precipitation patterns
      3. Extreme weather projections

b. Impacts of Global Warming (current and potential)
   i. Sea level rise
   ii. Floods, Droughts (food), and Fresh water
   iii. Human Health
   iv. Ecosystems (extinctions), biodiversity, deforestation
   v. Global Conflict and politics
      1. Northwest Passage
      2. Population displacement
      3. Food shortages

c. Vulnerabilities and Equity
   i. Unequal vulnerabilities to climate change
   ii. Issues of Distribution and Equity, Population change and economic development

d. Mitigation
Prefix and Course Number: MTR 1600

   i. Urgency to mitigate climate change
   ii. Policies to Slow Global Warming
       1. Kyoto Protocol (or updated policy as appropriate)
       2. Other proposed policies
   iii. Ways to Reduce CO₂ emissions or CO₂ concentrations
       1. Alternative Energy
       2. Geoengineering—interdependence, global solutions
   iv. Economic incentives to reduce emissions
   e. Adaptation
       i. Rising sea levels
       ii. Freshwater availability
       iii. Shifting weather patterns
       iv. Ability to adapt based on economic status
       v. Cultural and societal aspects of adapting to climate change

Evaluation of Student Performance

1. Exams on the scientific material presented
2. Homework assignments including graphical analysis and calculations using scientific data
3. Four Group Projects involving climate and climate change of selected global regions. Evaluation will be based upon papers and accompanying presentations.
4. Evaluation may also include quizzes or class participation.
School of: LAS
Department: EAS
Prefix & Course Number: MTR 2020
Crosslisted With*: ______
Course Title: Weather and Climate Lab for Scientists
Check All That Apply: Required for Major: x  Required for Minor: x  Specified Elective: ______
Required for Concentration: x  Elective: x  Service Course: ______
Credit Hours: 1 (0-2)
Total Contact Hours per semester (assuming 15-16 week semester):
Lecture: 0  Lab: 30  Internship: ____  Practicum: ____  Other (please specify type and hours): ______
Schedule Type(s): A  Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):
** NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): ______
Prerequisite(s): Completion of General Studies requirement in Quantitative Literacy
Corequisite(s): ______
Prerequisite(s) or Corequisite(s): MTR 1400
Banner Enforced:
Prerequisite(s): Completion of General Studies requirement in Quantitative Literacy
Corequisite(s): ______
Prerequisite(s) or Corequisite(s): MTR 1400
Catalog Course Description: Students are introduced to the basic measurements, calculations and analysis made in the study of atmospheric science. Meteorological lab work in the course includes surface and upper-air charts, thermodynamic diagrams, weather codes, and weather imagery. Students analyze and display weather data in multiple formats, using both traditional hand analysis and using computer analysis and display software. Skills developed include basic UNIX commands and programming logic.

APPROVED: _______________  2/11/13
Department Chair OR Program Director  Date

______________  2/11/13
Dean OR Associate Dean  Date

______________  2/15/13
Associate VP, Academic Affairs  Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:
Ng, S. and Wagner, R. (2012), *Weather and Climate Laboratory Manual*

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:

1. perform calculations using scientific notation and appropriate unit conversions;
2. solve atmospheric problems using basic physics equations;
3. draw isopleths on plotted meteorological data;
4. interpret satellite imagery, surface and upper air weather maps, and numerical model maps;
5. interpret thermodynamic diagrams to diagnose stability and thunderstorm potential;
6. calculate climate information from observed precipitation and temperature data;
7. utilize basic UNIX commands and make minor edits to computer program codes;
8. measure and interpret atmospheric data using meteorological instruments.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision) (format: I, A, l, a, etc.):

I. Scientific Calculations
   A. Scientific Notation,
   B. Dimensional Analysis and Units
   C. Conversions
II. Application of Atmospheric Physics Equations
   A. Radiation Laws
   B. Temperature and Temperature Advection
   C. Moisture and Humidity
   D. Pressure and Pressure Tendency
   E. Geostrophic Wind Calculation
   F. Stability Indices
III. Graphical Techniques
   A. Contouring
   B. Thermodynamic Diagrams
   C. Meteograms
IV. Map Interpretation
   A. Satellite Imagery: Visible, IR, and water vapor Channels
   B. Radar Imagery
   C. Surface and Upper Air Charts
   D. Numerical Model Maps
V. Instruments
   A. Thermometers
   B. Psychrometers
   C. Barometers
   D. Anemometers
VI. Computer Programming
   A. Simple UNIX commands
   B. Modifying computer programs
   C. Decoding METAR codes
VII. Weather Analysis
   A. Sea Level Pressure Analysis, 500-hPa height analysis, 850-hPa temperature analysis
   B. Streamlines, jet streaks, precipitation analysis
   C. Analysis of isotachs and jet stream
   D. Isallobaric analysis
VIII. Climatological Analysis
   A. Climate Classification
   B. Water Budgets
Evaluation of Student Performance (format: I, a, i, ii, etc.):
1. Weekly laboratory assignments comprised of calculations, map analysis and interpretation, and critical thinking exercises.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0401

Prefix & Course Number: MTR 2400 Crosslisted With*: None

Course Title: Introduction to Atmospheric Science

Check All That Apply: Required for Major: X Required for Minor: X Specified Elective: 

Required for Concentration: ____ Elective: X Service Course: ____

Credit Hours: 4 (3 + 2)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 45 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Successful completion of Level I mathematics requirement

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course provides a quantitative approach to understanding fundamental concepts in meteorology. Topics include radiation, heat balance of the atmosphere, thermodynamics, cloud formation, horizontal motion, general circulation of the atmosphere, and weather systems. In the laboratory sessions, students are introduced to surface and upper-air charts, thermodynamic diagrams, weather codes, and weather imagery. This is the introductory course designed for majors and minors in meteorology. Students receiving credit for MTR 2400 may not subsequently receive credit for MTR 1400.

APPROVED:

Department Chair OR Program Director

Date

Dean OR Associate Dean

Date

Associate VP, Academic Affairs

Date
Prefix and Course Number: MTR 2400

Required Reading and Other Materials will be equivalent to:


Specific, *Measurable* Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. describe the composition and structure of the atmosphere;
2. describe the basic laws of radiation and sun-earth radiation change;
3. draw isopleths on plotted meteorological data;
4. explain the laws that govern atmospheric motion;
5. describe basic features of the general circulation of the atmosphere;
6. interpret cloud and precipitation patterns from satellite and radar imagery;
7. interpret surface and upper air weather maps;
8. interpret basic features of numerical model maps; and
9. identify atmospheric storms and weather systems.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Atmospheric Composition and Structure
   11. Radiation and Energy in the Atmosphere
       A. Radiation processes and equations
       B. Atmospheric energy balance
       C. Controls of temperature, temperature gradients
       D. Measurement of temperature
   111. Moisture in the Atmosphere
       A. Humidity
       B. Clouds
       C. Precipitation processes
   IV. Vertical Motion and Stability
       A. Gas laws, hydrostatic equation
       B. Stability, thermodynamic diagrams
       C. Cloud development
   V. Forces and Wind
       A. Measurement of Atmospheric Pressure
       B. Isoplething of meteorological data
       C. Surface and Upper Air Charts
       D. Pressure gradient, Coriolis and Centripetal forces
       E. Geostrophic wind equation, cyclostrophic balance
       F. Frictional forces and surface winds, temperature advection
       G. Winds and vertical motion
   VI. General Circulation of the Atmosphere
       A. Global wind and pressure patterns
       B. Jet streams
       C. Atmosphere-Ocean interactions
   VII. Midlatitude Cyclones, Fronts
       A. Air masses and fronts
       B. Cyclogenesis, vorticity
       C. Longwaves, Shortwaves
   VIII. Thunderstorms
       A. Lightning
       B. Air mass thunderstorms
       C. Synoptically forced thunderstorms
       D. Hail, Microbursts, Tornadoes
   IX. Tropical Cyclones
Evaluation of Student Performance:

1. Written exams, including objective and short essay questions, map and diagram interpretation, and computations
2. Written, computational, and web-based homework assignments
3. Lab assignments, emphasizing the use of computer-based display and analysis programs
4. Final exam, comprehensive
Online or Hybrid Course Approval Form

For a course to be offered online, it must be signed and approved by the faculty member, department chair, dean and provost. Please refer to dates in the Academic Calendar for deadline information.

For an existing regular or omnibus course:
Complete this form and forward for signatures. You will also need a course adjustment form if the course needs to be added by the Registrar's Office (i.e., you are not working on a class schedule in Banner.)

For a new regular course:
The course must go through the curriculum process. This completed and signed form must accompany the new syllabus in the curriculum packet.

For a new omnibus course:
This form must accompany the omnibus syllabus and course adjustment form, if applicable.

Course Prefix and Number: MTR 2400  Online  X  Hybrid ___

Course Title: Introduction to Atmospheric Science

Term that online delivery will begin: Summer 2010

Degree or Certificate related to this course: MTR major, MTR minor,

Richard Wagner  Richard Wagner  1/6/10
Faculty Member Signature  Print Name  Date

Kenneth Enquist  1/6/10
Department Chair  Date

Linda Yang-Peratta  1/8/10
Dean  Date

Office of Academic Affairs  Date

☐ Forward to Academic Affairs for processing

Rev. 1.6.2010
Date: January 6, 2010
From: Ken Engelbrecht, Chair, Earth and Atmospheric Sciences
       Rich Wagner, Assoc. Professor of Meteorology
Re: Online Course Approval for MTR 2400

The Department of Earth and Atmospheric Sciences is requesting approval for teaching MTR 2400 Introduction to Atmospheric Science in the on-line format beginning in Summer 2010. The course is currently offered five times per year, with two sections each in the fall and spring semesters and one in the summer session.

One important reason for offering the course online in the summer is to enable transfer students who wish to begin the major the possibility of finishing the degree in two years. The course sequence and frequency of offerings for the major mean that a student entering the program in the fall without MTR 2400 would need an entire additional year to complete the degree. For various reasons, entering students may have difficulty in attending a class on campus prior to starting full-time in the summer.

