

Proposed Atmospheric Science Minor Scheme (18 Credits)

Atmospheric Science Minor Mandatory Courses			
Prerequisite	Course Number	Course Name	Credits
None	PHYS 016 (GENED)	Weather and Society	3
None	PHYS 017 (GENED)	Climate Change and Policy	3
PHYS 013, PHYS 014, MATH 156, MATH 157	PHYS 018	Introduction to Atmospheric Sciences	3
PHYS 018	PHYS 019	Atmospheric Observations and Measurements	3
Total			12
Advanced Courses for Atmospheric Science Minors (choose 2)			
PHYS 018, MATH 159	PHYS 150 ¹	Atmospheric Physics I	3
PHYS 018	PHYS 152	Introduction to Cloud Physics	3
PHYS 018	PHYS 153	Synoptic Lab and Forecasting	3
PHYS 150	PHYS 252 ^{1,2}	Remote Sensing of the atmosphere	3
Total			6
Optional Atmospheric Science courses for minors			
None	PHYS 030 ¹	Earth and Space Science I	3
None	PHYS 031 ¹	Earth and Space Science II	3
PHYS 018	PHYS 156	Climate Dynamics	3
PHYS 018,PHYS 019	PHYS 157	Applications and Data Analysis	3
Total for minor			18

1. These courses are already taught in the department of Physics and Astronomy
2. This is a graduate level course.

MEMORANDUM

THRU: Associate Dean of Arts and Sciences, Dr. Robert Catchings

FROM: Gregory S. Jenkins, Chair, Department of Physics and Astronomy

TO: Committee on Academic Policy, Standards and General Education

SUBJECT: Request for Establishing a Minor in Atmospheric Sciences in Department of Physics and Astronomy

DATE: 3/12/2010

1. The Department of Physics and Astronomy requests that Howard University and the College of Arts and Sciences formally establish a minor in Atmospheric Sciences. The minor was approved by the faculty members in the Department of Physics and Astronomy on 3/3/2010.

2. Rational for Proposal

- (a) The proposed classes provide the general student body a unique opportunity to learn about the fundamentals of weather and climate change, while also providing students in the atmospheric minor an opportunity to learn in-depth materials, gain hands-on experience as it relates to observations, measurements and computer applications. The students also experience first-hand research and measurements from the Howard University Atmospheric Observatory on the Beltsville campus.
- (b) There is at present one HBCU in the United States that confers an atmospheric science BS degree-Jackson State University. This undergraduate degree is given in the department of Physics, Atmospheric Sciences and Geosciences at Jackson State University. Establishing an atmospheric minor in the Department of Physics and Astronomy at Howard University creates the only atmospheric science program at an HBCU in the Northeastern United States. Within the Washington DC Metro area, only one program has a concentration in Atmospheric sciences. This is the new program at George Mason University. Howard University would serve as the second institution in the DC metro area to provide undergraduate courses in atmospheric sciences.
- (c) There is currently an atmospheric physics track (12 credits) for students as part of the applied physics track. However, there are no general education courses and no official credit outside of course work associated with their transcripts. Finally the majority of courses in the current atmospheric track are for graduate students. There are enough faculty members (3-4 FTEs) in the department to cover the teaching load associated with the atmospheric science minor.

- (d) The minor in atmospheric sciences provides the foundation for students who want to pursue a MS or PhD in atmospheric sciences at Howard University or another graduate program. Students who major in physics and minor in atmospheric sciences will have a competitive advantage over other students that want to pursue graduate students. The students in the atmospheric science minor can serve as a feeder to the graduate Howard University Program in Atmospheric Sciences (HUPAS). HUPAS graduate students may be offered teaching assistantship opportunities associated with proposed classes.
- (e) The Washington DC area offers atmospheric science minor students the opportunity to work at government labs (NASA, NOAA, EPA) and private companies (SAIC, HARRIS) for summer internships, cooperative work experiences and ultimately full employment. Recent MOUs with the National Center for Atmospheric Research (NCAR) and NASA Goddard Space Flight center offer additional student opportunities.
- (f) The HUPAS has just become a member of the DC-American Meteorological Society chapter. Atmospheric Science minors will become engaged the discipline at an early stage in their careers and learn about new opportunities.

