Analytical and environmental chemistry related courses at UM

updated November 2018

Notes: Some courses may only be offered every other year. Make sure to discuss with your advisor and thesis committee about those courses you'd like to take. Our degree requirement is available at http://hs.umt.edu/chemistry/student-info/graduate/forms.php .

Core courses offered at the UM chemistry Department

CHMY 595 (3) - Atmospheric Chemistry (Fall)
CHMY 442 (3) - Aquatic Chemistry (Fall)
CHMY 541 (3) - Environmental chemistry (Fall)
CHMY 544 (3) - Applied Spectroscopy (Fall)

CHMY 421 (4) - Advanced Instrumental Analysis (Spring)
CHMY 465 (3) - Organic Spectroscopy (Spring)
CHMY 542 (3) - Separation Science (Spring)
CHMY 595 (3) - Mass spectrometry (Spring)
CHMY 595 / CHMY 291 (3) - Chemistry in the Environment (Spring)

Other optional courses at the UM

M 414 (3) Deterministic Models (Spring).

This course is given once in two years, and some of the students in your department may be interested in taking it. The course presents a hands-on approach to formulating the dynamic models from ecology, population biology, chemical and bio-chemical kinetics and related fields, to qualitative and quantitative analysis of such models (together with briefly discussing the techniques of model parameter identification from the available data). The final projects involve group work on the problems which the students are interested in; the students working in the labs are encouraged to bring their own data for the final project analysis. During the finals week the students prepare the final written reports on their projects and present them to the class.

Purpose of the Course: To provide an in-depth introduction to modeling in terms of ordinary and partial differential equations, and difference equations. The emphasis is on the hands-on practical approach to modeling processes in population biology, ecology, propagation of infectious diseases, chemical and biological kinetics, and other applications. In addition to model formulation and analysis, the basics of model parameter identification using the data will be addressed. For the final projects the students working in the labs will be encouraged to use their own data and / or work on the problems that are of direct relevance to their research.

Course Description: 3 credit hours. Prerequisites: M 263 or M 311, or consent of instructor. Mathematical content involves material on linear and nonlinear difference and differential equations: qualitative and quantitative methods, stability, phase–plane analysis, oscillatory behavior, limit cycles, chaos, eigenvalues and eigenfunctions. Emphasis on models in biology.

STAT 451 (3) - Statistical methods I (Fall)

This course is an introduction to statistical methods for analyzing data. The course is intended primarily for students in disciplines outside of mathematics who are seeking statistical tools for data analysis. After some experimental design issues and an introduction to graphical and numerical methods of exploratory analysis, the course will focus on probability distributions, relationships between variables, statistical inference through estimation, hypothesis testing, and confidence intervals, categorical data, and linear regression. Throughout the course, both in class, and on homeworks, the software package R will be used to illustrate statistical techniques and elucidate statistical concepts.

STAT 457 (1) - Computer data analysis I (Fall, lab for STAT 451)

STAT 452 (3) - Statistical Methods II (Spring)
This course is the continuation of an introduction to statistical methods for analyzing data. The course is intended primarily for students in disciplines outside of mathematics who are seeking statistical tools for data analysis. After a review of simple linear regression, the course will concentrate on many areas of regression such as inference, multiple regression, logistic regression, etc., and on areas of analysis of variance (ANOVA) such as interpretation of ANOVA tables, experimental designs, and analysis of covariance among others. This course is taught in conjunction with STAT 458 which will use the software package R to illustrate statistical techniques and elucidate statistical concepts.

FORS 538 Statistical Models for Ecological Data Analysis
This is an applied course covering advanced statistical modeling techniques using examples from forestry, ecology, and the environmental sciences. We will cover data management, visualization, and scripting with R, an open source data analysis and statistics platform which is rapidly becoming the standard in many scientific disciplines. After reviewing the linear regression model and associated diagnostics, we will explore various parametric and semi-parametric modeling strategies that allow for non-linear response functions and/or non-Gaussian response distributions. Estimation and inference in the context of generalized linear models, generalized additive models, and classification and regression trees will be discussed using examples from the scientific literature. This course will lay the foundation for subsequent graduate-level analytic coursework that is offered.

GEOS 585 (3) - Hydrologic Modeling (Spring)
Overarching goals: System identification and parameter estimation using inverse modeling and Bayesian inference techniques. Advanced topics in forward computer modeling and model analysis. Ancillary goals: Along with the overarching goals, in this course we will revisit some linear algebra, probability, and optimization concepts necessary to understand the contents of the course and to understand the scientific literature. We will also run computer models and get familiar with data pre- and post-processing tools.

Geo 595-01 (3) - ST: Food-Energy-Water Nexus (Fall)
The Food-Energy-Water Nexus examines core nexus concepts and tools with an emphasis on bridging local and global scales, sectors and disciplines, and problems and analytic tools. The course integrates physical and biological sciences, social and behavioral sciences, economics, and engineering, and covers broad frameworks such as ecosystem-based approaches, decision science, economic valuation, and complex systems theory. These frameworks are applied to

specific food-energy-water problems and cases to build analytic skills and illuminate system drivers, leverage points, and cross-scale linkages. Readings draw from Montana, national, and international examples. The course is structured to highlight both disciplinary and interdisciplinary perspectives on the nexus. Active learning and student participation are essential components of the course.