The evaluation methods described in the official syllabus (attached) can be readily adapted for online delivery. The laboratory exercises can be completed without specialized software, but in many cases will require students to scan portions of completed work (e.g. hand analysis of weather maps) for submission.
School of: LAS  
Department: EAS  
Prefix & Course Number: MTR 2410  
Course Title: Weather Observing Systems  
Check All That Apply: Required for Major:  
Required for Minor: Specified Elective: X  
Required for Concentration:  
Elective: X  
Service Course:  
Credit Hours: 3 (2+2)  
Total Contact Hours per semester (assuming 15-16 week semester):  
Lecture 30  
Lab 30  
Internship 0  
Practicum 0  
Other (please specify type and hours): 0  
Schedule Type(s): L  
Grading Mode(s): L  
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):  
**NOTE: This information must be included in the course description.  
Restrictions (Variable Topics Course): None  
Prerequisite(s): MTR 2020 or MTR 2400  
Corequisite(s):  
Prerequisite(s) or Corequisite(s):  
Banner Enforced:  
Prerequisite(s): MTR 2020 or MTR 2400  
Corequisite(s):  
Prerequisite(s) or Corequisite(s):  
Catalog Course Description:  
This course provides a survey of the instruments and instrument systems used in operational and research meteorology. The theory of instrument measurement and error, operating principles, and method of operation of surface and upper air sensors, as well as radar and satellites, will be presented. The lab component of the course will involve the theory, use, calibration, and maintenance of instruments and the analysis and interpretation of the observations.  

APPROVED:  
Department Chair OR Program Director  
Date  
Dean OR Associate Dean  
Date  
Associate VP, Academic Affairs  
Date  

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 2410

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:

1. operate and properly maintain basic meteorological instrumentation;
2. interpret operating principles and sources of error for instruments and observations;
3. apply calibration procedures for instruments;
4. translate the physical principles governing instrument measurements and specifications to the observations; and
5. interpret the data obtained from the instruments.

Detailed Outline Of Course Content (Major Topics and Subtopics):

I. Requirements and Specifications of Instruments
II. Temperature Measurements
III. Pressure Measurement
IV. Windfield Measurement
V. Water Vapor Measurement
VI. Cloud and Precipitation Measurement
VII. Radiation Measurement
VIII. Automated Measuring Systems
IX. Meteorological Radar
X. Wind Profiler
XI. Satellites

Evaluation Of Student Performance:

1. short essay exams
2. lab assignments, based on instruments and computer displays of weather observations
3. final exam
REGULAR COURSE SYLLABUS

Prefix & Course Number: MTR 3100  
Course Title: Air Pollution

Check All That Apply:  
Required for Major:  
Required for Minor:  
Specified Elective: X

Required for Concentration:  
Elective: X  Service Course: ___

Credit Hours: 3 (3+0)

Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 45  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

**NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): ENV 1200 or MTR 2020 or MTR 2400

Corequisite(s):

Prerequisite(s) or Corequisite(s):

Banner Enforced:
Prerequisite(s): ENV 1200 or MTR 2020 or MTR 2400
Corequisite(s):
Prerequisite(s) or Corequisite(s):

Catalog Course Description:

This course examines the causes and control of air pollution. Topics include pollutant sources and sinks, regional and global-scale pollution problems, monitoring and sampling techniques, regulatory control, meteorological influences, and indoor air quality.

APPROVED:

Department Chair OR Program Director Date

Dean OR Associate Dean Date

Associate VP, Academic Affairs Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. compare the spatial distribution of ambient air pollutants with the geographical pattern of air pollution sources;
2. relate the definitions of air quality to its standards;
3. analyze the composition and behavior of air pollution sources;
4. design a sampling system for monitoring ambient air quality;
5. assess the control strategies employed against air pollution;
6. apply air quality data and concepts to policy decisions;
7. assess the effectiveness of state implementation plans for complying with federal air pollution mandates; and
8. analyze the sources and effects of indoor air quality

Detailed Outline Of Course Content (Major Topics and Subtopics):

I. Sources of air pollution
II. Effects of air pollution
   A. Effects on human health
   B. Effects on the environment
   C. Effects on materials
   D. Long-term planetary effects
III. Atmospheric Chemistry
IV. Ambient Air Sampling
V. Air Quality Standards, Clean Air Act Amendments
VI. U.S. Clean Air Act and Amendments
VII. Regulatory Control
VIII. Meteorological Aspects of Air Pollution
IX. Turbulence, Transport, and Dispersion
X. Air Pollution Modeling
XI. Air Pollution Climatology
XII. Indoor Air Quality
XIII. Pathways from Hazardous Waste Sites

Evaluation Of Student Performance:

1. written exams including objective and essay questions, map and diagram interpretation, and computations
2. written and web-based homework assignments
3. final exam
School of: LAS
Department: EAS
Prefix & Course Number: MTR 3330
Crosslisted With*: ___
Course Title: Climatology
Check All That Apply: Required for Major: x Required for Minor: ____ Specified Elective: ___ Required for Concentration: ____ Elective: Service Course: ___
Credit Hours: 3 (2+2)
Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 30 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0
Schedule Type(s): B Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):
** NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): None
Prerequisite(s): MTR 2020 or MTR 2400
Corequisite(s):
Prerequisite(s) or Corequisite(s):
Banner Enforced:
Prerequisite(s): MTR 2020 or MTR 2400
Corequisite(s):
Prerequisite(s) or Corequisite(s):
Catalog Course Description:
Climatology examines the characteristics, distribution, and causes of global and regional climate. Physical and dynamic mechanisms of climate are emphasized. The course also explores the spatial and temporal distributions of the main climate elements. Climate change topics include paleoclimatology, observed shifts in climate, climate model projections, and potential impacts of global warming.

APPROVED:

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<thead>
<tr>
<th>Role</th>
<th>Signature</th>
<th>Date</th>
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<tr>
<td>Department Chair OR Program Director</td>
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<td>Dean OR Associate Dean</td>
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<td>Associate VP, Academic Affairs</td>
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<td>2/15/13</td>
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*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. analyze large-scale climate controls and assess their contribution to the climate of any location;
2. diagram the earth-atmosphere energy balance and its relationship to local climate;
3. analyze the seasonal, diurnal, horizontal, and vertical distribution of temperature;
4. assess the greenhouse effect in terms of the earth-atmosphere energy balance;
5. analyze the global distribution of water vapor, clouds, fog, and precipitation;
6. analyze the general circulation of the global atmosphere;
7. analyze the ENSO (El Nino - southern oscillation) phenomenon;
8. analyze the synoptic climatology of North America;
9. assess the merits of the main climate classification systems;
10. evaluate the influence of urbanization on local climate;
11. compare and contrast typical regional climates around the world;
12. evaluate the various methods of reconstructing past climates;
13. evaluate and compare the main theories of global climate change; and
14. assess the main methods of estimating future climate.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Physical and Dynamic Climatology
   A. The study of Climatology and Applied Climatology
   B. The Energy Balance
   C. Atmospheric Temperatures
   D. Human Impact on the Energy Balance
   E. Moisture in the Atmosphere
   F. Precipitation and Water Budgets
   G. Motion in the Atmosphere
   H. Global Circulation of the Atmosphere
   I. Interannual Variation in Weather and Climate
   J. Synoptic Climatology

II. Regional Climatology
   A. Regional Climates: Scales of Study
   B. Climate classification systems
   C. Tropical Climates
   D. Midlatitude Climates
   E. Climates of North America
   F. Polar and Highland Climates
   G. Colorado climatology

III. Climates of the Past and Future
   A. Paleoclimatology
   B. Causes of Climate Change
   C. Evidence for Climate Change from Greenhouse Warming
   D. Impacts of Climate Change
   E. Adaptation and Mitigation of Climate Change
Evaluation of Student Performance

1. two exams consisting of computations, essay questions, and diagram interpretation
2. laboratory assignments based on climatic data analysis, climate classification, and water budgets.
3. research project emphasizing climate data analysis and the scientific method, including written and oral reports
METROPOLITAN STATE UNIVERSITY OF DENVER  
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of: LAS  
Department: EAS

Prefix & Course Number: MTR 3400  
Crosslisted With*: _____

Course Title: Synoptic Meteorology

Check All That Apply: Required for Major: X Required for Minor: X Specified Elective: Required for Concentration: _____ Elective: Service Course: _____

Credit Hours: 4 (3+2)  
Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 45 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): R  
Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

**NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 2020 or MTR 2400

Corequisite(s):

Prerequisite(s) or Corequisite(s):

Banner Enforced:

Prerequisite(s): MTR 2020 or MTR 2400

Corequisite(s):

Prerequisite(s) or Corequisite(s):

Catalog Course Description:

This course presents a descriptive approach to the structure and behavior of mid-latitude, synoptic-scale weather systems. Primary topics include the physics of synoptic-scale air motion, the role of synoptic weather systems in the general circulation, jet streams, airmasses, fronts, and the application of these to cyclones and anticyclones. Elementary quasi-geostrophic theory and weather forecasting are introduced.

APPROVED:

[Signature] [Date: 3/13/13]

Department Chair OR Program Director

[Signature] [Date: 3/14/13]

Dean OR Associate Dean

[Signature] [Date: 3/17/13]

Associate VP, Academic Affairs

[Signature] [Date]  

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:

**Basic Concepts of Synoptic Meteorology**, Anthony A. Rockwood, Auraria Book Center, no copyright.

Specific, *Measurable* Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. evaluate the role of synoptic-scale weather systems in global energetics;
2. relate the basic forces to explain synoptic-scale motion;
3. diagram and explain the causes of geostrophic, ageostrophic, and gradient winds;
4. analyze the relationship between temperature, pressure, and height and relate these to pressure gradients and resultant wind;
5. diagram and explain the concept of thermal wind, temperature advection, and their relationship to synoptic-scale vertical motion;
6. diagram and explain the principle of conservation of absolute and potential vorticity;
7. analyze the relationship between vorticity and synoptic-scale vertical motion;
8. diagram and explain the cause, seasonality, and variability of the Polar Front and subtropical jet streams;
9. analyze the relationship between jet streams and synoptic-scale vertical motion and fronts;
10. compare the characteristics, seasonality, and modification of the four main North American airmasses;
11. diagram and explain cold, warm, stationary, occluded fronts, troughs, drylines, and other zones of convergence associated with synoptic-scale airmasses, with emphasis on those occurring the Colorado;
12. compare and contrast frontogenesis and frontolysis;
13. diagram and explain the three-dimensional temperature, pressure, and wind structure of the idealized mid-latitude cyclone and anticyclone;
14. relate the theory of baroclinic instability to the life-cycle of a cyclone;
15. compare the elements of quasi-geostrophic theory to the Norwegian cyclone theory of cyclogenesis and cyclone life-cycle; and
16. compare common forecast techniques, including numerical weather prediction models, and choose the most appropriate ones for a particular weather situation.