3. **Description of the Minor.** The atmosphere Science minor consists of courses that will be developed by faculty in the Department of Physics and Astronomy. Some of the courses are being taught as part of the current atmospheric physics track.

4. **The following is a proposed description of a minor in atmospheric sciences:**

Requirements for a minor in Atmospheric Sciences: **18 credits** including 12 credits in PHYS 016, PHYS 017, PHYS 018, PHYS 019, PHYS 030, PHYS 031. 6 credits are required in advanced courses PHYS 150, PHYS 152, PHYS 153, PHYS 156 or, PHYS 157. Atmospheric Science minors are expected to take MATH 156, MATH 157, MATH 159 (recommended), PHYS 013, PHYS 014 in order to be successful as a minor. Students who are Physics majors will take these courses as the normal part of their course sequence.

5. **Rational for course selection regarding a minor in Atmospheric Sciences:**

- a.) The emphasis on these courses is on: (i) understanding the fundamental principles that govern atmospheric motions; (ii) understanding the principles that govern extreme weather events threatening society; (iii) understanding climate change and its linkage to public policy; (iv) developing skills in measurements, observations and computer data analysis.
- b.) The proposed atmospheric science minor at the department of Physics and Astronomy provides students with a strong background to pursue graduate studies in atmospheric sciences. Students that major in Physics and Astronomy and minor in Atmospheric Sciences will be uniquely prepared to enter the employment sectors or continue on for graduate studies in Physics or Atmospheric sciences.

6. **The point of contact** for this memo request is Dr. Gregory S. Jenkins, 202-806-6245, gjenkins@howard.edu.

PHYS 016 Weather and Society

3 Credits

Catalog Description

This algebra based course provides students with an overview of the fundamental principles that govern weather in mid-latitudes and the tropics. The goal of this course is for the student to have an understanding of the global circulation and how it impacts regional and local weather. The use of tools including numerical weather prediction models and satellite tools for observing and forecasting the weather are presented. Models that describe mid-latitude cyclones, thunderstorms, tornadoes and hurricanes are examined.

Course Objectives

The following learning objectives are covered in this course:

- Fundamental understanding of forces that govern weather
- Understanding of units of measure for describing weather
- Introduction to the concepts and applications of temperature, pressure, moisture and momentum in the atmosphere
- Introduction to electromagnetic radiation and how it is used in remote sensing for observing and measuring atmospheric properties.
- Description of models that describe the concept of air-mass and severe thunderstorms, tornadoes, cyclones and hurricanes.
- Description of agencies responsible for the protection of life and property and the role of preparedness.
- Concepts of the general circulation and the description of the Earth's general circulation as a heat engine.
- Concepts that describe the role of the ocean as a moisture source but also its role in hurricane development and seasonal variability (El Nino and La Nina)

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, quizzes, homework assignments and midterm/final exams.

Course outline

- 1: Weather Analysis: The Tools of the Trade
- 2: The Global Ledger of Heat Energy
- 3: Global and Local Controllers of Temperature
- 4: The Role of Water in Weather
- 5: Satellite and Radar Imagery: Remote Sensing of the Atmosphere
- 6: Surface Patterns of Pressure and Wind
- 7: Upper-air Patterns of Pressure and Wind
- 8: The Role of Stability in Weather
- 9: Thunderstorms
- 10: Tropical Weather, Part I: Patterns of Wind, Water and Weather
- 11: Tropical Weather, Part II: Hurricanes
- 12: Mid-Latitude I: Linking Surface and Upper-Air Patterns
- 13: Mid-Latitude II: The Cyclone Model
- 14: Mid-Latitude III: Spawning Severe Weather
- 15: A Closer Look at Tornadoes

General Education Classification and Assessment: Students enrolled in this course will be evaluated and will fulfill the following competency areas in this course: (a) Written Communication; (b) scientific reasoning, data management and data analysis; (c) critical thinking; (d) Historical awareness and cultural diversity appreciation; (e) computer information and technology.

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used.

