College of Engineering and Applied Science

Robert Ettema, Dean
2085 Engineering Building
Phone: (307)766-4253 FAX: (307)766-4444
Web site: wwweng.uwyo.edu

The College of Engineering offers coursework and research opportunities leading to the following master's degrees: master of science in atmospheric science, chemical engineering, civil engineering, computer science, electrical engineering, environmental engineering, mechanical engineering, and petroleum engineering. Candidates for the various master's degrees in engineering are required to do a full year's study in residence either under Plan A or Plan B.

Only graduates with satisfactory GPAs in programs accredited by the Accreditation Board for Engineering and Technology (ABET) are granted full admission to graduate study. In addition, graduates with satisfactory GPAs in undergraduate disciplines of meteorology, physics, mathematics, or related fields can be granted full admission to graduate studies in atmospheric science. Other engineering graduates can be admitted on a provisional basis.

The College of Engineering offers coursework and research opportunities leading to the following doctoral degrees: Ph.D. in atmospheric science, chemical engineering, civil engineering, computer science, electrical engineering, mechanical engineering, and petroleum engineering. Interdisciplinary programs of study and research leading to one of the above disciplinary degrees can be developed.

Department of Atmospheric Science

6034 Engineering Building, 766-3245
FAX: (307)766-2635
Web site: www.atmost.uwyo.edu
Department Head: Alfred R. Rodi

Professors:

TERRY DESHLER, B.A. University of Wyoming 1969; M.S. 1975; Ph.D. 1982; Professor of Atmospheric Science 1999, 1991.
ROBERT D. KELLY, B.A. University of Wyoming 1973; M.S. 1978; Ph.D. University of Chicago 1982; Professor of Atmospheric Science 1990, 1984.
THOMAS R. PARISH, B.S. University of Wisconsin 1975; M.S. 1977; Ph.D. 1980; Professor of Atmospheric Science 1990, 1980.
ALFRED R. RODI, B.S. University of Chicago 1967; M.S. 1969; Ph.D. University of Wyoming 1981; Professor of Atmospheric Science 1993, 1981.
JEFFERSON R. SNIDER, B.S. University of Oregon 1979; M.S. University of Arizona 1982; Ph.D. University of Wyoming 1989; Professor of Atmospheric Science 2004, 1990.

Associate Professors:

BART GEERTS, Licenciaat Physical Geography Katholieke University, Belgium 1984; Engineer in Irrigation Sciences 1986; Ph.D. University of Washington 1992; Associate Professor of Atmospheric Science 2005, 1999.
DEREK C. MONTAGUE, B.Sc. University of Southampton (UK) 1964; Ph.D. 1967; Associate Professor of Atmospheric Science 1988.

Assistant Professor:

ZHIEN WANG, B.S. Anhui Normal University (China) 1990; M.S. Chinese Academy of Sciences 1994; Ph.D. University of Utah 2000; Assistant Professor of Atmospheric Science 2004.

Professors Emeritus:

John D. Marwitz, Gabor Vali

Adjunct Professors:

W.A. Cooper, D.J. Hofmann, C.A. Knight, W.R. Sand, C.P.R. Saunders

The Department of Atmospheric Science offers degree programs leading to the master of science (Plan A only) and doctor of philosophy degrees.

The department has strong research programs in the following areas: cloud physics and dynamics; tropospheric aerosols and clouds; stratospheric aerosol and ozone; boundary layer processes; remote sensing; and airborne- and balloon-borne instrumentation. The department's observational facilities are: 1) the King Air research aircraft (UWKA); 2) the Wyoming Balloon Launch Facility; 3) the Elk Mountain Observatory at 11,000 ft altitude; 4) the Wyoming Cloud Radar (WCR) for the study of cloud structure and composition; and 5) the Keck Aerosol Laboratory. The UWKA and the WCR are designated Lower Atmospheric Observing Facilities by the National Science Foundation (NSF).