**Detailed Outline of Course Content** (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Introduction
   a. Synoptic vs. Dynamic meteorology
   b. Influence of technology
   c. Some goals in the study of synoptic meteorology
   d. The role of prediction

II. Dynamics of Synoptic-scale Motion
   a. Basic Laws - Newton's Laws
   b. Coriolis effect, parameter, and force
   c. Atmospheric pressure, mass, and pressure gradients
   d. Geostrophic and ageostrophic balance
   e. Hydrostatic balance
   f. Quasi-geostrophic motion
   g. Thickness and mean layer temperature
   h. Constant pressure and height surfaces
   i. Thermal wind and temperature advection
   j. Circulation and vorticity

III. Global-scale Review
   a. Scales of motion
b. Functions of the atmosphere in the global energy balance
c. One-cell model of general circulation
d. Three-cell model of general circulation

IV. Jet Streams and Jet Streaks
a. Historical background
b. Subtropical jet stream
c. Polar Front jet stream
d. Jet streaks and vorticity - the four-quadrant model
e. Connection between jet and low-level winds
f. Southern Plains low-level jet

V. Airmasses
a. Airmass defined
b. Airmass movement
c. Primary airmasses over the US
d. Airmass modification

VI. Fronts
a. Common characteristics
b. Fronts and vertical motion
c. Fronts aloft
d. Tropopause folding
e. Frontogenesis and frontolysis
f. Identifying frontal passage (FROPA) in northeast Colorado
g. Classifying fronts
h. General descriptions of frontal types

VII. Cyclones and Anticyclones
a. Historical perspective
b. Thermal structure of cyclones and anticyclones
c. Dynamic Lows and Highs
d. 3-Dimensional model of classic cyclone
e. Airflow through the classic cyclone
f. Baroclinic instability
g. Cyclone life-cycle
h. Cyclogenesis

VIII. Introduction to Quasi-geostrophic Theory
a. Omega equation
b. Height tendency equation
c. Vertical motion and height tendency diagnosis of an ideal baroclinic wave

IX. Introduction to Synoptic-scale Forecasting
a. Types of forecasts
b. Mesoscale forecasts
c. The forecast process

Evaluation Of Student Performance:
1. written exams including objective and short essay questions, and map interpretation
2. final exam
METROPOLITAN STATE COLLEGE OF DENVER
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of Letters, Arts Sciences

Department: Earth and Atmospheric Sciences

Prefix & Course Number: MTR 3410

Course Title: Weather Analysis Techniques

Credit Hours: 3 (2+2)

Contact Hours: Lecture 30  Lab 30  Internship 0  Practicum 0

Schedule Type(s): Lect  Grading Mode(s): L

Repeat* (Variable topics): ___
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 3400

Banner Enforced Prerequisite(s): MTR 3400

Corequisite(s): None

Catalog Course Description:
This is a course in interpretation, understanding, and analysis of weather data, focusing on conventional surface and upper-air data and use of these data in current weather diagnostics. Topics include traditional hand analysis of surface and upper-air weather maps, spatial and temporal cross-sections, thermodynamic diagrams, meso-analyses, and prognostic charts. These topics form the foundation for correct and efficient use of modern computer analysis. The lab component of the course involves application of the techniques using hand analysis and computer analysis and display software.

Required Reading Materials will be equivalent to (Title, Author, Publisher, Copyright Date):
No required Text, Selected manuals and references on topics related to practical weather analysis are provided.

APPROVED:

Department Chair/Institute Director

Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3410

Specific (Measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. read and interpret surface (METAR) and upper-air weather reports;
2. apply quality control to weather reports;
3. complete a synoptic-scale analysis of a surface and upper-air weather map including isobars, isotherms, isodrosotherms, isallobars, and fronts;
4. complete a meso-scale analysis of a surface and upper-air weather map including isobars, isotherms, isodrosotherms, isallobars, and fronts;
5. plot and analyze an atmospheric temperature, dew point, and wind sounding using a Skew-T diagram, to diagnose airmass characteristics and convection potential;
6. construct and interpret a spatial cross-section of potential temperature and other thermodynamic variables;
7. interpret and use satellite and radar imagery to support weather map analyses;
8. interpret wind profiler data;
9. obtain and interpret data from operational forecast models;
10. assess forecast model data to develop a short-range, regional forecast;
11. integrate objectives 1-8 to formulate a three-dimensional conceptual model of a mid-latitude weather system.

Detailed Outline Of Course Content (Major Topics and Subtopics):

1. Interpretation of weather data
   a. surface weather observing, data quality control, ASOS, METAR observations
   b. upper-air observing, data quality control, data codes
   c. source of weather data and analyses
   d. data display using GEMPAK/GARP/TDV
   e. critique of hand vs. computerized analyses

2. Surface weather map analysis
   a. data plotting techniques
   b. contour (pressure, temperature, moisture, wind) analysis
   c. analysis of parameter change and tendency
   d. frontal analysis

3. Upper-air analysis
   a. fundamentals of constant pressure charts, vertical continuity concepts
   b. geopotential height, temperature, moisture, and wind analysis
   c. frontal analysis
   d. jet stream analysis

4. Thermodynamic Diagrams - the Skew-T
   a. plotting and analysis techniques
5. Cross-sectional analysis
   a. principles of isentropic analysis
   b. frontal cross-sections
   c. time-height analysis

6. Interpretation of numerical forecast model output
   a. overview of numerical weather prediction models
   b. predictability limits
   c. operational model data
   d. MOS

7. Meso-analysis techniques
   a. application of analysis techniques to mesoscale
   b. local analysis problems

8. Transition to computer analyses

Evaluation Of Student Performance:
1. Data interpretation quizzes
2. Surface analysis quizzes
3. Upper-air analysis quizzes
4. Comprehensive case study project
   a. selection and analysis of 10-20 maps and charts (surface, upper air, cross-section)
   b. written interpretation and synthesis of the analyses
5. Forecast model interpretation exercise
REGULAR COURSE SYLLABUS

Prefix & Course Number: MTR 3420  
Crosslisted With*: ____

Course Title: Radar and Satellite Meteorology

Check All That Apply:  
Required for Major: ____  
Required for Minor: ____  
Specified Elective: x  
Required for Concentration: ____  
Elective: x  
Service Course: ____

Credit Hours: 3 (2+2)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30  
Lab 30  
Internship 0  
Practicum 0  
Other (please specify type and hours): 0

Schedule Type(s): B  
Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 2020 and MTH 1110

or MTR 2400

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): MTR 2020 and MTH 1110

Corequisite(s): ___

Prerequisite(s) or Corequisite(s): ___

Catalog Course Description:

This course provides a physics-based study of the uses of radar and satellites and their application to various meteorological problems. Basic theories of radar and satellites will be applied to the interpretation and analysis of various radar and satellite products. The lab component focuses on the interpretation of radar and satellite imagery using computer display software.

APPROVED:  
[Signature]

Department Chair OR Program Director  
Date

[Signature]  
Date

Dean OR Associate Dean  
Date

[Signature]  
Date

Associate VP, Academic Affairs  
Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3420

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. describe the basic operating theories of radar and satellites;
2. apply the proper nomenclature concerning radars and satellites;
3. differentiate among errors produced by radar and satellite observations;
4. evaluate the use of radar and satellites in precipitation, cloud physics, and severe storm studies; and
5. synthesize information from multiple radar and satellite display products.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Review of Radar Principles
II. Radar Hardware
III. Electromagnetic Waves
IV. Radar Equation for Point Targets
V. Distributed Targets
VI. Doppler Velocity Measurements
VII. Meteorological Targets and Interpretation
VIII. Clear-Air Return
IX. Advanced Uses of Meteorological Radar
X. History of Satellite Meteorology
XI. Orbits and Navigation
XII. Radiative Transfer Review
XIII. Satellite Instrumentation
XIV. Image Interpretation
XV. Temperature and Trace Gases
XVI. Winds
XVII. Clouds and Aerosols
XVIII. Precipitation
XIX. Earth Radiation Budget

Evaluation of Student Performance

1. written exams, consisting of short essay and mathematical problem questions
2. written homework assignments, emphasizing interpretation of radar and satellite imagery
3. final exam
Prefix & Course Number: MTR 3430  
Crosslisted With*: ____

Course Title: Atmospheric Thermodynamics

Check All That Apply:  
Required for Major: x  
Required for Minor: ____  
Specified Elective: ____  
Required for Concentration: ____  
Elective: ____  
Service Course: ____

Credit Hours: 3 (3+0)

Total Contact Hours per semester (assuming 15-16 week semester):  
Lecture 45  
Lab 0  
Internship 0  
Practicum 0  
Other (please specify type and hours): 0

Schedule Type(s): L  
Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):  

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): MTH 2410, PHY 2311, PHY 2321, and MTR 2400 or MTR 2020

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): MTH 2410, PHY 2311, PHY 2321, and MTR 2400 or MTR 2020

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description:

This course covers classical thermodynamics and its application to atmospheric processes. Main topics include the equation of state, first and second laws of thermodynamics, adiabatic processes of dry and moist air, stability, thermodynamic diagrams, thermodynamic variables, and convection.
Required Reading and Other Materials will be equivalent to:


**Specific, Measurable Student Behavioral Learning Objectives:**
Upon completion of this course the student should be able to

1. assess and apply the physical laws of thermodynamics, radiation, and hydrostatics that are most applicable to the atmosphere;
2. demonstrate a unit and dimensional analysis of an atmospheric physics problem;
3. derive the equation of state for an Ideal Gas, starting from Charles’ and Boyle’s laws, and apply the equation to both a single gas and a mixture of gases;
4. derive the first law of thermodynamics in generic, work, and non-work forms, and apply each form to relevant atmospheric processes;
5. relate the first law of thermodynamics to adiabatic processes;
6. evaluate the significance of isentropic processes in atmospheric motion;
7. modify the equation of state for dry air to include water vapor;
8. compare the thermodynamics of phase changes and latent heat;
9. examine all commonly used thermodynamic variables and demonstrate their use in meteorological analysis;
10. construct a skew-T, ln $P$ diagram, and demonstrate its use as a tool for assessing stability, airmasses, and convective potential;
11. evaluate the concept of hydrostatic equilibrium as it applies to a wide range of atmospheric motion scales;
12. analyze the hydrostatics of ‘special’ atmospheres for the purpose of testing fundamental principles of hydrostatics; and
13. evaluate atmospheric stability using various methods.

**Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)**

I. **Introduction**
   A. The subjects of dynamic meteorology
   B. Laws of thermodynamics, radiation, and hydrodynamics
   C. Newton's Laws
   D. Units and dimensions
   E. Some aspects of the Earth and Atmosphere

II. **The Equation of State**
    A. Variables of state
    B. Charles' and Boyle's Laws
    C. Ideal Gas Law - equation of state for an Ideal gas
    D. Gas Law for a mixture of gases

III. **The Principles of Thermodynamics**
    A. Work, Heat, heat capacity
    B. Conservation of Energy - the First Law of Thermodynamics
    C. Adiabatic processes
    D. Poisson's Equation and potential temperature
    E. Entropy - the Second Law of Thermodynamics
    F. Reversible and irreversible processes
    G. Isentropic processes
    H. Enthalpy

IV. **The Thermodynamics of Water Vapor and Moist Air**
    A. Phase diagrams, thermal properties of water
    B. Equation of state of moist air
    C. Virtual temperature
    D. Changes of phase and latent heat
Prefix and Course Number: MTR 3430

V. The Thermodynamics of Water Vapor and Moist Air
   A. Clausius-Clapeyron Equation
   B. Supercooled water
   C. Adiabatic processes of saturated air
   D. Moist adiabatic or pseudo-adiabatic processes
   E. Equivalent potential temperature
   F. Equivalent temperature
   G. Other moisture variables
      1. Vapor pressure, absolute humidity, mixing ratio
      2. Specific humidity, relative humidity, virtual temp,
      3. Dew point temp, LCL, wet bulb temp, wet bulb potential temp

VI. Thermodynamic Diagrams
   A. General features and characteristics
   B. Skew T-Log P diagram

VII. Hydrostatic Equilibrium
   A. Hydrostatic equation
   B. Geopotential
   C. Height computations from soundings
   D. Hydrostatics of special atmospheres
      1. Homogeneous atmosphere - lapse rates
      2. Isothermal atmosphere
      3. Constant lapse rate atmosphere
      4. Dry adiabatic atmosphere
      5. U.S. Standard Atmosphere
   E. Altimetry
   F. Pressure reduction to sea level

VIII. Hydrostatic Stability and Convection
   A. General definitions
   B. Dry and moist adiabatic lapse rates
   C. Parcel method - definitions of stability
   D. Conditional instability
   E. Changes of stability during layer displacements
   F. Convective instability
   G. Slice method, entrainment
   H. Bubble theory

Evaluation of Student Performance

1. written exams including computations, short essay questions, and diagram interpretation
2. problem sets
3. final exam
REGULAR COURSE SYLLABUS

Prefix & Course Number: MTR 3440

Course Title: Physical Meteorology

Check All That Apply: Required for Major: x

Required for Minor: ___ Specified Elective: ___

Required for Concentration: ___ Elective: ___ Service Course: ___

Credit Hours: 3 (3+0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 45 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): MTH 2410, PHY 2311, PHY 2321, and MTR 2400 or MTR 2020

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced: None

Prerequisite(s): MTH 2410, PHY 2311, PHY 2321, and MTR 2400 or MTR 2020

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description:

This course is an application of classical physics to common processes in the atmosphere. Main topics include cloud and precipitation physics, atmospheric radiation, radiative transfer, lightning, optical phenomena, and weather modification.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3440

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. assess and apply the basic laws governing the emission and absorption of electromagnetic radiation;
2. relate the characteristics of solar and terrestrial radiation;
3. perform calculations of solar declination angle, zenith angle, time of sunrise/sunset, length of day;
4. synthesize all components of the average global earth-atmosphere energy budget;
5. compare the main instruments used in atmospheric radiation studies;
6. derive the radiative transfer equation for generic use, shortwave applications and longwave applications;
7. perform calculations of atmospheric heating rates from net radiant energy values;
8. assess the role of radiation in the energetics of weather systems on all scales of atmospheric motion;
9. analyze the formation of a cloud droplet from nucleation to 10μ in a non-freezing cloud;
10. analyze the formation of a raindrop from 10μ to precipitation size in a non-freezing cloud;
11. analyze the formation and growth of cloud particles in a sub-freezing cloud;
12. characterize the formation of snow and the various crystal types that are found;
13. characterize the formation of snow and the various crystal types that are found;
14. evaluate the main theories of charge separation within clouds leading to the lightning discharge;
15. analyze the sequence of steps involved in both the positive and negative lightning strokes;
16. examine and interpret the data from the national lightning detection network;
17. evaluate the main methods of intentional and inadvertent weather modification in warm and cold clouds;
18. evaluate the pros and cons of the methods of weather modification described above

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Atmospheric Radiation
   A. Terminology, radiation laws
   B. Solar geometry
   C. Characteristics of solar radiation
   D. Characteristics of terrestrial radiation
   E. Energy balances and budgets, transport requirements
   F. Radiation instruments, absorption processes
   G. Optical depth; radiative transfer equation
   H. Atmospheric heating rates
   I. Synoptic and mesoscale applications of radiation

II. Cloud Physics
   A. Aerosols and atmospheric nuclei
   B. Formation of cloud droplets
   C. Droplet growth by condensation
   D. Initiation of rain in non-freezing clouds
   E. Formation and growth of ice crystals
   F. Rain and snow; precipitation processes

III. Atmospheric Optics
   A. Mirages, rainbows, halos, coronas, etc.

IV. Atmospheric Electricity
   A. Charge separation, lightning theory, lightning detection
V. Weather Modification
   A. Snow, fog, hail, intentional versus inadvertent

**Evaluation of Student Performance**

1. Four problem sets
2. Three Exams
3. Final Exam
School of: LAS
Department: EAS
Prefix & Course Number: MTR 3450
Crosslisted With*: __
Course Title: Dynamic Meteorology
Check All That Apply: Required for Major: x  Required for Minor: ___ Specified Elective:
Required for Concentration: ___ Elective: ___ Service Course: ___
Credit Hours: 3 (3+0)
Total Contact Hours per semester (assuming 15-16 week semester):
   Lecture 45 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0
Schedule Type(s): L Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): None
Prerequisite(s): PHY 2331, PHY 2341, MTH 2420, and MTR 2400 or MTR 2020
Corequisite(s):
Prerequisite(s) or Corequisite(s): MTH 3420
Banner Enforced:
   Prerequisite(s): PHY 2331, PHY 2341, MTH 2420, and MTR 2400 or MTR 2020
   Corequisite(s):
   Prerequisite(s) or Corequisite(s): MTH 3420
Catalog Course Description:
This course covers the fundamentals of fluid dynamics necessary for understanding large-scale atmospheric motions. The focus of the course is the development, derivation, and analysis of the laws of conservation of mass, momentum, and energy, as they apply to middle latitude, synoptic scale weather systems.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3450

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. apply vector notation, algebra, and calculus to the analysis of the governing equations;
2. formulate the governing equations of mass, momentum, and energy for the atmosphere;
3. analyze horizontal flow types in our atmosphere;
4. formulate the Thermal Wind balance and analyze its application to the atmosphere;
5. formulate the equations for Circulation and Vorticity and evaluate these equations as measures of atmospheric rotation; and
6. compare this theoretical aspect of atmospheric motion to atmospheric motion as depicted on weather maps.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Review of Vectors
II. Introduction to Dynamic Meteorology
   A. Fundamental Forces
   B. Noninertial Reference Frames
   C. “Apparent” Forces
   D. Structure of the Static Atmosphere
III. The Basic Conservation Laws
   A. The Vectorial Form of the Momentum Equation in Rotating Coordinates
   B. The Component Equations in Spherical Coordinates
   C. Scale Analysis of the Equations of Motion
   D. The Continuity Equation
   E. The Thermodynamic Energy Equation
IV. Elementary Applications of the Basic Equations
   A. The Basic Equations in Isobaric Coordinates
   B. Balanced Flow
   C. The Thermal Wind
   D. Vertical Motion
   E. Surface Pressure Tendency
V. Circulation and Vorticity
   A. The Circulation Theorem
   B. Vorticity
   C. Potential Vorticity
   D. The Vorticity Equation

Evaluation of Student Performance

1. three exams
2. mathematical homework assignments
3. final exam
REQUEST FOR GENERAL STUDIES DESIGNATION (2012-13)
NATURAL AND PHYSICAL SCIENCES

Please review the Course Selection Criteria for this category for assistance in completing this form, particularly as it relates to the percentages associated with each Student Learning Outcome.

If this course is also being submitted for the Global Diversity Category, check here, and complete and attach the separate Global Diversity General Studies Designation request.

Date: 9-27-2012
School: LAS
Department: EAS

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTR</td>
<td>3500</td>
<td>3</td>
</tr>
</tbody>
</table>

Title: Hazardous Weather

Prerequisite(s): MTR 1400 or MTR 2400 or AES 1400 and completion of General Studies Written Communications requirements

Corequisite(s): None

Banner enforced prerequisite(s) and/or corequisite(s): None

Recommended maximum enrollment per section: 30

A. Student Learning Outcomes

Describe the specific ways in which this course addresses each of these Student Learning Outcomes, providing students opportunities to develop the skills and/or acquire the knowledge. Include reference to readings, discussions, lectures, and other pedagogical tools which will be used. See the Criteria Table for examples.

1. Demonstrate effective use of technologies appropriate to the task and discipline. (10%)

Students are required to locate information for two written reports, including sources of real-time and archived weather data, and reliable published research. Students also use meteorological instruments to generate data.
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)

Students are required to locate information for two written reports, including sources of real-time and archived weather data, and reliable published research.

10. Describe how the methods of science are used to generate new knowledge. (30%)

Principles of weather analysis are an excellent tool to develop the concept of generating new science knowledge. As measurements evolved, so did the ability to analyze weather phenomena and create better forecast methodologies.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)

Maps and mapping include symbolic and graphical approaches in deciphering weather events. Throughout the course, students will be able to use maps, charts, thermodynamic diagrams to interpret different types of hazardous weather.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)

Lectures, class activities will emphasize the important concepts, terminology, and patterns (temporal and spatial) associated with various types of hazardous weather. Societal impacts for each type of hazardous weather will play an important part of the course.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)

In-class discussions will frequently revolve around (1) analyzing the current weather situation and (2) predicting the evolution of weather patterns resulting in hazardous weather events. Then students will choose a real-time event, make predictions while gathering data, and present their findings in a written report.

21. Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

Accuracy and precision will be discussed in detail when describing the various “tools” available for monitoring and forecasting weather events. Students will apply these concepts in an in-class activity revolving around measurement of weather variables.

B. Assessment of Student Learning

Identify and describe at least one specific form of assessing student achievement of each Student Learning Outcome which will be a regular part of the course. Include attachments as applicable.
A single piece of student work may be used to assess student achievement of more than one Student Learning Outcome. See the Criteria Table for potential data for use in assessment.

1. Demonstrate effective use of technologies appropriate to the task and discipline.

Current Hazardous Weather Event Paper (excerpt from class syllabus follows)

Monitor an Event in Real-Time: Use real-time observations, imagery, model maps, text products to monitor a hazardous weather event. This is easiest to do for a large-scale event such as winter storms, severe thunderstorms, and hurricanes. Describe the development of the storm, as well as impacts of the storm. Include elements of the scientific method: observations, problem, hypothesis, experiment (how you tested the hypothesis), and conclusions.

Format
Approximately 4 pages in length, not including bibliographic references and figures as appropriate.

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.

Written Paper (excerpt from class syllabus follows)

Report 2 Topics: Choose from the following general topics

A. Describe an Event from the Past: Describe the development of the event, as well as human and economic impacts. Material for researching these events can include resources on the web, as well as newspaper and journal reports.

