

ASTR 390 Undergraduate Problems (1-3). N Undergraduate observational or theoretical problems in astronomy. Maximum credit, six hours. Prerequisite: Permission of department. IND

ASTR 391 Physical Astronomy, Honors (3). NP/N An honors, calculus-based introduction to astronomy and astrophysics, required for astronomy majors. Components of the Universe—from planetary systems, stellar systems, large scale structure and cosmology—are examined to illuminate the physics principles which govern their evolution. Not open to students with prior credit in ASTR 191 or ASTR 291. Prerequisite: MATH 121, and either permission of instructor, or participation in the University Honors Program. LEC

ASTR 503 Undergraduate Research (1-4). N This course is for students seeking to fulfill the undergraduate research requirement. Students are expected to participate in some area of ongoing research in the department, chosen with the help of their adviser. At the end of the term, students will present their results in a seminar to other students and faculty. (Same as EPHX 503 and PHSX 503.) Prerequisite: Junior/Senior standing in Astronomy, Engineering Physics, or Physics, or permission of instructor. IND

ASTR 591 Stellar Astronomy (3). N Fundamentals of stellar astronomy including astronomical optics and techniques, coordinate and time systems, stellar spectroscopy, properties of normal, binary and variable stars. Prerequisite: PHSX 212. An introductory astronomy course is desirable. LEC

ASTR 592 Galactic and Extragalactic Astronomy (3). N A study of stellar groups, the interstellar medium, galactic structure and dynamics, galaxies, and cosmology. Prerequisite: ASTR 591 or consent of instructor. LEC

ASTR 596 Observational Astrophysics (1-3). N Students learn skills involved in modern observational techniques using the facilities of the K.U. observatory. Maximum credit, six hours. Prerequisite: ASTR 592. LEC

ASTR 597 Analysis in Astrophysics (1-3). N Individual students work on specialized research problems in the field of observational or theoretical astrophysics. Maximum credit, six hours. Prerequisite: ASTR 592. IND

ASTR 691 Astrophysics I (3). N An introduction to radiation processes, thermal processes, and radiative transfer in stellar atmospheres and the interstellar medium. (Same as EPHX 691 and PHSX 691.) Prerequisite: PHSX 313 or consent of instructor. LEC

ASTR 692 Astrophysics II (3). N The formation and evolution of stars, nucleosynthesis of the elements, and the physical processes of high energy physics. Prerequisite: ASTR 691 or consent of instructor. LEC

ASTR 791 Seminar in Astrophysics (1-3).

ASTR 795 Space Plasma Physics (3).

Atmospheric Science

(Offered within the Department of Geography)

Chair: Terry Slocum

Associate Chair: Johannes Feddema

Lindley Hall, 1475 Jayhawk Blvd., Room 213

Lawrence, KS 66045-7613, www.geog.ku.edu, (785) 864-5143

Undergraduate Coordinator: David Mechem, 404B Lindley Hall, (785) 864-4738

Degree offered: B.S. (several options)

Why study atmospheric science? The study of atmospheric processes enables us to understand human interactions with the environment.

The program provides a fundamental knowledge of the atmosphere and the weather it generates. Interactions between weather phenomena and human decisions and activities give the subject important applications. Several tracks lead to a Bachelor of Science degree.

Majors

Students who may decide to major in atmospheric science should confer early with a departmental representative about the selection of courses.

Requirements for the B.S. Degree. Four specialized options are available for students who plan professional careers in meteorology or atmospheric science. The general meteorology option satisfies all

the traditional professional meteorology requirements for employment with the National Weather Service, airlines, or other agencies. The air pollution meteorology option meets the need for trained specialists. The hydrometeorology option may lead to a career as a meteorologist in one of the many water-related activities in private and governmental agencies. The news media forecasting option can lead to a career forecasting the weather on television or radio. The B.S. degree with any of these specialties also prepares students to begin graduate programs in meteorology or atmospheric science.