Please refer to the departmental homepage at www.atmos.uwyo.edu for programmatic updates, or contact the department directly.

Program Specific Admission Requirements

Admission based on the university minimum requirements. Admissions are competitive.

Program Specific Graduate Assistantships

Assistantships are offered for both the M.S. and Ph.D. tracks.

Program Specific Degree Requirements

Master's Program

Approval of research plan by the graduate committee (at the end of year one)
Colloquium and oral defense of M.S. thesis
Approval of M.S. thesis by the graduate committee
Requires a minimum of 26 hours of acceptable graduate coursework and four hours of thesis research and a thesis (final written project).
21 in-residence coursework hours

Doctoral Program

Qualifying assessment exam
Approval of research plan by the graduate committee
At least one colloquium presentation per year
Preliminary exam (at least 15 weeks before dissertation defense)
Oral defense of Ph.D. dissertation
Approval of Ph.D. dissertation by the graduate committee
Ph.D. requires a minimum of 72 graduate hours, but at least 42 hours must be earned in formal coursework.
42 hours of formal graduate coursework including appropriate coursework from a master's degree.
Additional credits toward the 72 credit hour requirement may include dissertation research hours, internship hours, or additional coursework.
24 in-residence coursework hours

Required Courses

These courses are required for both master's and doctoral programs.

ATSC 5001. Atmospheric Energetics. 2.
ATSC 5002. Atmospheric Radiation. 3.
ATSC 5003. Problems in Energetics and Radiation. 1.
ATSC 5100. Atmospheric Dynamics I. 3.
ATSC 5004. Problems in Dynamic Meteorology. 1.
ATSC 5005. Microphysics. 2.
ATSC 5006. Problems in Microphysics. 1.
ATSC 5160. Synoptic Meteorology. 2.
ATSC 5007. Problems in Synoptic Meteorology. 1.
ATSC 5008. Mesoscale Meteorology. 2.
ATSC 5020. Physical Meteorology Lab. 1.
ATSC 5210. Cloud and Precipitation Systems. 3.
UW Elective(s) to be determined by committee. 3 minimum
ATSC Elective(s). To be determined by committee. 3 minimum

Atmospheric Science (ATSC)

5001. Atmospheric Energetics. 2. First and second laws of thermodynamics applied to energy transformations in the atmosphere. Investigated are: air saturating processes, conserved temperatures, dry air entrainment into clouds, and first and second law applications in atmospheric models. *Prerequisites:* MATH 2210, PHYS 1310 and 1320 (or equivalent).

5002. Atmospheric Radiation I. 3. Covers the principles of atmospheric radiative transfer. Conceptual and theoretical frameworks are provided for the understanding of radiative measurement systems (e.g., satellite, lidar and radar), blackbody radiation, the planetary radiative budget, and the propagation of both longwave and shortwave radiation. *Prerequisites:* MATH 2210, PHYS 1310 and 1320 (or equivalent).

5003. Problems in Energetics and Radiation. 1. Proficiency in the use of tools for assimilation, analysis and presentation of quantitative information is fostered. Also considers solutions to problems developed theoretically in ATSC 5001 and 5002. These consist of solution to thermodynamic and radiative transfer governing equations. *Prerequisites:* ATSC 5001 and 5002, or concurrent enrollment in each.

5004. Problems in Dynamic Meteorology I. 1. Focuses on computational solutions to problems developed theoretically in ATSC 5100. In addition, students gain proficiency in interpretation and analysis of weather data, including surface and upper level maps, and sounding data, which will be used to understand static stability. Data visualization software is also introduced and used to develop understanding of dynamical processes. *Prerequisite:* ATSC 5100 or concurrent enrollment in ATSC 5100.

5005. Microphysics. 2. Microphysical observations of clouds and precipitation are first briefly surveyed. Thermodynamic equilibria in multiphase microphysical systems are then examined, as are homogeneous and heterogeneous nucleation, and diffusional and collisional processes leading to time-dependent changes in hydrometeor size. Embedded in these discussions are elementary considerations of single particle mechanics and hydrodynamics. *Prerequisites:* ATSC 5001, 5002 and 5003.

