ATMOSPHERIC SCIENCE (ATM)

College of Agricultural & Environmental Sciences

ATM 005 — Global Climate Change (3 units)

Course Description: Scientific concepts needed to understand climate and climate change. Principles of regional variations in climate. Understanding observed seasonal, decadal and millennial changes. Analysis of the Antarctic ozone hole, El Nino and human-induced global warming.
Learning Activities: Lecture 2 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

ATM 006 — Fundamentals of Atmospheric Pollution (3 units)

Course Description: Effects of human emissions on the atmosphere: smog, ozone pollution, and ozone depletion; indoor air pollution; global warming; acid rain. Impacts of these problems on the earth, ecosystems, and humans. Strategies to reduce atmospheric pollution.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Scientific Literacy (SL); Visual Literacy (VL).

ATM 010 — Severe & Unusual Weather (3 units)

Course Description: Introduction to physical principles of severe and unusual weather: flood, blizzards, thunderstorms, lightning, tornadoes, and hurricanes. Emphasis on scientific perspective and human context. Not open to students who have received credit for ATM 100. (Former ATM 100.)
Prerequisite(s): High school physics.
Learning Activities: Lecture 2 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

ATM 060 — Introduction to Atmospheric Science (4 units)

Course Description: Fundamental principles of the physics, chemistry, and fluid dynamics underlying weather and climate. Solar radiation, the greenhouse effect, and the thermal budget of the Earth. Clouds and their formation, convection, precipitation, mid-latitude storm systems.
Prerequisite(s): (MAT 016A or MAT 021A); (PHY 007A or PHY 009A).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 092 — Atmospheric Science Internship (1-12 units)

Course Description: Internship off and on campus in atmospheric science. Internship supervised by a member of the faculty.
Prerequisite(s): Consent of instructor; lower division standing.
Learning Activities: Internship 3-36 hour(s).
Grade Mode: Pass/No Pass only.

ATM 098 — Directed Group Study (1-5 units)

Course Description: Directed group study.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

ATM 099 — Special Study for Undergraduates (1-5 units)

Course Description: Special study for undergraduates.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

ATM 110 — Weather Observation & Analysis (4 units)

Course Description: Acquisition, distribution and analysis of meteorological data. Vertical sounding analysis, stability indices, probability of local severe weather, weather map analysis. Use of National Weather Service analyses and forecast products. Laboratory makes use of computer-generated analyses.
Prerequisite(s): ATM 060.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 111 — Weather Analysis & Prediction (3 units)

Course Description: Tools for analyzing observed properties of mid-latitude weather systems. The analysis-forecast system, including various weather forecast models. General structure and properties of mid-latitude weather systems.
Prerequisite(s): ATM 110; ATM 121B; (ATM 111L (can be concurrent) or ATM 111LY (can be concurrent)); knowledge of a programming language.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 111LY — Weather Analysis & Prediction Laboratory (2 units)

Course Description: Subjective and objective analysis of weather data. Web-based learning of the analysis-forecast system and various weather forecasting situations. Weather map interpretation and forecast discussions.
Prerequisite(s): ATM 111 (can be concurrent).
Learning Activities: Laboratory 2 hour(s), Web Virtual Lecture 4 hour(s).
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 112 — Weather Forecasting Practice (2 units)

Course Description: Formal practice in preparing local weather forecasts. Analysis of current weather conditions and recent model performance. Verification and discussion of prior forecast. Interpretation of current forecast model guidance. Posting of forecast.
Prerequisite(s): ATM 110.
Learning Activities: Discussion 2 hour(s), Laboratory 1 hour(s).
Repeat Credit: May be repeated 3 time(s).
Grade Mode: Pass/No Pass only.

ATM 115 — Hydroclimatology (3 units)

Course Description: Examination of climate as the forcing function for the hydrologic system. Emphasis on seasonal variations in the relationship between precipitation and evapotranspiration for meso-scale areas. Watershed modeling of floods and drought for evaluating the effects of climatic fluctuations.
Prerequisite(s): ATM 060.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Scientific Literacy (SL).

ATM 116 — Modern Climate Change (3 units)

Course Description: Factors that determine the Earth's climate, including natural and human-caused changes. Impacts of climate change. Possible future climates and policies to reduce human emissions of greenhouse gases.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 120 — Atmospheric Thermodynamics & Cloud Physics (4 units)

Course Description: Atmospheric composition and structure, thermodynamics of atmospheric gases, thermal properties of dry and moist air, atmospheric stability; cloud nucleation, cloud growth by condensation and collision, cloud models.
Prerequisite(s): MAT 021C; PHY 009B; ATM 060 (can be concurrent).
Learning Activities: Lecture 3 hour(s), Extensive Problem Solving 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 121A — Atmospheric Dynamics (4 units)

Course Description: Fundamental forces of atmospheric flow; noninertial reference frames; development of the equations of motion for rotating stratified atmospheres; isobaric and natural coordinate systems; geostrophic flow; thermal wind; circulation and vorticity.
Prerequisite(s): ATM 120; MAT 021D; PHY 009B.
Learning Activities: Lecture 3 hour(s), Extensive Problem Solving.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).