PHYS 017 Climate Change and Policy

3 Credits

Catalog Description

This algebra based course provides students with an overview of the fundamental principles that govern the climate system, and various aspects of climate change. The goal of this course is for the student to have an understanding of anthropogenic forcing, attribution and detection and projections in the 21st century. The course examines vulnerability, adaptation strategies, mitigation strategies and the political forces both with the United States and abroad in the adoption of state, national and international policies to combat climate change.

Course Objectives

The following learning objectives are covered in this course:

- Fundamental understanding of concepts of the climate system and the science of climate change
- Understanding of units of measure for describing climate and climate change
- Introduce the concepts of greenhouse forcing, deforestation, detection and attribution
- Introduction to climate models and climate projections.
- Introduce and discuss vulnerability and vulnerable populations in the Developed and Developing world with an emphasis on the United States, the Caribbean and Africa.
- Introduce adaptation strategies to climate change and the associated costs.
- Introduce Mitigation strategies and the role of green technology in reducing carbon emission
- Introduction to international agreements and climate change policy, its implementation and various tools (such as carbon trading).

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, quizzes, homework assignments and midterm/final exams.

Course outline

1: The Climate System

2: The Greenhouse effect, feedbacks and climate forcing

3: Observing and detecting Anthropogenic climate change (Greenhouse gases and land-use change)

4: Tools for understanding climate change

- 5: Attribution of anthropogenic climate change
- 6: Projection of anthropogenic climate change
- 7: Vulnerability to anthropogenic climate change
- 8: Adaptation to anthropogenic climate change
- 9: Mitigating anthropogenic climate change
- 10: Green technology and anthropogenic climate change
- 11: National and international policy for addressing anthropogenic climate change

General Education Classification and Assessment: Students enrolled in this course will be evaluated and will fulfill the following competency areas in this course: (a) Written Communication; (b) scientific reasoning, data management and data analysis; (c) critical thinking; (d) Historical awareness and cultural diversity appreciation; (e) computer information and technology.

Ethnic Studies Categories: N/A

Global Perspectives: This course will examine anthropogenic climate change in developed and developing countries with an emphasis on the African Diaspora.

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy. The course is interdisciplinary and will seek some team teaching from the department of Political Sciences, the school of Medicine, the economics and anthropology departments, although it can be taught solely in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used.

PHYS 018 An Introduction to Atmospheric Sciences

3 Credits

Catalog Description

This calculus based course provides students with an overview of the fundamental principles and laws that govern weather in mid-latitudes and the tropics. The goal of this course is to introduce the sophomore/junior student to atmospheric thermodynamics, radiative transfer, atmospheric dynamics, atmospheric chemistry, cloud physics and extra-tropical cyclones. The use of tools for observing and forecasting the weather including numerical weather prediction models and satellite tools are discussed. Prerequisites: MATH 156, 157, PHYS 013. Co-requisites: PHYS 014.

Course Objectives

The following learning objectives are covered in this course:

- Fundamental understanding of the atmosphere's structure on various spatial and temporal scales
- An introduction to atmospheric thermodynamics
- Introduction to radiative transfer
- An introduction to atmospheric chemical processes.
- An introduction to cloud microphysics and precipitation processes
- An introduction to atmospheric dynamics and its applications to extra-tropical cyclones

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, quizzes, homework assignments and midterm/final exams.

Course outline

- 1: A Brief Survey of the Atmosphere
- 2: The Earth System
- 3: Atmospheric Thermodynamics
- 4: Radiative Transfer
- 5: Atmospheric Chemistry
- 6: Atmospheric dynamics
- 7: Extratropical Weather Systems

General Education Classification and Assessment: N/A

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

The atmospheric Science minor will be housed and taught in the department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy. The course is interdisciplinary and will seek some team teaching from the department of Political Sciences, the school of Medicine, the economics and anthropology departments, although it can be taught solely in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used.