5006. Problems in Microphysics. 1. Atmospheric processes altering the hydrometeor size distribution are examined using computer algorithms developed by the student. Condensational and collisional growth processes, in warm and cold clouds, are examined. Data from hydrometer size spectrometers are used to initialize the problems. *Prerequisite:* ATSC 5005 or concurrent enrollment.

5007. Problems in Synoptic Meteorology. 1. Laboratory supplement to ATSC 5160. Analysis of weather systems using operational observations and numerical model output. Real-time weather briefings. Numerical simulation of select weather phenomena. *Prerequisite:* ATSC 5160 or concurrent enrollment.

5008. Mesoscale Meteorology. 2. Mesoscale energy sources, including symmetric instability. Fronts, frontogenesis, and frontogenetic circulation. Surface fronts and cold fronts aloft. Orographically modified flow and boundary-layer circulations. Shallow and deep convection and mesoscale organized convection. Effects of bouyancy, shear and cold pool-shear interaction on the structure and longevity of thunderstorms. *Prerequisites:* ATSC 5160 and ATSC 5007.

5020. Physical Meteorology II Lab. 1. Laboratory course concerned with physical processes in the atmosphere. Approximately eight experiments are conducted examining phenomena related to atmospheric radiation, gas expansions, phase transitions, and nucleation. *Prerequisites:* ATSC 5005, ATSC 5006 or concurrent enrollment.

5100. Atmospheric Dynamics I. 3. Development and interpretation of the atmospheric equations of motion, scales of motion, horizontal atmospheric winds, thermal wind equation, circulation and vorticity. Introduction to planetary boundary layer flows. *Prerequisite:* MATH 2210, PHYS 1310 and 1320 (or equivalent).

5160. Synoptic Meteorology. 2. Structure and evolution of the extratropic cyclone, identification and development of fronts, jet streams and associated weather features; theories of cyclogenesis; role of topography. Climatology of formation and movement of a cyclone. Mesoscale circulation features; ingredients of severe weather. *Prerequisite:* ATSC 5001, 5003, 5100 and 5004.

5210. Cloud and Precipitation Systems. 3. Types of clouds and precipitation systems, and the precipitation mechanisms in those systems; structure of convective, orographic, and frontal systems and severe storms. Schematic and numerical models of clouds and storms with emphasis on hailstorms. *Prerequisite:* ATSC 5005 and 5100.

5310. Atmospheric Dynamics II. 3. Introduction to the dynamic energetics of the atmosphere, wave motions, atmospheric instabilities. Introduction to numerical modeling, applications. *Prerequisite:* ATSC 5100.

5320. The Ocean Environment. 3. Focuses on the ocean as a system. Objective is the development of interdisciplinary understanding of marine processes, especially those processes occurring along coastal margins. Emphasis is on the development of quantitative models and their use in understanding anthropogenic impact on ocean resources. Dual listed with ATSC 4320. *Prerequisite:* MATH 2310, PHYS 1310, CHEM 1030, ES 3060 (or ES 3070), LIFE 1010, senior standing or higher.

5330. Boundary Layer Meteorology. 3. A quantitative and descriptive study of the thermodynamics and dynamics of the planetary boundary layer, including budgets (heat, moisture, momentum, turbulent kinetic energy, radiation), stability, turbulence and turbulent fluxes, convection, terrain effects, phenomenology, and measurement and analysis techniques. *Prerequisite:* ATSC 5001, 5100.

5340. Radar Meteorology. 3. The theory of radar and the application of radars to studies of the atmosphere, including basic radar design, distributed targets, attenuation, polarization, Doppler velocities, analysis techniques, and examples of radar studies of clear air, clouds, and precipitation. *Prerequisite:* ATSC 5002 and 5005.