ATM 121B — Atmospheric Dynamics (4 units)

Course Description: Dynamics of fluid motion in geophysical systems; quasi-geostrophic theory; fundamentals of wave propagation in fluids; Rossby waves; gravity waves; fundamentals of hydrodynamic instability; two-level model; baroclinic instability and cyclogenesis.
Prerequisite(s): ATM 121A.
Learning Activities: Lecture 3 hour(s), Extensive Problem Solving.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).

ATM 124 — Meteorological Instruments & Observations (3 units)

Course Description: Modern meteorological instruments and their use in meteorological observations and measurements. Both standard and micrometeorological instruments are included.
Prerequisite(s): ATM 060.
Learning Activities: Lecture 2 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

ATM 128 — Atmospheric Radiation & Remote Sensing (4 units)

Course Description: Concepts of atmospheric radiation with an emphasis on the modification of solar and infrared radiation by the atmosphere. Applications to remote sensing with satellite and ground-based sensors, including radar, for the retrieval of atmospheric variables such as temperature, cloudiness, and precipitation.
Prerequisite(s): ATM 060; (PHY 007C or PHY 009B); (MAT 017B or MAT 021B).
Learning Activities: Lecture 3 hour(s), Discussion/Laboratory 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

ATM 133 — Biometeorology (4 units)

Course Description: Atmospheric and biological interactions. Physical and biological basis for water vapor, carbon dioxide and energy exchanges with the atmosphere associated with plants and animals, including humans. Microclimate of plant canopies and microclimatic modification such as frost protection and windbreaks.
Prerequisite(s): MAT 016B or MAT 017B or MAT 021B; one course in a biological discipline or consent of instructor.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

ATM 149N — Air Pollution (4 units)

Course Description: Physical and technical aspects of air pollution. Factors that determine local, regional, and global air quality; climate change; and physical and chemical properties of pollutants.
Prerequisite(s): MAT 021D; (MAT 022B or MAT 027B); CHE 002B C- or better; (ATM 121A or ENG 103 C- or better or ECI 100 C- or better).
Learning Activities: Discussion 1 hour(s), Lecture 3 hour(s).
Cross Listing: ECI 149N.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL).

ATM 150 — Introduction to Computer Methods in Physical Sciences (4 units)

Course Description: Computational techniques used in physical sciences. Integral and differential equation numerical solution: mainly finite differencing and spectral (Fourier transform) methods. Time series applications (time-permitting). Specific applications drawn from meteorology. Accelerated introduction to FORTRAN including programming assignments.
Prerequisite(s): MAT 022B; PHY 009B; computer programming course such as ECS 030; additional courses in fluid dynamics (ATM 121A or ENG 103) and in Fourier transforms (MAT 118C or PHY 104A) helpful but not required.
Learning Activities: Lecture 3 hour(s), Discussion/Laboratory 2 hour(s).
Enrollment Restriction(s): Enrollment limited to 12, preference to Atmospheric Science majors.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

ATM 158 — Boundary-Layer Meteorology (4 units)

Course Description: Dynamics of the atmosphere nearest the Earth's surface. Friction and heat transfer. Properties of turbulent flows; statistical and spectral techniques; use and interpretation of differential equations. Emphasis on the importance to weather, air pollution, and the world's oceans.
Prerequisite(s): ATM 121A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

ATM 160 — Introduction to Atmospheric Chemistry (4 units)

Course Description: Quantitative examination of current local, regional and global problems in atmospheric chemistry (including photochemical smog, acid deposition, climate change, and stratospheric ozone depletion) using fundamental concepts from chemistry. Basic chemical modeling of atmospheric reaction systems.
Prerequisite(s): CHE 002B.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

ATM 192 — Atmospheric Science Internship (1-12 units)

Course Description: Internship off and on campus in atmospheric science. Internship supervised by a member of the faculty.
Prerequisite(s): Consent of instructor. Completion of 84 units.
Learning Activities: Internship 3-36 hour(s).
Grade Mode: Pass/No Pass only.

ATM 198 — Directed Group Study (1-5 units)

Course Description: Directed group study.
Prerequisite(s): Consent of instructor; three upper division units in Atmospheric Science.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

ATM 199 — Special Study for Advanced Undergraduates (1-5 units)

Course Description: Special study for advanced undergraduates.
Prerequisite(s): Consent of instructor; three upper division units in Atmospheric Science and at least an overall B average.
Learning Activities: Variable.
Grade Mode: Pass/No Pass only.