FORS 551 (3) - Digital Image Processing (Spring)
This course will concentrate on the extraction of spatial and thematic information from digital image data. Hands-on lab exercises involving image preprocessing, rectification, classification, accuracy assessment, and macro programming will be conducted throughout the semester. The educational goals of the course will be addressed through lectures covering the concepts and theory of image processing. Students will then work through a tutorial exercise designed to train them in the use of ERDAS/IMAGINE image processing software.

GPHY 588 (3) - Spatial Analysis and Modeling (Fall)
Coreq., GPHY 589. Theoretical/conceptual and practical aspects of entity-based GIS modeling and spatial analysis. Point pattern analysis (i.e. cluster detection, density analysis, kriging), network analysis (i.e. network construction, network-based spatial statistics, accessibility modeling), and areal pattern analysis (i.e. spatial autocorrelative pattern, spatial regression modeling). Applications in urban and environmental planning, transportation, natural resource management, ecology, health, criminology, engineering, and business. Level: Graduate

GEOS 595 (2) - Food Energy Water Nexus Field Lab (Spring)
This course is offered through the UM BRIDGES training program, which trains future leaders from diverse backgrounds to advance societally-relevant science toward more sustainable food-energy water systems (umt.edu/bridges). This field-based course connects theory and practice by examining food-energy-water case studies, conducting interdisciplinary synthesis, and communicating with diverse stakeholders. This course meets throughout the semester (see schedule) to research and discuss local case studies and culminates in an end-of-semester field trip that enables trainees to examine food-energy-water issues on-the-ground and to meet with and learn from farmers and ranchers, energy and water managers, policy-makers, and tribal members. The Field Lab also integrates lessons from communications workshops (described below), which are required of all field lab students, and will conclude with students completing a synthesis podcast, video vignette, or other digital-platform project. For this semester, the case studies and field trip will focus on the Columbia River basin.

Geo 548 (3) - Topics in the Cryosphere (Fall)
The primary goal of this course is to gain in-depth understanding of processes, research methods, and recent scientific breakthroughs related to ice sheet flow. In contrast to a survey course, we will go deep into a few specific topics. This course is only appropriate for graduate students conducting advanced research related to the broad field of glaciology.

PHSX 444 (3) - Advanced Physics Lab (Fall)
Offered autumn. Prereq., PHSX 461; PHSX 323 suggested but not required. Advanced experiments in classical and modern physics, including optics, spectroscopy, laser science,

atomic, nuclear, and particle physics, Data analysis techniques for experimental scientists. Recommended for students entering graduate school in any experimental science.

PHSX 446 (3) - Thermodyn & Stat Mech (Spring)
Offered spring even-numbered years. Prereq., PHSX 343; prereq., or coreq., M 221. Topics in thermodynamics and statistical mechanics.

PHSX 461 (3) - Quantum Mechanics I (Fall)
Prereq., PHSX 311, PHSX 343; prereq. or coreq., M 311 or M 221. Introduction to quantum mechanics. Topics include Schroedinger equation, piecewise constant potential, harmonic oscillator, hydrogen atom, angular momentum theory, electron spin.

PHSX 462 (3) - Quantum Mechanics II (Spring)
Prereq., PHSX 461 or consent of instr. Advanced topics in quantum mechanics including linear vector spaces and Dirac notation, quantum dynamics, time-dependent perturbation theory, and scattering theory.

GPHY 587 (3) - Image Analysis & Modeling (Fall)
Offered every two years. Prereq., GPHY 487 or FORS 351 or Consent of instructor; coreq., GPHY 589. Advanced topics in image analysis (e.g. hyperspectral images and pattern-recognition-based classification) and foundations of simple raster-based models. Level: Graduate

NRSM 408 (3) - Global Cycles and Climate (Spring)
Offered spring even-numbered years. Same as CCS 408. An analysis of the earths major global biogeochemical cycles with a focus on the ways and extent to which each of them influences and interacts with the global climate system.

NRSM 415 (3) - Environmental Soil Science (Spring)
Offered spring odd-numbered years Prereq., ENSC 245N or NRSM 210N or consent of instr. A detailed analysis of the physical, chemical and biological properties of soils and how they function, with a focus on soil processes and how they affect, and are affected by human activities. Specific topics include element cycling, water quality, the effects of environmental change soil biogeochemistry, plant-soil interactions, and the consequences of large-scale disturbances on soil processes.

NRSM 418 (3) - Ecosystem Climatology (Spring)
Interactions between the biosphere and atmosphere to advanced undergraduate students and graduate students. This course will explore the interactions between Earth's biosphere and atmosphere and how they affect climate over a range of scales. We will focus on the exchange of energy, mass, and important elements between the biosphere and atmosphere and how this exchange can lead to fascinating feedbacks in Earth's climate system. Basic physics and math is not required but it is recommended.

PUBH 510 (3) - Introduction to Epidemiology (Spring)
This course introduces principles and methods of epidemiologic investigation and an overview of relevant biostatistical applications. Students will be provided with the basis for conducting and

interpreting epidemiologic studies. The techniques of descriptive and analytic epidemiology are presented. Measures of disease frequency and quantitative measures to determine risk association will be described as well. Several types of study design will be introduced, including randomized trials, case-control and cohort studies, and outbreak investigations. Approaches for assessing causality and validity will be described. Finally, we will discuss approaches for using biomarkers in epidemiological studies.

PUBH 560 (3) - Environmental and Rural Health (Spring)
This course will provide students with a comprehensive introduction to environmental health. This includes an overview of the methods and paradigms used in the field, ranging from ecology to epidemiology, from toxicology to environmental psychology, and from genetics to ethics.