5350. Atmospheric Chemistry. 3. Origin and composition of the atmosphere. Sources, lifetimes, transport of gases and aerosols. Cycles of C, S, N and trace elements. Removal processes: precipitation, and dry deposition. Homogenous and Heterogeneous kinetics. Anthropogenic influences: effect of air pollution on radiation balance and cloud processes. *Prerequisite:* graduate standing in a physical science or engineering.

5370. Meteorological Instrumentation. 3. Physical principles of instruments, their response characteristics and their proper use. Error analysis and interpretation of data. Classical instruments. Introduction to modern methods and instrumentation. Remote sensing, such as by radar and lidar. Instrument systems, such as on aircraft, and remote platforms, such as satellites and buoys. Laboratory experience with a large variety of instruments will be part of the course. *Prerequisite:* graduate standing in a physical science or engineering.

5400. The Physical Basis of Climate. 3. Global atmospheric and oceanic circulations, radiation balance, water balance and hydrologic cycle, energy balance, energy and moisture transport, evaporation and evapotranspiration, energetic processes, and theories of climate change. Dual listed with ATSC 4400. *Prerequisite:* MATH 2200, PHYS 1310, and CHEM 1020.

5500. Atmospheric Radiation and Optics. 3. Overview of atmospheric radiation, basic definitions, and basic laws of radiation. Nature of solar and terrestrial radiation, and atmospheric transmission. Derivation and analytic solutions to the equation of radiative transfer. Radiative transfer models at solar and terrestrial wavelengths, net radiation, and effects of polarization. Radiative properties of molecules, aerosols, and clouds (Rayleigh and Mie scattering). Inadvertent climate modification. Atmospheric refraction, diffraction and polarization phenomenon. *Prerequisite:* ATSC 5002.

5600. Advanced Cloud Micophysics. 3. Analysis of the processes involved in cloud and precipitation formation. Detailed treatments of the condensation, ice nucleation, vapor growth, and collection processes. Emphasis is on reviewing the current state of knowledge in the field and on surveying directions of research. *Prerequisite:* ATSC 5005.

5880. Atmospheric Science Problems. 1-3 (Max. 6). A special course for graduate students in atmospheric science only, designed to make possible the study and investigation of problems or phases of atmospheric science selected to fit the needs of students.

5890. Atmospheric Science Seminar. 1-3 (Max. 6). A seminar-type class furnishing motivation for advanced study of current problems by means of library research, study of current literature, and carefully guided class discussions. *Prerequisite:* consent of department head.

5900. Practicum in College Teaching. 1-3 (Max. 3). Work in classroom with a major professor. Expected to give some lectures and gain classroom experience. *Prerequisite:* graduate status.

5920. Continuing Registration: On Campus. 1-2 (Max. 16). *Prerequisite:* advanced degree candidacy.

5940. Continuing Registration: Off Campus. 1-2 (Max. 16). *Prerequisite:* advanced degree candidacy.

5959. Enrichment Studies. 1-3 (Max. 99). Designed to provide an enrichment experience in a variety of topics. Note: credit in this course may not be included in a graduate program of study for degree purposes.

5960. Thesis Research. 1-12. (Max. 24). Designed for students who are involved in research for their thesis project. Also used for students whose coursework is complete and are writing their thesis. *Prerequisites:* enrolled in a graduate degree program.

5980. Dissertation Research. 1-12 (Max. 48). Graduate level course designed for students who are involved in research for their dissertation project. Also used for students whose coursework is complete and are writing their dissertation. *Prerequisite:* enrolled in a graduate level degree program.

5990. Internship. 1-12 (Max. 24). *Prerequisite:* graduate standing.

Department of Chemical and Petroleum Engineering

4055 Engineering Building, 766-2500
FAX: (307) 766-6777
Web site: wwweng.uwyo.edu/chemical
Department Head: Morris D. Argyle

Professors:

H. GORDON HARRIS, B.S. University of Texas 1961; M.S. 1962; Ph.D. University of California 1968; Professor of Petroleum Engineering 1984.