PHYS 019 Atmospheric Instrumentation and Measurements

3 credits

Catalog Description

In this course will provide the student with lectures on the basic principles of atmospheric measurements, errors in data analysis, precision and accuracy as well as the concept of time lag and its influence in the physics of measurements. The physics and principles of operation of selected atmospheric physics instrumentation will be discussed. These will, at first, be selected research instrumentation available at the Howard University Research Campus (HURC; see table attached). In parallel with these lectures, students will be asked to design and execute a class projects which will have components that progress from conception, to development, to testing, to validation, and to critical evaluation of impact. The class will be focused on combining theory, skills and interest of the students have acquired in understanding the weather as it evolves during the semester. They will have opportunities to use data from state of the art HURC instrumentation and apply different data analysis techniques to the observations. Substantial points will be reserved to the hands-on aspect of the work done by the students. An integral part of the course will be a visit to the National Weather Service Office in Sterling, VA or to NASA/GSFC to observe cutting edge research instrumentation in ground based observations and satellite instrumentation, respectively. Prerequisite: PHYS 018

Course Objectives

The following learning objectives are covered in this course:

- Basic principles of atmospheric measurements both from static and dynamic platforms
- Data reduction principles and error analysis
- Planning, reporting and presentation of given atmospheric experiment task on time
- Time-lag for 1st and 2nd order systems and its handling in the design of an experiment
- Familiarize the students with the many types of atmospheric instrumentation: remote and in-situ

Evaluation

- The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, homework assignments, semester project (organization, timeliness, writing, critical thinking, data presentation and analysis) and midterm/final exams. A

final student independent report and presentation on a current cloud physics research topic is also required.

Course Outline

I. Atmospheric Instrumentation

- A. Basic Principles of Atmospheric measurements
 - a. Precision, accuracy and error analysis
 - b. Time lag, Time constant, 1st and 2nd order systems, Taylor's hypothesis, Cross Talk
- B. Measurement from a moving platform
 - a. Design and interpretation of data from a moving platform
- C. Aerosol and Cloud measuring systems
 - a. Satellite based aerosol studies.
- D. Tower and associated measurements
 - a. Temperature and Wind measurements
- E. Remote sensing instruments
 - a. Passive: Microwave radiometry, satellite
 - b. Active: principles of Lidars and Radars

II. Instrumentation for student selection

- A. Thermometers, Flux Towers, Precipitation Gauges,
- B. Lidars, radars, wind profilers
- C. Wind Measurements in general
- D. The Radio sounding
- E. Aerosol samplers

III. Visit to NASA/GSFC, NOAA/NWS or NIST labs.

General Education Classification and Assessment: Students enrolled in this course will be evaluated and will fulfill the following competency areas in this course: (a) Written and oral communication; (b) scientific reasoning, data management and data analysis; (c) critical thinking and hands-on work on experimentation; (d) computer information and technology.

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course: The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences. Some of the lectures will be given at the Howard University Research Campus in Beltsville Maryland and the students will use instruments that are available at HURC.

Resource Requirements:

Material- All material will be purchased through the HU bookstore or online outlets.

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used. Part of the course also requires use of state of the art instrumentation and data located at the Beltsville research campus. Department of Physics and Astronomy and its faculty operate most instruments at HURC and will make provisions for student training.

PHYS 152 Cloud and Aerosol Physics

3 credits

Catalog Description

This calculus based course provides students with an overview of the fundamental principles that govern aerosol and cloud dynamics. Aerosol and cloud physics are the basis for all atmospheric numerical models including pollution, precipitation and cloud movements. This course will provide the student a solid understanding of the basic mechanics, dynamics and kinematics of aerosol and cloud production and evolution in the atmosphere. The course uses many of the physics and mathematics of principles of mechanics, dynamics as well as oscillations and applies them to aerosols and clouds. Prerequisite: PHYS 018.

Course Objectives

The following learning objectives are covered in this course:

- Fundamental understanding of concepts of aerosol production and distribution
- Understanding the physics of diffusion and coagulation of aerosol and cloud particles
- Apply the physics of dynamics and kinematics to cloud aerosols and precipitation processes
- Introduce the complex physical processes in cloud models and interpretation of their outputs.
- Introduce the physics of lightning and lightning processes as well as its controls.
- Introduce and discuss cloud physics instrumentation and their principle of operation

Evaluation

- The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, quizzes, homework assignments and midterm/final exams. A final student independent report and presentation on a current cloud physics research topic is also required.