ATM 215 — Advanced Hydroclimatology (3 units)

Course Description: Theoretical and applied aspects of energy and mass fluxes linking the earth's surface, atmosphere, and hydrologic system. Emphasis on regional scale analysis and modeling, spatial data representation, and climate change influences on precipitation and its hydroclimatic expression.
Prerequisite(s): ATM 115.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 221 — Advanced Atmospheric Dynamics (3 units)

Course Description: Conditions for instability in stratified atmospheres; baroclinic instability; forced topographic Rossby Waves; wave-mean flow interaction theory; tropical dynamics; stratospheric dynamics.
Prerequisite(s): ATM 121B.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 223 — Advanced Boundary-Layer Meteorology (3 units)

Course Description: Characteristics of the atmospheric boundary layer under convective and nocturnal conditions. Heat budget at the surface and boundary layer forcing. Similarity theory and scaling of the boundary layer. Measurement and simulation techniques.
Prerequisite(s): ATM 230.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 230 — Atmospheric Turbulence (3 units)

Course Description: Dynamics and energetics of turbulence in the atmosphere including vorticity dynamics. Statistical description of turbulence; Eulerian and Lagrangian scales, spectral analysis, conditional sampling techniques. Turbulent diffusion; the closure problem, gradient-diffusion and second-order methods.
Prerequisite(s): ATM 121B or ATM 158.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 231 — Advanced Air Pollution Meteorology (3 units)

Course Description: Processes determining transport and diffusion of primary and secondary pollutants. Models of chemical transformation, of the atmospheric boundary layer and of mesoscale wind fields, as applicable to pollutant dispersion problems.
Prerequisite(s): ATM 160; ATM 149A; course in fluid dynamics.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 233 — Advanced Biometeorology (3 units)

Course Description: Current topics in biometeorology. Physical and biological basis for water vapor, other gases, and energy exchange with the atmosphere. Topics include modeling and measuring turbulent transport from plant canopies, surface temperatures and energy budgets, bio-aerosol physics and aerobiology.
Prerequisite(s): ATM 133; or consent of instructor.
Learning Activities: Lecture/Discussion 3 hour(s).
Grade Mode: Letter.

ATM 240 — General Circulation of the Atmosphere (4 units)

Course Description: Large-scale, observed atmospheric properties. Radiation, momentum, and energy balances derived and compared with observations. Lectures and homework synthesize observations and theories, then apply them to understand the large-scale circulations.
Prerequisite(s): ATM 121B.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

ATM 241 — Climate Dynamics (3 units)

Course Description: Dynamics of large-scale climatic variations over time periods from weeks to centuries. Description of the appropriate methods of analysis of atmospheric and oceanic observations. Conservation of mass, energy and momentum. Introduction to the range of climate simulations.
Prerequisite(s): ATM 121B.
Learning Activities: Lecture/Discussion 3 hour(s).
Grade Mode: Letter.

ATM 244 — Cloud & Precipitation Physics (3 units)

Course Description: Observations and modeling of clouds and precipitation. Physics and parameterization of cloud microphysical processes including nucleation, condensation/evaporation, deposition/sublimation, collision-coalescence and sedimentation.
Learning Activities: Lecture 3 hour(s).
Enrollment Restriction(s): Restricted to Atmospheric Science graduate group students or consent of instructor.
Grade Mode: Letter.

ATM 245 — Climate Change Science & Impacts (4 units)

Course Description: Overview of climate change science with a focus on climate change communication. Impacts of climate change on water, agriculture, energy, health, infrastructure, ecosystem services, tribal and indigenous communities. Climate justice, political, societal, and economic dimensions of these issues.
Learning Activities: Lecture 3 hour(s), Project.
Cross Listing: HYD 245, ECL 245.
Grade Mode: Letter.

ATM 250 — Meso-Scale Meteorology (3 units)

Course Description: The study of weather phenomena with horizontal spatial dimensions between 2.5 and 2500 kilometers. Methods of observational study and numerical modeling of the structure and temporal behavior of these weather systems.
Prerequisite(s): ATM 150; graduate standing; course in partial differential equations or consent of instructor.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 255 — Numerical Modeling of the Atmosphere (4 units)

Course Description: Principles of numerical modeling of the dynamic, thermodynamic and physical processes of the atmosphere. Hands-on experiments on model development using the shallow water equations and the primitive equations. Operational forecast models.
Prerequisite(s): ATM 121B; ENG 005; ATM 150 recommended.
Learning Activities: Lecture 2 hour(s), Laboratory 6 hour(s).
Grade Mode: Letter.