General Requirements for All Options (94-95 hours)

ATMO 105 Introductory Meteorology	5
ATMO 321/GEOG 321 Climate and Climate Change	3
ATMO 505 Weather Forecasting	3
ATMO 521/GEOG 521 Microclimatology	3
ATMO 630 Synoptic Meteorology	3
ATMO 640 Dynamic Meteorology	3
ATMO 642 Remote Sensing	3
ATMO 660 Advanced Dynamic Meteorology	3
ATMO 680 Physical Meteorology	3
ATMO 697 Seminar for Seniors	1
CHEM 184 Foundations of Chemistry I	5
COMS 130 Speaker-Audience Communication (3) or	
COMS 150 Personal Communication (3) and	
COMS 330 Effective Business Communication (3)	6
EECS 138 Introduction to Computing; FORTRAN	3
ENGL 101, ENGL 102, and any 200-level English course or	
ENGL 362 Foundations of Technical Writing	9
EVNR 148 Scientific Principles of Environmental Studies	3
MATH 581 Numerical Methods	3
MATH 121, MATH 122, MATH 223, MATH 290, MATH 320 or MATH 220,	
MATH 526 Applied Mathematical Statistics I or DSCI 301 Statistics ...	21-22
PHSX 211 and PHSX 212 General Physics I and II	8
Humanities and social sciences (one course each)	6

General Meteorology Option (29 hours)

ATMO 525 Air Pollution Meteorology	3
ATMO 605 Operational Forecasting	2
ATMO 650 Advanced Synoptic Meteorology	3
Free electives	21

Air Pollution Meteorology Option (29 hours)

ATMO 525 Air Pollution Meteorology	3
CHEM 188 Foundations of Chemistry II	5
CE 477 Introduction to Environmental Engineering and Science	3
Free electives	18

Hydrometeorology Option (29 hours)

ATMO 525 Air Pollution Meteorology	3
ATMO 605 Operational Forecasting	2
CE 301 Statics and Dynamics	5
CE 330 Fluid Mechanics	4
CE 455 Hydrology	3
Free electives	12

News Media Forecasting Option (29 hours)

ATMO 605 Operational Forecasting	2
ATMO 650 Advanced Synoptic Meteorology	3
JOUR 301 Research and Writing	3
JOUR 415 Multimedia Reporting	3
JOUR 512 Principles of Broadcasting, Cable, and New Technologies	3
Free electives	15

Concentration in Business. A student may graduate from the School of Business with a concentration in atmospheric science. Departmental requirements are

Required Courses in Atmospheric Science

ATMO 321 Climate and Climate Change	3
ATMO 505 Weather Forecasting	3
ATMO 521 Microclimatology	3
ATMO 525 Air Pollution Meteorology	3
ATMO 640 Dynamic Meteorology	3
ATMO 680 Physical Meteorology	3
Prerequisites for these courses include	
ATMO 105 Introductory Meteorology	5
EECS 138 Introduction to Computing; FORTRAN	3

Atmospheric science offers options in general meteorology, air pollution meteorology, hydrometeorology, and news media forecasting.

The holdings of KU's Anschutz Library cover a complete range of chemistry, biology, and physics periodicals and books.

MATH 122 Calculus II 5
 PHSX 211 General Physics I 4
 Students who plan to elect this option should consult advisers in the School of Business and the Department of Geography.

Requirements for the Minor (20 hours)

ATMO 105 Introductory Meteorology 5
 ATMO 321 Climate and Climate Change 3
 ATMO 505 Weather Forecasting 3
 Three courses from the following choices: 9
 ATMO 521 Microclimatology (3)
 ATMO 525 Air Pollution Meteorology (3)
 ATMO 630 Synoptic Meteorology (3)
 ATMO 640 Dynamic Meteorology (3)
 ATMO 642 Remote Sensing (3)
 ATMO 680 Physical Meteorology (3)

Honors. To be accepted as a candidate for honors, a major must have completed at least 9 hours of upper-division credit in atmospheric science with a grade-point average of 3.5 in all atmospheric science courses and an overall average of at least 3.25. In addition, the program requires ATMO 499, an independent study course consisting of the creation of an honors paper. The student presents the results of this paper in an oral examination to a committee of a minimum of two faculty members, normally from the geography department, and chaired by the ATMO 499 supervisor. To graduate with honors, the student must complete the paper and the examination and maintain the 3.5 and 3.25 grade-point averages.