COURSE OUTLINE

The course will be divided into five parts: Aerosols, clouds, cloud modeling, cloud instrumentation, and electricity

I. Atmospheric Aerosols

A. Introduction to tropospheric and stratospheric aerosol: Importance in atmospheric processes and radiative transfer; description of mechanical generation of salt and dust particles; gas-to-particle conversion; sulfate and nitrate particle chemistry; carbon and other particles.

B. Size distribution: Measured and analytic aerosol size distributions

C. Evolution of size distributions and instrumentation: Homogeneous nucleation (nucleation mode); Growth by diffusion, coagulation, kinematic, cloud processing (accumulation mode); Removal – settling, impaction, collision with cloud and precipitating particles (Coarse mode)

II. Clouds

A. Warm cloud processes

1. Cloud droplet microphysics (homogenous/heterogeneous nucleation, Kelvin equation, solute effect, CCN)
2. Droplet growth by condensation
3. Initial cloud droplet size distributions (CCN spectrum measurements, effect of CCN on cloud droplet concentration)
4. Droplet coagulation and warm cloud precipitation processes

B. Ice cloud processes

1. Homogeneous/heterogeneous nucleation, ice nuclei
2. Ice particle growth by deposition
3. Crystal habits
4. Riming, aggregation, breakup, and secondary ice generation mechanisms

C. Current topics in cloud microphysics

III Cloud modeling: basic structure of cloud models will be discussed to give the student an appreciation of the complexity and ways of how the information in the previous chapters is used in day to day forecasting and research models.

IV - Cloud-physics instrumentation: An brief introduction and discussion to the cloud physics instrumentation and the physical principles used by the instruments will be provided.

V. Atmospheric Electricity: A brief introduction on cloud electrification and lightning generation will be discussed and the student will explore ways of how the aerosol and cloud physics principles studied affect and/or control lightning.

General Education Classification and Assessment: Students enrolled in this course will be evaluated and will fulfill the following competency areas in this course: (a) Written Communication; (b) scientific reasoning, data management and data analysis; (c) critical thinking and presentation (e) computer information and technology.

Ethnic Studies Categories: N/A

Global Perspectives: This course will examine anthropogenic climate change in developed and developing countries with an emphasis on the African Diaspora.

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course: The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements:

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used.

PHYS 153 Synoptic Meteorology and Forecasting

3 Credits

Catalog Description

This calculus based course provides students with the tools and skills for map analysis and forecasting mid-latitude (synoptic) weather on a daily/weekly basis. The course builds on earlier courses (PHYS 018, PHYS 019) applying concepts to daily forecasts. Students are introduced to map analysis as it relates to the development of extra-tropical cyclones and severe weather. The use of tools for forecasting the weather including numerical weather prediction models and satellite tools are discussed. Students will be required to generate daily forecasts and lead map discussions.

Course Objectives

The following learning objectives are covered in this course:

- An introduction to the station model in analyzing weather maps.
- Methods of isoplething various atmospheric variables (temperature, moisture, winds, pressure)
- Analysis of fronts, precipitation variables and developing cyclones
- Analysis of cold and warm advection through thickness maps
- Understanding storm development through upper atmospheric measurements
- The use of multiple numerical weather models in analysis in forecasting
- Determining student forecasting skills

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, labs, homework assignments and exams.

Course outline

- 1: Temperature analysis using horizontal maps and vertical cross sections.
- 2: The station model and the analysis of Sea Level Pressure, Fronts, high and low pressure systems
- 3: Remote Sensing of the atmosphere in forecast analysis
- 4: Ridges, Jet stream and jet streaks in forecasting weather
- 5: Thickness, thermal wind, Advection
- 6: Numerical Models in Forecasting

7: Vorticity, vorticity advection, divergence, convergence analysis and cyclone development

8: Vertical Motions in Synoptic scaled systems

9: Forecasts of thunderstorms and severe weather

General Education Classification and Assessment: N/A

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

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Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy. The course is interdisciplinary and will seek some team teaching from the department of Political Sciences, the school of Medicine, the economics and anthropology departments, although it can be taught solely in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used. Students will be required to use computers for map analysis.