B. Emergency Management/Risk Assessment/Hazard Mitigation
Material for researching these events can include resources on the web, but should also include references from journal articles and books.

C. Forecasting Techniques/Research Advances
Material for researching these events can include resources on the web, but should also include references from journal articles and books.

Format
Approximately 4 pages in length, not including bibliographic references and figures as appropriate. You must use at least 2 properly cited published sources, but may also use additional sources from the internet.

10. Describe how the methods of science are used to generate new knowledge.

Current Hazardous Weather Event Paper (excerpt from class syllabus follows)

Monitor an Event in Real-Time: Use real-time observations, imagery, model maps, text products to monitor a hazardous weather event. This is easiest to do for a large-scale event such as winter storms, severe thunderstorms, and hurricanes. Describe the development of the storm, as well as impacts of the storm. Include elements of the scientific method: observations, problem, hypothesis, experiment (how you tested the hypothesis), and conclusions.

Format: Approximately 4 pages in length, not counting references and figures.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

Exams – See attachment 1 for sample exam.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.

**Monitor an Event in Real-Time:** Use real-time observations, imagery, model maps, text products to monitor a hazardous weather event. This is easiest to do for a large-scale event such as winter storms, severe thunderstorms, and hurricanes. Describe the development of the storm, as well as impacts of the storm. Include elements of the scientific method: observations, problem, hypothesis, experiment (how you tested the hypothesis), and conclusions. **Format:** Approximately 4 pages in length, not counting references and figures.


In-class activity requires students to make measurements using weather instruments and explore the concepts of accuracy, precision, and repeatability. See attachment 2.

**C. Conformance with Course Selection Guidelines**

Briefly describe how the course meets the course section guidelines:

The course must meet the full requirements of the Student Learning Outcomes, or must be paired with a corequisite lab course that, as a pair complete the outcomes.

This is a stand-alone course, for which all of the 7 SLO’s will be assessed.

**Approvals:**

[Signatures and dates]

Department Curriculum Committee / Date

[Signatures and dates]

Department Chair or Program Director / Date
School Curriculum Committee / Date

Sandra Slagel-Brett 1/24/12

Dean or Associate Dean / Date

Richard Wagner 3/6/13

Chair, General Studies Committee / Date

Sheila A. Thompson 3/20/13

Associate Vice President, Academic Affairs / Date
REGULAR COURSE SYLLABUS

School of Letters, Arts Sciences

Department: Earth and Atmospheric Sciences

Prefix & Course Number: MTR 3500  
Crosslisted With*: _____

Course Title: Hazardous Weather

Check All That Apply:  
Required for Major: _____  Required for Minor: _____  Specified Elective: _____
Required for Concentration: _____  Elective: X  Service Course: _____

Credit Hours: 3 (3+0)

Contact Hours: Lecture 45  Lab 0  Internship 0  Practicum 0

Schedule Type(s):  
L  Grading Mode(s):  

Variable Topics Courses: _____
Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 1400 or MTR 2400 or AES 1400, and completion of General Studies Written Communications requirements

Banner Enforced Prerequisite(s): MTR 1400 or MTR 2400 or AES 1400 and completion of General Studies Written Communications requirements

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description:
This course considers the nature and causes of hazardous weather, the predictability of hazardous weather events, and the economic and societal impacts of these events. The strategies for the protection of life and property from hazardous weather are also considered.

Required Reading and Other Materials will be equivalent to:

APPROVED:  

[Signature]

Department Chair/Institute Director  
[Signature]  

Dean  
[Signature]  

Associate VP, Academic Affairs  
[Signature]

Date  10/1/12

Date  10/24/12

Date  3/12/12

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3500

Course Category and Related Student Learning Outcomes:
The following student learning outcomes (SLOs) for this course are prescribed in the General Studies - Natural and Physical Sciences Course Selection Criteria

1. SLO #1: Demonstrate effective use of technologies appropriate to the task and discipline. (10%)
2. SLO #2: Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)
3. SLO #10: Describe how the methods of science are used to generate new knowledge. (30%)
4. SLO #11: Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)
5. SLO #19: Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)
6. SLO #20: Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)
7. SLO #21: Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. Relate and quantitatively use meteorological data, including weather observations, radar and satellite imagery, and atmospheric models to evaluate hazardous weather (SLO #1, 2, 10, 11, 19);
2. Make judgements about the predictability of hazardous weather events (SLO #10, 20, 21);
3. Use the scientific method to assess atmospheric processes (10, 11, 19, 20, 21);
4. Analyze and interpret data presented in graphs, weather maps, and statistical data (1, 10, 11, 19, 20, 21);
5. Exhibit proficient use of technology by using the internet to locate reliable sources for current weather observations, forecasts, and timely information on inclement weather, while recognizing the limitations or uncertainty in the data (1, 2, 19); and
6. Evaluate the societal impact of hazardous weather (SLO #2, 10, 19).

Detailed Outline Of Course Content (Major Topics and Subtopics)

I. The Scientific Method
   A. Scientific Theories and Laws
   B. Scientific Hypothesis

II. Tools for Predicting Severe Weather
   A. Numerical Weather Models
   B. Satellite and Radar Imagery
   C. Radar Imagery
   D. Wind profilers and Atmospheric Soundings
   E. Surface Observations

III. Mid-latitude Cyclones
   A. Air masses and Fronts
   B. Jetstream

IV. III. Winter Weather Hazards
   A. Blizzards and Snowstorms
   B. Downslope Winds
   C. Ice Storms
   D. Winter Fog
   E. Avalanches

V. Severe Thunderstorms Hazards
   A. Lightning
   B. Hail
   C. Tornadoes
   D. Microbursts

VI. Floods and Droughts
VII. Heat Waves
VIII. Hurricanes

Evaluation Of Student Performance:

1. written exams including objective and essay questions, and map interpretation
2. a minimum of two written papers
3. homework assignments that focus on analyzing and interpreting meteorological data
MTR 3500 HAZARDOUS WEATHER

Exam 1

Spring 2011

PART 1: Multiple Choice - 45 pts.

1. A falling snowflake that melts as it falls and then completely freezes prior to contact with the ground is called
   a) sleet    b) hail    c) freezing rain    d) supercooled water

2. The process by which cold, dry air is forced against the Appalachian mountains is called cold air
   a) damming   b) front   c) aloft    d) intrusion

3. As you go north through the warm front zone associated with a mid-latitude cyclone, you might expect to encounter bands of precipitation in this order:
   a) rain, snow, sleet, freezing rain
   b) snow, sleet, freezing rain, rain
   c) rain, sleet, freezing rain, snow
   d) rain, freezing rain, sleet, snow

4. The heaviest snowfall from a mid-latitude cyclone generally occurs to the ______ of the surface low.
   a) east    b) south    c) southwest    d) north

5. Lake effect snow bands are typically located to the _____________ of one of the Great Lakes.
   a. east or south   b. north or west    c. west

6. The wind chill index takes into account:
   a. temperature, humidity, wind speed, and precipitation
   b. temperature and wind speed
   c. temperature, wind speed, and solar radiation
   d. temperature, wind speed, and humidity

7. When energy loss from the body substantially exceeds energy production, internal body temperature lowers, causing
   a) hypothermia   b) hyperthermia    c) cold stress    d) wind-chill effect

8. The name for a blizzard with no falling snow (only blowing snow) is a
   a) dry blizzard    b) wind blizzard   c) radiation blizzard    d) ground blizzard

9. Heaviest snowfall rates in Denver are most often associated with
   a) westerly (downslope) winds
   b) a cold frontal passage
   c) easterly (upslope) winds
   d) lake effect snow
10. When upslope snowstorms occur in eastern Colorado, where is a surface low-pressure center located?
   a. over Wisconsin
   b. over eastern Wyoming
   c. over southeastern Colorado
   d. over the Pacific Northwest

11. What is the name given to downslope windstorms experienced in southern California?
   a. Bora  b. Chinook  c. katabatic winds  d. Santa Ana winds

12. Strong downslope winds can be regarded as a shooting flow. This shooting flow develops because a large volume of air must pass between a mountaintop and
   a. the base of a lenticular cloud
   b. the tropopause
   c. an inversion
   d. the jet stream

13. You hear reports of a winter storm with widespread power outages associated with downed power lines and trees. What is the most likely cause for these problems?
   a. winter fog  b. blowing snow  c. freezing rain  d. tornadoes

14. A common type of fog is called “radiation fog” because
   a. cold air forms over ground which has cooled as a result of radiating out heat (infrared radiation)
   b. it is formed during “nuclear winter”
   c. it spreads out or radiates in all directions
   d. it reflects away solar radiation

15. The type of avalanche where a whole layer of snow slides on top of another layer is called a ____________ avalanche.
   a) slab  b) layer  c) triggered  d) loose

PART 2: True/False - 10 pts.

16. Avalanche potential is greatest along near-vertical slopes.
17. Ice storms are more common in early morning than in early afternoon.
18. Shivering helps keep your body warm because the muscular activity is converting “food energy” into heat.
19. Cold outbreaks are associated with very slow southward movement of cold air masses.
20. Night-time fog is best shown by standard IR satellite imagery.
PART 3: Short Answer/Essay Questions - 30 pts.

21. What is frostbite? What causes the damage associated with it? What physiological might contribute to it occurring?

22. In addition to cold temperatures, what conditions can contribute to hypothermia and frostbite?

23. What are the causes for lake effect snow?
24. Where do Colorado severe downslope winds occur? During what months are they most prevalent?

25. Describe the impacts of ice storms with freezing rain.

26. Describe some of the safety precautions recommended for avoiding avalanches and for improving survival chances if caught in an avalanche.
PART 4: Map Analysis - 15 pts

For each of the maps below, identify the associated type of hazardous weather. Choose from (ice storm, lake effect snow, cold wave, plains blizzard, upslope snow, winter fog, downslope wind storm)
In-Class Assignment-- Measurements

Using instruments to find temperature, pressure, and wind speed

Objectives: Students will take measurements, compare them with measurements taken by their classmates, create a station model, and discuss accuracy and precision.

Pick two places on campus a significant distance apart. Use the instruments given to you and other means available to you to fill in the following table.

<table>
<thead>
<tr>
<th>Description of location</th>
<th>Station 1</th>
<th>Station 2</th>
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</thead>
<tbody>
<tr>
<td>Temperature (°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure (hPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloud Cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation type (if relevant)</td>
<td></td>
<td></td>
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</tbody>
</table>

Draw a station model using the data from one of your stations. Be sure to code your pressure.

Draw this station model on the white-board to share your data with the class.
Compare these to surface observations from Denver at this time, using the internet to find the current official observations. How do your observations compare?

Compare results from your group to the data from other groups in the class. Were there any differences?

Calculate the mean temperature reported by the class.