■ Atmospheric Science Courses

ATMO 105 Introductory Meteorology (5). NE N A lecture and laboratory course introducing students to the atmosphere, weather and climate phenomena, and their controlling physical processes. Topics covered include: the structure of the atmosphere, energy and energy budgets, climate and climate change, air pollution, clouds and precipitation, pressure and wind systems, severe weather, and weather forecasting. LEC

ATMO 106 Introductory Meteorology, Honors (5). NE N Honors version of ATMO 105. A lecture and laboratory course introducing students to the atmosphere, weather and climate phenomena, and their controlling physical processes. Topics covered include: the structure of the atmosphere, energy and energy budgets, climate and climate change, air pollution, clouds and precipitation, pressure and wind systems, severe weather, and weather forecasting. Prerequisite: Membership in University Honors Program or by permission of instructor. LEC

ATMO 220 Unusual Weather (3). NE N An introductory lecture course which surveys the general principles and techniques of atmospheric science and illustrates their application through discussions of natural but unusual weather phenomena such as blizzards, hurricanes, tornados, and chinooks, of the effects of air pollution on weather, and of intentional human alteration of the atmosphere. LEC

ATMO 321 Climate and Climate Change (3). N This course is designed to introduce students to the nature of the Earth's physical climate. It introduces the basic scientific concepts underlying our understanding of our climate system. Particular emphasis is placed on energy and water balances and their roles in evaluating climate change. The course also evaluates the impact of climate on living organisms and the human environment. Finally, past climates are discussed and potential future climate change and its impact on humans is evaluated. (Same as GEOG 321.) Prerequisite: ATMO 105 or GEOG 104. LEC

ATMO 499 Honors Course in Atmospheric Science (2-3). N Open to students with nine hours of upper level credit in Atmospheric Science, an average of at least 3.5 in all Atmospheric Science courses, and an overall average of at least 3.25. Includes the preparation of an honors paper and its defense before a committee of at least two regular faculty members. LEC

ATMO 505 Weather Forecasting (3). N A first course in synoptic meteorology designed to introduce students to weather analysis and forecasting through the application of hydrodynamic and thermodynamic principles to operational analysis and forecasting. Topics include analysis and interpretation of surface and upper-air observations and data from satellites, radars, and wind profilers; chart and sounding analysis; and three-dimensional, conceptual models of weather systems. The course includes student-led weather briefings and analysis exercises. LEC

ATMO 506 Forecasting Models and Methods (3). N Introduction to basic numerical weather prediction methods. Computer programs are used to apply numerical methods to weather data and to evaluate dynamical processes on numerical grids. Meteorological graphics packages are used to analyze current weather data and numerical model output. Current operational numerical models and output products are discussed. Prerequisite: ATMO 505, MATH 122, and EECS 138 or EECS 168. LEC

ATMO 515 Energy and Water Balance (3). N A study of the distribution and circulation of water in the air-earth system as influenced by atmospheric processes and surface conditions. The solar and terrestrial radiation budget and the water balance at the earth's surface will be applied to agricultural and urban energy and water problems. Prerequisite: ATMO 105 or EECS 138. LEC

ATMO 521 Microclimatology (3). N A study of climatic environment near the earth-atmosphere interface. Consideration of rural climates in relation to agriculture and urban climates as influenced by air pollution and other factors. Emphasis is on physical processes in the lower atmosphere, distribution of atmospheric vari-

ables, the surface energy budget and water balance. (Same as GEOG 521.) Prerequisite: ATMO 105 and MATH 116 or MATH 121. LEC

ATMO 525 Air Pollution Meteorology (3). N A study of background levels and concentrated sources of atmospheric pollution together with considerations of pollution buildup in urban areas as related to particular weather conditions. Inadvertent weather modifications and effects of atmospheric pollution on particular weather events and general climate will be discussed. Prerequisite: ATMO 105, MATH 121, and EECS 138. LEC

ATMO 531 Topics in Atmospheric Science: _____ (1-3). N An investigation of special topics in atmospheric science. May include topics in dynamic, physical or synoptic meteorology or climatology as well as related topics in earth and physical sciences. May be repeated if topic differs. LEC