PHYS 156 Climate Dynamics

3 Credits

Catalog Description

Climate Dynamics delve into the fundamental processes that control the past, present and future climate of Earth. Fundamentals are developed from concepts of basic dynamic meteorology, radiative transfer and thermodynamics. Basic atmospheric thermodynamics, radiative transfer, the surface energy and hydrologic budgets and atmospheric and oceanic circulation and applied to the climate system. The course is broken up into three parts : (1) the global climate system and various aspect of radiative transfer; (2) the general circulation, energy and water cycles; (3) modeling the climate system and anthropogenic climate change.

Course Objectives

The following learning objectives are covered in this course:

- The Global energy balance and its relationship to solar and infrared radiation
- The poleward transport of heat by the atmospheric and ocean system.
- The surface energy balance and its role in controlling surface conditions.
- The hydrologic cycle and its variations.
- The atmospheric and oceanic circulation
- The Evolution of Earth's climate through geologic time.
- Climate Sensitivity and Feedbacks
- Global Climate Models
- Anthropogenic climate change and GCM studies

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, labs, homework assignments and mid-term/final exams.

Course outline

- 1: Introduction to the Climate System
- 2: The Global Energy Balance
- 3: Atmospheric Radiative Transfer
- 4: The surface Energy Balance

5: The Hydrologic Cycle

6: Atmospheric and Ocean Circulation

7: Climate Sensitivity and Feedback Mechanisms

8: Global Climate Models

9: Anthropogenic Climate Change

10: The Evolution of Earth's Climate

General Education Classification and Assessment: N/A

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy. The course is interdisciplinary and will seek some team teaching from the department of Political Sciences, the school of Medicine, the economics and anthropology departments, although it can be taught solely in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used.

PHYS 157 Computer Applications to Atmospheric Sciences

3 Credits

Catalog Description

This course examines statistical, computational and numerical aspects of atmospheric. Computer programs will be designed and applied for various topics in this course using real data. Computer languages and software will be applied for various assignments throughout this courses and a basic computer language (C, Fortran) is required.

Course Objectives

The following learning objectives are covered in this course:

- Understanding the role of statistics in the interpretation of data.
- Determining significance and applying the null hypothesis to the same variable but using different datasets.
- Understanding the use objective analysis in data poor regions.
- Understanding numerical integration, interpolation and finite differencing in the atmospheric sciences.
- Understanding Ensemble forecasting and data assimilation.

Evaluation

The assessment of learning objectives as provided by the syllabus will be measured during classroom instruction periods, labs, homework assignments and mid-term/final exams.

Course outline

Chapter 1-4: Statistical measures

Chapter 5-6: Objective Analysis

Chapter 7-8: Interpolation, numerical integration and derivatives

Chapter 9: EOF analysis

Chapter 10: An introduction to Ensemble modeling and data assimilation

General Education Classification and Assessment: N/A

Ethnic Studies Categories: N/A

Global Perspectives: N/A

Special considerations

The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy.

Impact on Existing Courses: The atmospheric science minor will replace the atmospheric physics track.

Housing the Course

The atmospheric Science minor will be housed and taught in the Department of Physics and Astronomy within the College of Arts and Sciences.

Resource Requirements

Material- All material will be purchased through the HU bookstore or online outlets

Faculty Time – The Atmospheric Science minor courses will be delivered by faculty in the Department of Physics and Astronomy. The course is interdisciplinary and will seek some team teaching from the department of Political Sciences, the school of Medicine, the economics and anthropology departments, although it can be taught solely in the Department of Physics and Astronomy.

Classroom- This course requires the use of a classroom equipped with desks and chalkboard. An in-focus projector will be used. Access to computers with compilers will be required for this course.

Existing Physics courses that will be offered for the minor.

PHYS-150. Atmospheric Physics. 3

Atmospheric thermodynamics, hydrostatics, cloud and radiative processes and chemical cycles. Cloud physics and formation, energy balance, and the impact on global climate. Elementary dynamics with applications to the earth and planetary atmospheres.

PHYS-252. Remote Sensing of the Atmosphere. 3 crs.

Elements of radiative transfer as applied to the upper and lower atmospheres and ocean surface. Both passive and active remote sensing methods are discussed. Satellite technology and applications to the understanding of the Earth and extraterrestrial atmospheres will be discussed