Calculate the standard deviation of temperature data reported by the class.

What can account for differences in observations among the class and the official observations?

Assuming the official report of temperatures in Denver are the true values, were the classes measurements accurate?

Were they precise?
HAZARDOUS WEATHER (MTR 3500)
SYLLABUS: SPRING 2011

Time: MW 12:30 -1:45 PM
Place: North Classroom 3112

Instructor: Dr. Richard Wagner
Office: Science 2020
Phone: 556-3166
E-mail: wagnerri@mscd.edu
Office Hours: Mondays: 2:00-4:00pm
Tuesdays 2:00-3:30pm
Wednesdays 9:00-10:30am
Other times when available or by appointment

Text: Severe and Hazardous Weather by Robert Rauber,
J. Walsh, and D. Charlevoix, 3rd Edition

Part 1: Review And Extratropical Cyclones

<table>
<thead>
<tr>
<th>DATES</th>
<th>TOPICS</th>
<th>TEXT CHAPTERS</th>
</tr>
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<tbody>
<tr>
<td>Jan. 19</td>
<td>Introduction and Review</td>
<td>(1-5)</td>
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<tr>
<td>Jan. 24, 26</td>
<td>NO CLASS</td>
<td>(6-9)</td>
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<tr>
<td>Jan. 31</td>
<td>Review</td>
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<tr>
<td>Feb. 2</td>
<td>Mid-latitude Cyclones</td>
<td>10</td>
</tr>
<tr>
<td>Feb. 7</td>
<td>Mid-latitude Cyclones</td>
<td>11</td>
</tr>
<tr>
<td>Feb. 7</td>
<td>Quiz on Chapters 10-11</td>
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Part 2: Winter Weather Hazards

<table>
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<th>TOPICS</th>
<th>TEXT CHAPTERS</th>
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<tbody>
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<td>Ice Storms</td>
<td>12</td>
</tr>
<tr>
<td>Feb. 14</td>
<td>Lake Effect Snow</td>
<td>13</td>
</tr>
<tr>
<td>Feb. 16</td>
<td>Quiz on Chapters 12-14</td>
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CLASS POLICIES

PREREQUISITE

MTR 1400: Weather and Climate or MTR 2400: Introduction to Atmospheric Science or AES 1400 Aviation Weather.

GRADING CRITERIA

Your grade will be determined as follows:

- 3 Exams: 60%
- 4 Quizzes (drop lowest): 10%
- Two Written Reports: 20%
- Class Participation / Attendance: 10%

Grading Scale

- A: 90-100%
- B: 80-89%
- C: 70-79%
- D: 60-69%

MAKE-UP EXAM POLICY

If you cannot take an exam at the scheduled time, you must arrange an alternative time in advance. A student who misses an exam because of reasonable circumstance must contact me within 48 hours to arrange a make-up exam. There will be no make-ups for quizzes. If you miss one quiz, you may drop that score.
WRITTEN REPORTS

The homework for this course will consist of 2 short written reports.

**Report 1 Topic:**
**Monitor an Event in Real-Time:** Use real-time observations, imagery, model maps, text products to monitor a hazardous weather event. This is easiest to do for a large-scale event such as winter storms, severe thunderstorms, and hurricanes. Describe the development of the storm, as well as impacts of the storm. Include elements of the scientific method: observations, problem, hypothesis, experiment (how you tested the hypothesis), and conclusions.

**Format**
Approximately 4 pages in length, not including bibliographic references and figures as appropriate.

**Due Date:** Wednesday, March 16

**Report 2 Topics:** Choose from the following general topics
A. **Describe an Event from the Past:** Describe the development of the event, as well as human and economic impacts. Material for researching these events can include resources on the web, as well as newspaper and journal reports.

B. **Emergency Management/Risk Assessment/Hazard Mitigation**
Material for researching these events can include resources on the web, but should also include references from journal articles and books.

C. **Forecasting Techniques/Research Advances**
Material for researching these events can include resources on the web, but should also include references from journal articles and books.

**Format**
Approximately 4 pages in length, not including bibliographic references and figures as appropriate. You must use at least 2 properly cited published sources, but may also use additional sources from the internet.

**Due Date:** Wednesday, Monday, April 25

**NO CREDIT (NC) POLICY**
The "NC" notation is available to students until April 4. Students are responsible for logging on to MetroConnect and indicating an NC for the appropriate courses. Under no circumstances can an NC request be processed after April 4. A complete description of the NC policy is covered in the MSCD Student Handbook.

**RELIGIOUS HOLIDAYS**

Students who are unable to attend classes, take examinations, participate in graded activities, or submit graded assignments on particular days, shall be excused from such classes, and be given a meaningful opportunity to make up such examinations and graded activities or assignments provided that advance notice is given. The policies and procedures designed to excuse class attendance on religious holidays are covered in the Student Rights and Responsibilities section of the MSCD Student Handbook.
REGULAR COURSE SYLLABUS

Prefix & Course Number: MTR 3710          Crosslisted With*: _____

Course Title: Meteorology Internship

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____
Required for Concentration: _____ Elective: x Service Course: _____

Credit Hours: 1-6 (0+3-18)

Total Contact Hours per semester (assuming 15-16 week semester):
Lecture _____ Lab _____ Internship 135-270 Practicum _____ Other (please specify type and hours):

Schedule Type(s): _____ Grading Mode(s): _____

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): May be repeated for up to 12 credit hours; the first enrollment must be a
minimum of 3 credit hours.

Prerequisite(s): Registration with the Applied Learning Center Internship Program
Corequisite(s): _____

Prerequisite(s) or Corequisite(s): _____

Banner Enforced:
Prerequisite(s): Registration with the Applied Learning Center Internship Program
Corequisite(s): _____
Prerequisite(s) or Corequisite(s): _____

Catalog Course Description: This course provides an on-the-job internship experience with an
meteorology-related company or agency. The experience must be done under qualified supervision and
the auspices of an Earth and Atmospheric Sciences faculty member.

APPROVED:

Department Chair OR Program Director
Date

Dean OR Associate Dean
Date

Associate VP, Academic Affairs
Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 3710

Required Reading and Other Materials will be equivalent to:
None

Specific, *Measurable* Student Behavioral Learning Objectives:
Determined by students and their faculty supervisor prior to the internship

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision) (format: I, A, I, a, etc.):
Determined by students and their faculty supervisor prior to the internship

Evaluation of Student Performance (format: I, a, i, ii, etc.):
Determined by students and their faculty supervisor prior to the internship
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0401

Prefix & Course Number: MTR 3720 Crosslisted With*: N/A

Course Title: Meteorological Cooperative Education II

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: X

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 1-6 (0 + 3-18)

Total Contact Hours per semester (assuming 15-16 week semester):

 Lecture 0 Lab 0 Internship 135-270 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Employment in a meteorological cooperative education position and MTR 3710

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course involves educational work experience with a consulting meteorologist, meteorological firm, or government agency. The learning process is under supervision of meteorology faculty and the meteorologist at the firm or agency.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs
Prefix and Course Number: MTR 3720

Required Reading and Other Materials will be equivalent to:

None

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. evaluate and apply knowledge acquired in the classroom to the work environment;
2. select the meteorological specialty in which the student wishes to work; and
3. select a research topic and compose a research paper pertaining to the student's work experience.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

The course content will be established by:
1. A site visit at the beginning of the semester to establish the specific nature of the student's educational work program for the semester with the resident meteorologist and the student.
2. A meeting with the student to outline the scope of the mandatory research paper and the amount of semester hours to be credited.
3. Additional site visits as necessary to coordinate and insure supervision of the educational work process.

Evaluation of Student Performance:

1. Research paper concerning some aspect of the student's work experience
2. Supervisory report submitted by the resident meteorologist
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0401

Prefix & Course Number: MTR 3730  Crosslisted With*: N/A

Course Title: Meteorological Cooperative Education III

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: X

Required for Concentration: _____ Elective: X Service Course: ____

Credit Hours: 1-6 (0-3-18)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 0 Lab 0 Internship 135-270 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Employment in a meteorological cooperative education position and MTR 3720

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course involves educational work experience with a consulting meteorologist, meteorological firm, or government agency. The learning process is under supervision of meteorology faculty and the meteorologist at the firm or agency.

APPROVED:

[Signature]

Department Chair OR Program Director Date

[Signature]

Dean OR Associate Dean Date

[Signature]

Associate VP, Academic Affairs Date
Prefix and Course Number: MTR 3730

Required Reading and Other Materials will be equivalent to:

None

Specific, Measureable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. evaluate and apply knowledge acquired in the classroom to the work environment;
2. select the meteorological specialty in which the student wishes to work; and
3. select a research topic and compose a research paper pertaining to the student's work experience.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

The course content will be established by:

I. A site visit at the beginning of the semester to establish the specific nature of the student's educational work program for the semester with the resident meteorologist and the student.
II. A meeting with the student to outline the scope of the mandatory research paper and the amount of semester hours to be credited.
III. Additional site visits as necessary to coordinate and insure supervision of the educational work process.

Evaluation of Student Performance:

1. Research paper concerning some aspect of the student's work experience
2. Supervisory report submitted by the resident meteorologist
Prefix and Course Number: MTR 4210

METROPOLITAN STATE COLLEGE OF DENVER
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of Letters, Arts Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall, Spring

Prefix & Course Number: MTR 4210 Crosslisted With*: ___

Course Title: Forecasting Laboratory I

Credit Hours: 1 (0+2)

Contact Hours: Lecture 0 Lab 30 Internship 0 Practicum 0

Schedule Type(s): Lab Grading Mode(s): letter

Repeat* (Variable topics): ___
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 3410

Banner Enforced Prerequisite(s): MTR 3410

Corequisite(s): None

Catalog Course Description:
This is a laboratory course in which the principles of synoptic meteorology and weather computer technology are used in developing a weather forecast. Students are introduced to computerized weather data access, display, and analysis using meteorological software applications. Students learn to use surface and upper-air data, satellite and radar imagery, numerical model output, and other weather data in the preparation of weather forecasts. Principles of weather briefing and forecast decision making are also introduced.

Required Reading Materials (Title, Author, Publisher, Copyright Date):
Handouts provided in class including selected sections of meteorological software manuals.

APPROVED:

Department Chair/Institute Director

Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 4210

Specific (Measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. demonstrate competence in using the Weather computer network;
2. access and use appropriate software applications to display and analyze the scope of weather products;
3. use the World Wide Web to access all types of weather information;
4. interpret the NEXRAD radar plots and reflectivity, radial velocity, and vertical wind profile modes;
5. organize the current weather information using the above systems into a weather briefing;
6. prepare and present an oral presentation of the above weather briefing to the class; and
7. synthesize the appropriate weather information using the above systems into a local, 24 hour forecast.