ATMO 605 Operational Forecasting (2). N Students enhance their forecasting expertise by preparing forecasts for presentation to the public through a variety of media. Classroom activities include weekly map discussions and analysis of current weather situations. Forecasting topics such as forecast verification, aviation forecast products, severe weather, flash floods and watches and warnings are examined. Credit for ATMO 605, ATMO 606, and ATMO 607 is limited to a total of eight hours, six of which may be counted toward a degree in atmospheric science. Prerequisite: ATMO 505. FLD

ATMO 606 Forecasting Practicum—Television (2). N Practical experience in the analysis and preparation of weather forecasts. Students will use current meteorological data from the National Weather Service network to prepare forecasts for use on television. May be repeated two times for credit. Credit for ATMO 605, ATMO 606, and ATMO 607 is limited to a total of eight hours, six of which may be counted toward a degree in atmospheric science. Prerequisite: ATMO 605. FLD

ATMO 607 Forecasting Intern—National Weather Service (2). N Practical experience working in a National Weather Service forecasting center in analyzing weather data and preparing weather forecasts. May be repeated two times for credit. Credit for ATMO 605, ATMO 606, and ATMO 607 is limited to a total of eight hours, six of which may be counted toward a degree in atmospheric science. Prerequisite: ATMO 605. FLD

ATMO 630 Synoptic Meteorology (3). N Interpretation, development, and analysis of synoptic charts. Prerequisite: ATMO 505 and ATMO 640. LEC

ATMO 634 Physical Climatology (3). N Atmospheric processes are described and discussed in relation to the climate of the earth's surface. Such topics as the greenhouse effect, ozone depletion, and the effect of solar irradiance on climatic change will be included. The physical processes and relationships between various climatic features will be studied. Prerequisite: ATMO 505, DSCI 301. LEC

ATMO 640 Dynamic Meteorology (3). N This course introduces the student to the fundamentals of fluid dynamics necessary for understanding large scale atmospheric motions. Fundamental physical laws of conservation of mass, momentum and energy are examined and applied to atmospheric flows. Rotation in the atmosphere is examined quantitatively in terms of both circulation and vorticity. Prerequisite: MATH 223, PHSX 212, prerequisite or corequisite of ATMO 505. LEC

ATMO 642 Remote Sensing (3). This course is designed to prepare students to effectively use remotely sensed data in operational or research settings for further work in this field. Topics include radiation and radiation transfer applied to active and remote sensing; radiative properties of space, sun, earth and atmosphere; instrument design considerations and operational characteristics; inversion methods for temperature or concentration profiling; surface temperature measurement; cloud top height determination; rain rate and wind velocity measurement; severe weather detection; satellite photograph interpretation. Prerequisite: ATMO 680, MATH 581. LEC

ATMO 650 Advanced Synoptic Meteorology (3). N Analysis and interpretation of synoptic weather charts including treatment of numerical weather forecasting. Prerequisite: ATMO 630 and ATMO 660. LEC

ATMO 660 Advanced Dynamic Meteorology (3). N Advanced study of the atmosphere including treatment of the vorticity equation. Prerequisite: ATMO 630, ATMO 640, PHSX 211, and MATH 123. LEC

ATMO 680 Physical Meteorology (3). N This course is designed to enhance the student's understanding of atmospheric processes through the study of these processes at molecular through micro scales. Topics include the properties and behavior of gases; transfer processes; phase change; solar and earth radiation; cloud drop, ice crystal and precipitation formation; atmospheric electricity; stratospheric chemistry. Prerequisite: MATH 223, PHSX 212. LEC

ATMO 690 Special Problems in Meteorology (1-3). N Prerequisite: Nine hours in meteorology. IND

ATMO 697 Seminar for Seniors (1). N Current research in atmospheric science will be discussed. May be repeated for a total of two credit hours. Prerequisite: Senior level in atmospheric science. LEC

ATMO 699 Undergraduate Research (2). U Prerequisite: Twelve credit hours in meteorology. IND

ATMO 710 Atmospheric Dynamics (3).

ATMO 720 Atmospheric Modeling (3).

ATMO 727 Atmospheric Storms (3).

ATMO 731 Advanced Topics in Atmospheric Science: _____ (1-3).

ATMO 750 Numerical Weather Prediction (3).

Biochemistry

B.A. and B.S. degrees in biochemistry are offered by the KU Undergraduate Biology Program. See Biology Undergraduate Program in this chapter of the catalog.