NORMAN R. MORROW, B.Sc. University of Leeds, England 1959; Ph.D. 1962; Professor of Petroleum Engineering 1992.

MACIEJ RADOSZ, M.S. Cracow University of Technology 1972; Ph.D. 1977; Professor of Chemical Engineering 2000; Department Head 2000.

MRITYUNJAI P. SHARMA, B.Sc. B.I.T.T. in Dhanbad, India 1967; M.Tech. I.I.T. in Kampur, India 1970; Ph.D. Washington State University 1977; Professor of Petroleum Engineering 1992, 1982.

BRIAN F. TOWLER, B.E. University of Queensland 1972; Ph.D. 1978; Professor of Petroleum Engineering 2006, 1988; Department Head, Chemical and Petroleum Engineering 2004.

Associate Professors:

MORRIS D. ARGYLE, B.S. Brigham Young University 1990; Ph.D. University of California at Berkeley 2003; Associate Professor of Chemical Engineering 2008, 2003.

DAVID A. BELL, B.S. University of Washington 1976; M.S. Rice University 1979; Ph.D. Colorado State University 1992; Associate Professor of Chemical Engineering 2000, 1993.

MAOHONG FAN, B.S. Wuhan University of Science and Engineering 1984; M.S. Beijing University of Science and Tech., 1992; Ph.D. Chinese Academy of Sciences 1997; Ph.D. Iowa State University 2000; Ph.D. Osaka University 2003; Associate Professor of Chemical Engineering 2008.

GUAN QIN, B.S. Tsinghua University 1984; M.E. Research Institute for Petroleum Exploration and Development, China National Petroleum Corporation 1987; Ph.D. University of Wyoming 1995; Associate Professor of Petroleum Engineering 2009.

Assistant Professors:

HERTANTO ADIDHARMA, B.Sc. Institute of Technology, Surabaya 1987; Ph.D. Louisiana State University 1999; Assistant Professor of Chemical Engineering 2005.

VLADIMIR ALVARADO, B.Sc. Universidad Central de Venezuela 1987; M.S. Institut Francais du Pétrole 2002; Ph.D. University of Minnesota 1996; Assistant Professor of Petroleum Engineering 2006.

LAMIA GOUAL, B.Sc. Ecole Nationale Polytechnique 1993; M.Sc. Imperial College London 1998; Ph.D. 2003; Assistant Professor of Chemical and Petroleum Engineering 2007.

PATRICK JOHNSON, B.S. Lehigh University 1992; M.S. University of Virginia 1994; Ph.D. Columbia University 2004; Assistant Professor of Chemical Engineering 2006.

MOHAMMAD PIRI, B.Sc. Azad University, Arak 1995; M.Sc. Azad University, Tehran 1998; M.Sc. Imperial College, London 2000; Ph.D. 2004; Assistant Professor of Petroleum Engineering 2006.

SHUNDE YIN, B.S. Shijiazhuang Railway University, China 1999; M.S. Chinese Academy of Sciences 2003; Ph.D. University of Waterloo 2008; Assistant Professor of Petroleum Engineering 2008.

Assistant Lecturer:

John Myers

Adjunct Professors:

John Ackerman
Michal Banaszak
Jill Buckley
Geoffrey Mason
Koichi Takamura

Professors Emeriti:

Chang Yul Cha
Harry A. Deans
Jack Evers
Henry W. Haynes

The Department of Chemical and Petroleum Engineering offers graduate programs leading to the M.S. and Ph.D. degrees in chemical engineering and in petroleum engineering. The M.S. degree is offered under Plan A and Plan B. In addition, an environmental engineering program, run jointly by the Department of Chemical and Petroleum Engineering and the Department of Civil and Architectural Engineering, offers graduate programs leading to an M.S. in environmental engineering under either Plan A or Plan B.