Detailed Outline Of Course Content (Major Topics and Subtopics) or Outline Of Field Experience/Internship (experience, responsibilities and supervision):

I. Introduction to weather data systems
   A. GEMPAK/GARP
   B. WWW
   C. NEXRAD
   D. Weather data distribution system
II. GEMPAK/GARP
   A. Display and analysis of surface and upper-air data
   B. Satellite and radar imagery
   C. Model output
   D. Text products
III. NEXRAD radar data
   A. Reflectivity
   B. Radial velocity
   C. Vertical wind profile interpretation
IV. Internet - World Wide Web weather data access
V. Introduction to weather briefings
   A. Information organization
   B. Presentation methods
VI. Introduction to weather forecasting
   A. Review of skills
   B. Forecast methodology
   C. Organization of data
   D. Decision making
   E. Checklists
   F. Forecast presentation
Evaluation Of Student Performance:

1. attendance
2. oral presentation of weather briefing
3. oral presentation of forecast
4. final exam
METROPOLITAN STATE COLLEGE OF DENVER
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of Letters, Arts, Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall, Spring

Prefix & Course Number: MTR 4220

Course Title: Forecasting Laboratory II

Credit Hours: 1 (0+2)

Contact Hours: Lecture 0  Lab 30  Internship 0  Practicum 0

Schedule Type(s): Laboratory  Grading Mode(s): Letter

Repeat* (Variable topics): ______
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 4210

Banner Enforced Prerequisite(s): None

Corequisite(s): None

Catalog Course Description:
This course follows MTR 4210, Forecasting Laboratory I. Students practice the skills learned in MTR 4210 in a more independent setting, gaining experience in computerized data analysis, diagnosis, and weather forecasting.

Required Reading Materials (Title, Author, Publisher, Copyright Date):
Handouts provided in class including selected sections of meteorological software manuals.

APPROVED:

[Signature]
Department Chair/Institute Director  Date

[Signature]
Dean  Date

[Signature]
Associate VP, Academic Affairs  Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:

1. demonstrate increased competence using the Metlab computers,
2. use McIDAS and GEMPAK/GARP applications to analyze increasingly complex weather situations,
3. generate diagnostic graphics and save them to a personal web site for archive and retrieval,
4. interpret the NEXRAD radar plots and reflectivity, radial velocity, and vertical wind profile modes,
5. organize the appropriate weather information using the above systems into a local, 24 hour forecast.

Detailed Outline Of Course Content (Major Topics and Subtopics) or Outline Of Field Experience/Internship (experience, responsibilities and supervision):

I. McIDAS/GEMPAK/GARP usage
   A. Advanced techniques in display and analysis of weather data surface and upper air data
   B. Advanced techniques in numerical model display and interpretation
   C. expanded use of NWX text products
II. 24 hour weather forecast for DIA
   A. review of skills and forecast methodology
   B. advanced temperature and precip forecast concepts
III. Techniques in forecast verification
   A. Post-analysis discussions

Evaluation Of Student Performance:

attendance
Forecast skill scores
Final exam
METROPOLITAN STATE COLLEGE OF DENVER
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of Letters, Arts, Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall, Spring

Prefix & Course Number: MTR 4230 Crosslisted With*: ______

Course Title: Forecasting Laboratory III

Credit Hours: 1 (0+2)

Contact Hours: Lecture 0 Lab 30 Internship 0 Practicum 0

Schedule Type(s): laboratory Grading Mode(s): letter

Repeat* (Variable topics): ______
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 4220

Banner Enforced Prerequisite(s): None

Corequisite(s): None

Catalog Course Description:
This lab allows students to continue to develop skills learned in MTR 4220, Forecasting Laboratory II, in an independent setting, gaining experience in computerized data analysis, diagnosis, and weather forecasting. Forecast format is that of the National Collegiate Weather Forecasting Contest, allowing students to participate in the National Contest, if desired.

Required Reading Materials (Title, Author, Publisher, Copyright Date):
Handouts provided in class including selected sections of meteorological software manuals.

APPROVED:

[Signature]
Department Chair/Institute Director

[Signature]
Dean

[Signature]
Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. demonstrate increased competence using the Metlab computers,
2. use McIDAS and GEMPAK/GARP applications to analyze increasingly complex weather situations,
3. generate diagnostic graphics and save them to a personal web site for archive and retrieval,
4. prepare a forecast in accordance with NCWFC format.
5. organize the appropriate weather information using the above systems into a local, 24 hour forecast.

Detailed Outline Of Course Content (Major Topics and Subtopics) or Outline Of Field Experience/Internship (experience, responsibilities and supervision):
I. McIDAS/GEMPAK/GARP usage
   A. Advanced techniques in display and analysis of weather data surface and upper air data
   B. Advanced techniques in numerical model display and interpretation
   C. Techniques in model intercomparison
   D. expanded use of NWX text products
II. 24 hour weather forecast for DIA
   A. review of skills and forecast methodology
   B. advanced temperature and precip forecast concepts
   C. NCWFC forecast procedures
III. Techniques in forecast verification
   A. Post-analysis discussion

Evaluation Of Student Performance:
attendance
Forecast skill scores
Final exam
REGULAR COURSE SYLLABUS

School of Letters, Arts Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall, Spring

Prefix & Course Number: MTR 4240 Crosslisted With*: _____

Course Title: Forecasting Laboratory IV

Credit Hours: 1 (0+2)

Contact Hours: Lecture 0 Lab 30 Internship 0 Practicum 0

Schedule Type(s): laboratory Grading Mode(s): letter

Repeat* (Variable topics): _____ *(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 4230

Banner Enforced Prerequisite(s): None

Corequisite(s): None

Catalog Course Description:
This lab allows students to continue to develop skills learned in MTR 4230, Forecasting Laboratory III, in an independent setting, using advanced computerized data analysis and diagnosis to generate a weather forecast. Forecasts format is that of the National Collegiate Weather Forecasting Contest, so students may participate in the National Contest, if desired. Students may also lead weekly departmental weather briefings.

Required Reading Materials (Title, Author, Publisher, Copyright Date):
Handouts provided in class including selected sections of meteorological software manuals.

*If crosslisted, attach completed Course Crosslisting Agreement Form
Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. demonstrate a high level of competence using the Metlab computers,
2. use McIDAS and GEMPAK/GARP applications to analyze complex weather situations,
3. generate diagnostic graphics and save them to a personal web site for archive and retrieval,
4. prepare a forecast in accordance with NCWFC format,
5. organize the appropriate weather information using the above systems into a local, 24 hour forecast,
6. Present 30 minute weather briefing to Department faculty and students.

Detailed Outline Of Course Content (Major Topics and Subtopics) or Outline Of Field Experience/Internship (experience, responsibilities and supervision):
I. McIDAS/GEMPAK/GARP usage
   A. Advanced techniques in display and analysis of weather data surface and upper air data
   B. Advanced techniques in numerical model display and interpretation
   C. Techniques in model intercomparison
   D. Analysis of model biasing
II. 24 hour weather forecast for DIA
    A. Advanced temperature and precip forecast concepts
    B. Local mesoscale forecasting methods
    C. NCWFC forecast procedures
III. Techniques in forecast verification
    A. Post-analysis discussion
IV. Weather Briefing concepts

Evaluation Of Student Performance:
attendance
Forecast skill scores
Final exam
REGULAR COURSE SYLLABUS

School of: LAS
Department: Earth and Atmospheric Science (EAS)
Prefix & Course Number: MTR 4400
Course Title: Advanced Synoptic Meteorology
Check All That Apply: Required for Major: X Required for Minor: Required for Concentration: Specified Elective: Elective: Service Course:

Credit Hours: 3 (2+2)
Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 30 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0
Schedule Type(s): B Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course):
Prerequisite(s): MTR 3450 and PHY 2331
Corequisite(s): None
Prerequisite(s) or Corequisite(s): MTH 3420

Banner Enforced:
Prerequisite(s): MTR 3450 and PHY 2331
Corequisite(s): None
Prerequisite(s) or Corequisite(s): MTH 3420

Catalog Course Description:
This course is a calculus-based examination of the three dimensional structure of mid-latitude, synoptic scale weather systems. Main topics include quasi-geostrophic theory, extratropical cyclone structure and evolution, diagnosis of vertical motions, jet streams, and frontogenesis. The lab component involves the hand analysis and computer-based analysis of live, forecasted, and archived weather data.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:

1. Diagnose upward vertical motions on the synoptic scale using the terms in the quasigeostrophic omega Equation
2. Use the quasigeostrophic height tendency equation to determine the propagation and intensification of a system
3. Diagram Q-vectors to determine areas of upward vertical motion
4. Determine areas of upward and downward vertical motions within a jet streak and explain jet stream dynamics
5. Distinguish between frontogenetic and frontolytic processes
6. Describe cyclogenesis and cyclone self-development, and compare new and conventional theories for occlusion
7. Describe the three dimensional structure of synoptic-scale weather systems
8. Distinguish precipitation type using temperature and moisture profiles
9. Formulate rules of thumb for weather forecasting using QG theory, then perform a weather analysis on live weather
10. Use numerical weather prediction products in forecasting while understanding predictability and chaos theory
11. Design and assemble series of weather maps showing the synoptic meteorology of a cyclogenesis event
12. Orally present a complete analysis of a weather event

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Introduction, Background, and Basics
   a. Scales of motion
   b. Variables, coordinate systems
   c. The governing equations
   d. Geopotential, thickness and thermal wind
   e. Vorticity and the vorticity equation

II. Quasigeostrophic Theory
   a. The basic equations and quasigeostrophic approximations
   b. The quasigeostrophic omega equation
      i. Jet Streak Dynamics
   c. The quasigeostrophic height tendency equation
   d. Addition of diabatic processes to the quasigeostrophic system
   e. Quasigeostrophic potential vorticity and the height tendency equation

III. Isentropic Analysis
   a. General Overview on interpretation of charts

IV. PV Analysis
   a. General Overview on interpretation of charts

V. Extratropical Cyclones
   a. Cyclones in the climate system
   b. Climatology of cyclones
   c. Cyclogenesis
      i. Vorticity View
      ii. Pressure View
      iii. Quasigeostrophic interpretation
      iv. Upper-trough structure and evolution
      v. Sutcliffe-Petterssen “self development”
      vi. PV framework
Prefix and Course Number: MTR 4400

vi. Explosive cyclogenesis
vii. Cyclone classifications

VI. Fronts
a. Definition
b. Kinematic frontogenesis
c. Dynamic frontogenesis
d. Types of fronts
   i. Cold
   ii. Warm
   iii. Occluded
   iv. Middle- and upper-level

VII. Cold Air Damming (Optional topic)
a. Physical Mechanisms
b. Cold air damming climatology, classification, impact
c. Cold air damming erosion

VIII. Winter Storms (Optional topic)
a. Forecast considerations
b. Physical processes
c. Precipitation type forecasting techniques
d. Lake-effect precipitation

IX. Numerical Weather Prediction (Optional Topic)
a. Historical Perspectives
b. Dynamical Core
c. Parameterization
d. Data Assimilation
e. Ensemble Forecasting
f. Model configuration and MOS

X. Lab Exercises may include the following topics
a. Thermal wind
b. Q-vectors
c. Quasigeostrophic omega interpretation
d. Quasigeostrophic height tendency interpretation
e. Frontal cross section

Evaluation of Student Performance

1. Written exams including computations, essay questions, and diagram interpretation.
2. Laboratory Exercises
3. Oral Presentation
4. Comprehensive Final Exam
REGULAR COURSE SYLLABUS

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall or Spring Semesters

Prefix & Course Number: MTR 4410 Crosslisted With*: __

Course Title: Numerical Weather Prediction

Credit Hours: 3 (3+0)

Contact Hours: Lecture 45 Lab 0 Internship 0 Practicum 0

Schedule Type(s): lecture Grading Mode(s): Letter

Repeat* (Variable topics): __

*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 3450, MTH 3420, and MTH 1510 or an equivalent course in an approved programming language.