ATM 260 — Atmospheric Chemistry (3 units)

Course Description: Chemistry and photochemistry in tropospheric condensed phases (fog, cloud, and rain drops and aerosol particles). Gas-drop and gas-particle partitioning of compounds and effects of reactions in condensed phases on the fates and transformations of tropospheric chemical species.
Prerequisite(s): ATM 160.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

ATM 265 — The Art of Climate Modeling (4 units)

Course Description: Over the past fifty years, global models have given us incredible insight into the Earth system. Provides an introduction to these models, with a focus on their design and the science questions they have been built to address.
Prerequisite(s): ATM 121A.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

ATM 270A — Topics in Atmospheric Science: Meteorological Statistics (1-3 units)

Course Description: Applications and concepts in meteorological statistics.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270B — Topics in Atmospheric Science: Computer Modeling of the Atmosphere (1-3 units)

Course Description: Applications and concepts in computer modeling of the atmosphere.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270C — Topics in Atmospheric Science: Design of Experiments & Field Studies in Meteorology (1-3 units)

Course Description: Applications and concepts in design of experiments and field studies in meteorology.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270D — Topics in Atmospheric Science: Solar & Infrared Radiation in the Atmosphere (1-3 units)

Course Description: Applications and concepts in solar and infrared radiation in the atmosphere.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270E — Topics in Atmospheric Science: Aerosol & Cloud Physics (1-3 units)

Course Description: Applications and concepts in aerosol and cloud physics.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270F — Topics in Atmospheric Science: Atmospheric Chemistry (1-3 units)

Course Description: Applications and concepts in atmospheric chemistry.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 270G — Topics in Atmospheric Science: General Meteorology (1-3 units)

Course Description: Applications and concepts in general meteorology.
Learning Activities: Discussion 1-3 hour(s).
Grade Mode: Letter.

ATM 280A — Air Quality Policy in the Real World (4 units)

Course Description: In-depth investigation of an air quality problem with a team and mentor from government or industry. Science, engineering and policy will be involved. Findings will be presented orally and in writing.
Prerequisite(s): (ATM 149 or ECI 149); ECI 242; consent of instructor, or equivalent of ECI 242.
Learning Activities: Project.
Grade Mode: Letter.

ATM 280B — Air Quality Policy in the Real World (4 units)

Course Description: In-depth investigation of an air quality problem with a team and mentor from government or industry. Science, engineering and policy will be involved. Findings will be presented orally and in writing.
Prerequisite(s): ATM 280A; and consent of instructor.
Learning Activities: Project.
Grade Mode: Letter.

ATM 290 — Seminar (1 unit)

Course Description: Current developments in selected areas of atmospheric research. Topics will vary according to student and faculty interests.
Prerequisite(s): Graduate standing in Atmospheric Science or related field.
Learning Activities: Seminar 1 hour(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291A — Research Conference in Atmospheric Science: Air Quality Meteorology (1-3 units)

Course Description: Review and discussion of current literature and research in Air Quality Meteorology.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291B — Research Conference in Atmospheric Science: Biometeorology (1-3 units)

Course Description: Review and discussion of current literature and research in Biometeorology.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291C — Research Conference in Atmospheric Science: Boundary Layer Meteorology (1-3 units)

Course Description: Review and discussion of current literature and research in Boundary Layer Meteorology.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291D — Research Conference in Atmospheric Science: Climate Change (1-3 units)

Course Description: Review and discussion of current literature and research in Climate Change.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291E — Research Conference in Atmospheric Science: General Meteorology (1-3 units)

Course Description: Review and discussion of current literature and research in General Meteorology.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 291F — Research Conference in Atmospheric Science: Atmospheric Chemistry (1-3 units)

Course Description: Review and discussion of current literature and research in Atmospheric Chemistry.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1-3 hour(s).
Repeat Credit: May be repeated 6 unit(s).
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 298 — Group Study (1-5 units)

Course Description: Group study.
Prerequisite(s): Consent of instructor; graduate standing.
Learning Activities: Variable.
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 299 — Research (1-12 units)

Course Description: Research.
Prerequisite(s): Consent of instructor. Graduate standing.
Learning Activities: Variable.
Grade Mode: Satisfactory/Unsatisfactory only.

ATM 393 — Teaching Assistant Training Practicum (1-4 units)

Course Description: Teaching assistant training practicum.
Prerequisite(s): Graduate standing.
Learning Activities: Variable.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.

ATM 396 — Teaching Assistant Training Practicum (1-4 units)

Course Description: Teaching assistant training practicum.
Prerequisite(s): Graduate standing.
Learning Activities: Variable.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.