Banner Enforced Prerequisite(s): None

Corequisite(s): None

Catalog Course Description:

This course presents the theoretical background to numerically modeling the atmosphere using the primitive equations. Current numerical models will be analyzed and finite-difference techniques will be applied to a simple computer model of the atmosphere developed during the course.

Required Reading Materials (Title, Author, Publisher, Copyright Date):

Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:

1. formulate a method to numerically solve the set of primitive equations;
2. evaluate the limitations of the numerical method;
3. assess the sources of error in various numerical models;
4. analyze the forecasts of a number of numerical models; and
5. construct and test run a simple numerical model of the atmosphere.

Detailed Outline Of Course Content (Major Topics and Subtopics):

I. Numerical Weather Prediction
   A. Historical Background
   B. Filtering Meteorological Noise
   C. The Finite Difference Method
   D. The Barotropic Vorticity Equation in Finite Differences
   E. Constructing a Numerical Model based on the Barotropic Vorticity Equation

II. Current Operational Models
   A. The Spectral Model
   B. The Nested Grid Model
   C. The Eta Model
   D. The Medium Range Forecast Model
   E. The Aviation Model
   F. The Rapid Update Cycle Model

Evaluation Of Student Performance:
1. Midterm Exam
2. Term Paper
3. Class Computer Modeling Project
METROPOLITAN STATE COLLEGE of DENVER  
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of: LAS  
Department: EAS

Prefix & Course Number: MTR 4500  
Crosslisted With*: ___

Course Title: Mesomeetorogology  

Check All That Apply:  
Required for Major: X  
Required for Minor: ___  
Specified Elective: ___  
Required for Concentration: ___  
Elective: ___  
Service Course: ___

Credit Hours: 3 (2+2)

Total Contact Hours per semester (assuming 15-16 week semester):
  Lecture 30  Lab 30  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Gracing Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None

Prerequisite(s): MTR 3410 and MTH 1410

Corequisite(s):

Prerequisite(s) or Corequisite(s):

Banner Enforced:
  Prerequisite(s): MTR 3410 and MTH 1410
  Corequisite(s):
  Prerequisite(s) or Corequisite(s):

Catalog Course Description:

This is an advanced course in recognizing, understanding, and forecasting mesoscale weather events (severe thunderstorms, hailstorms, tornadoes, downslope windstorms, flash floods, snowstorms, etc) with emphasis on theory, analysis of weather data, and forecast decision making.

APPROVED:

[Signature]

Department Chair OR Program Director

[Signature]  Date

Dean OR Associate Dean

[Signature]  Date

Associate VP, Academic Affairs  
[Signature]  Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:


**Specific, Measurable Student Behavioral Learning Objectives:**
Upon completion of this course the student should be able to

1. compare and contrast the various definitions of the mesoscale;
2. appraise the various methods of mesoscale forecasting;
3. analyze the conditions conducive to a Colorado Front Range downslope windstorm;
4. contrast the cause of extreme downslope winds under pre- and post-frontal conditions;
5. analyze the conditions conducive to cyclonic and anticyclonic snow events in eastern Colorado;
6. compare and contrast the major categories of convective storms;
7. analyze the conditions conducive to severe thunderstorms, hail storms, tornadic storms, flash floods, and microbursts over the southern Plains and the High Plains; and
8. present analyses of plotted weather data leading to a diagnosis of potential for a severe downslope windstorm, a severe thunderstorm, a tornadic thunderstorm, a cyclonic snow event, and an anticyclonic snow event.

**Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)**

I. Introduction to Mesometeorology
   A. course objectives, format
   B. books, papers, case studies
   C. map discussions

II. Mesoscale Weather Concepts
    A. scaling concepts
    B. short-range forecasting
       1. linear and non-linear extrapolation
       2. diagnosis as a element of forecasting data, analyses, conceptual models
    C. methods of short-range forecasting
       1. Climatology, checklists, objective guidance, decision trees, expert systems
    D. an example of short-range forecasting

III. Colorado Front Range Downslope Windstorms
    A. definitions
    B. climatology, synoptic patterns
    C. overview of windstorm theory - mountain waves
       1. theory of linear waves forced by mountain ridges
       2. theory of waves in more realistic situations
       3. interpretation of clouds in satellite photos
       4. development of large-amplitude mountain waves
    D. forecasting procedure - Brown et al expert system
    E. warm advection (chinook) type example
    F. cold advection (bora) type example
    G. Ft. Collins example

IV. Colorado Snow Events
    A. Eastern Plains snow events
       1. anticyclonic "upslope" events
          a. definitions
          b. climatology, synoptic patterns
          c. physical processes - vertical motion mechanisms
          d. cold air damming, conditional symmetric instability
             e. case study - 14 December 1988
Prefix and Course Number: MTR 4500

2. cyclonic "upslope" events
   a. definitions
   b. climatology, synoptic patterns
   c. physical processes - vertical motion mechanisms

B. mountain snow events
   1. definitions
   2. climatology, synoptic patterns
   3. physical processes
   4. case study - 3 April 1989

V. Mid-latitude Convective Weather
   A. characteristics of isolated convective storms
      1. observed types of convective storms
         a. single cell thunderstorms
         b. multi-cellular thunderstorms
         c. supercell thunderstorms
   B. severe thunderstorm settings
      1. Southern Plains severe thunderstorm
      2. High Plains severe thunderstorm
   C. extratropical squall lines and rainbands
      1. definitions, examples, relation to other storms
      2. synoptic setting for squall lines
      3. example 27 April 1984
   D. tornadoes and tornadogenesis
      1. observations - tornado life cycle
      2. theories of tornadogenesis
   E. forecasting severe thunderstorms and tornadoes
      1. vertical motion, instability, thermodynamics, vertical wind shear
   F. flash floods from convective storms
      1. quasi-stationary convective events
      2. storm types
      3. synoptic setting and mean wind considerations
      5. mountain events - 31 July 1976
   G. mesoscale convective systems
      1. definitions
      2. climatology
      3. structure and life cycle
      4. large scale setting
      4. scale interactions - 7 June 1982
Prefix and Course Number: MTR 4500

**Evaluation of Student Performance**

1. Two exams
2. Final exam
3. Weather briefing
4. Comprehensive case studies, combining surface, upper-air and cross-sectional analyses with written interpretation of how each analysis contributes to the weather system structure.
REGULAR COURSE SYLLABUS

School of: LAS
Department: EAS
Prefix & Course Number: MTR 4600 Crosslisted With*: ___
Course Title: Senior Research Seminar
Check All That Apply: Required for Major: x Required for Minor: ___ Specified Elective: ___
Required for Concentration: ___ Elective: ___ Service Course: ___

Credit Hours: 3 (3+0)
Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 45 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0
Schedule Type(s): M Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): None
Prerequisite(s): MTR 4440 and senior standing
Corequisite(s):
Prerequisite(s) or Corequisite(s):

Banner Enforced:
Prerequisite(s): MTR 4440 and senior standing
Corequisite(s):
Prerequisite(s) or Corequisite(s):

Catalog Course Description:
This is a senior-level capstone course required of all Meteorology majors. Students will engage in a research project that involves the application of scientific methodology to meteorological or climatological data and problem solving. Experience will be gained in literature searches, problem statement, data handling, statistical analysis, data presentation, and presentation of results. Technical writing and oral presentation skills are emphasized.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: MTR 4600

Required Reading and Other Materials will be equivalent to:

Required reading materials will vary depending on the specific project(s) assigned. They may include scientific journal articles, technical reports, textbook chapters, and interdisciplinary reading.

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1. design a scientific research project using the scientific method;
2. collect weather and climate data and evaluate their usefulness for the project proposed;
3. judge several methods of scientific inquiry;
4. complete a literature search, using current search technology, that is appropriate for the proposed project;
5. organize, arrange, and analyze the data to address the question posed;
6. prepare a written presentation including results, in accordance with standard technical writing practices; and
7. give an oral presentation of the project including results to an audience.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Introduction to the Scientific Method
II. Meteorological and Climatological data sets
III. Scientific Inquiry – posing a research question
IV. Literature searches
V. Data analysis
VI. Presentation of results
VII. Technical writing formats and styles
VIII. Referencing
IX. Oral presentation

Evaluation of Student Performance

Student performance will be based on the written and oral presentation of the research project, as well as adherence to procedures, deadlines and formats, and class participation.
REQUEST FOR NEW OR CONTINUED SENIOR EXPERIENCE DESIGNATION

(SENIOR EXPERIENCE)

(To accompany old and new regular syllabus form and Curriculum Change Proposal forms)

Date: 11/8/2010
School: LAS
Department: EAS

<table>
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<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
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Title: Senior research Seminar

Prerequisites: MTR 440 and senior standing

Corequisites: ______

Recommended maximum enrollment per section: 20

Current Course Status (check all that apply)
☐ New course
☒ Existing Senior Experience Course

Criteria for Senior Experience

The following criteria must be addressed for all courses seeking Senior Experience designation.
Please type on this form; it will expand to accommodate any length of text.

The Senior Experience must allow students to:

1. synthesize learning through critical analysis and logical thinking.

2. apply theoretical constructs to practical applications.

3. critique philosophical tenets and current practices.

4. integrate and refine oral and/or written communication skills.
5. verify their expertise.

This course will challenge senior meteorology students to synthesize course content and skills mastered in previous coursework. The process of designing and carrying out a research project will require posing a research question in accordance with the scientific method, completing a literature search of relevant topics, and organizing and analyzing data. Written and oral presentation of research results will stress critical analysis and logical thinking, as will critiquing of fellow students' methods.