

NM Tech Distance Education Program in Hydrology



New Mexico Tech's Hydrology Program was established in 1957 making it the oldest in the United States. When [#] *US News and World Report* ranked top Hydrology Programs (circa 2001), NM Tech was 4th behind Stanford University, the University of Arizona and Wisconsin. The Hydrology Program at NM Tech now offers an on-line 15-Credit Graduate Certificate and a 30-Credit coursework only Professional Masters Degree Hydrology. The hydrology faculty who teach distance education classes are listed below in Table 1. These are the same classes that our on-campus hydrology graduate students take.

Table 1. Distance Education Instructors.



Dan Cadol, PhD Colorado State University, 2010. **Interests:** *Eco-hydrology and ecohydraulics, surface water hydrology*



Alex Rinehart, PhD New Mexico Tech, 2015. **Interests:** *hydrogeomechanics, hydro-geochemistry, hydrogeodesy*



Mark Person, PhD Johns Hopkins University, 1990. **Interests:** *hydrogeology, paleohydrogeology, geothermal systems*



Kate Leary, PhD Arizona State University, 2018. **Interests:** *fluvial geomorphology, process sedimentology, surface water hydrology*



Michael Schaefer
PhD Stanford University, 2017. **Interests:** *Hydro-geochemistry,*



Phil Miller, New Mexico Bureau of Geology and Mineral Resources, BSc. New Mexico Tech, **Interests:** *Geographic Information Systems*

US News and World Reports no longer ranks hydrology programs

Students can interact with the faculty during the classes as they are taught (Fig. 1) or view lectures asynchronously using the CANVAS distance education software environment. Prospective students need access to a computer with a web-browser and an internet connection in order to participate in lectures, download assignments, take examinations and communicate with faculty and peers. Off-line Zoom sessions can also be arranged if students have questions about their assignments. The classes are accessed via NM Tech distance learning portal described below. We encourage students to view the lectures in real time, if possible, so they can ask questions interactively. Distance education students who are on professional travel may turn assignments in late but will be required to take the exams within 1-2 days as regular graduate students.

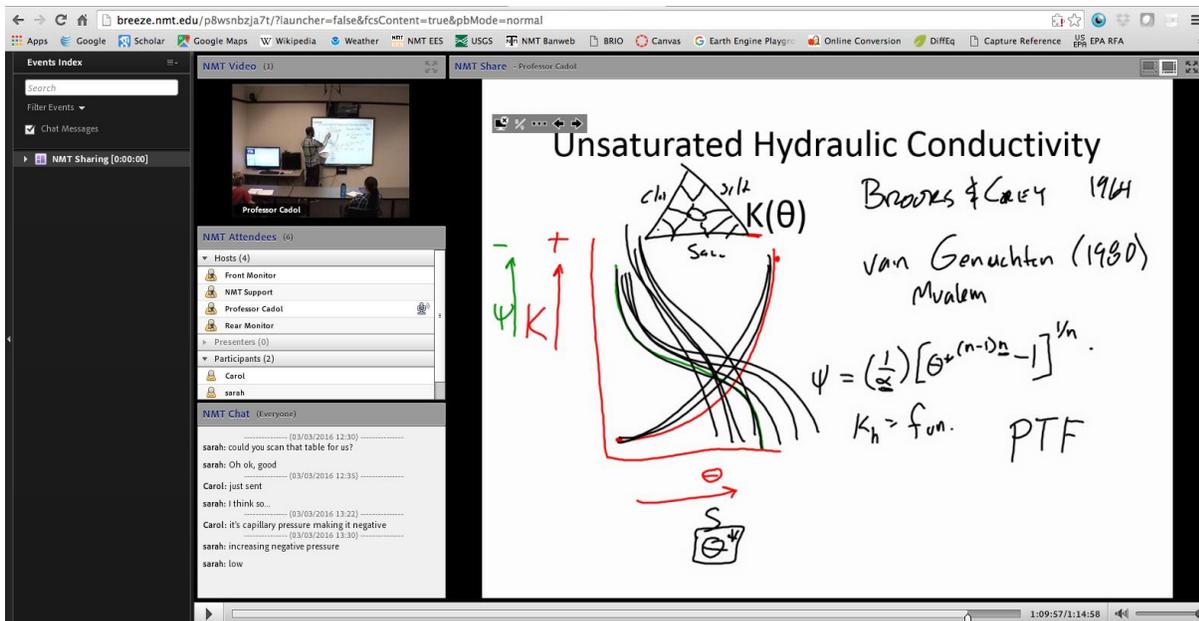


Figure 1. Example of on-line presentations. The instructor and class are seen in the upper left image. The lecture material being presented is shown in the large image in the upper right hand corner of the window. Distance education students can send text messages (lower left hand corner) to interact with the instructor.

Overview of Online Certificate in Hydrology Program

Our 15-credit Graduate Certificate in Hydrology is intended to provide students with much of the course work that our on-campus MSc. students are required to take. Certificate classes can be applied toward the Professional Masters degree in Hydrology. On-line students will not be required to participate in laboratory and field components of distance education (DE) classes such as Erth 440. Students who complete the Certificate Program with a B average are eligible to apply this course work towards completion of an MSc. or Ph.D. degrees at NM Tech in Socorro. An on-campus MSc. Hydrology degree requires 30 credits and a research thesis. There is also a 1-semester residency requirement. All Certificate students are required to take **Erth 440**. To complete the 15-credit Hydrology Certificate degree

requirements, students may choose from the following list of courses: **Geol 512D, Geol 550D, Hyd 507D, Hyd 510D, Hyd 511D, Hyd 513D, Hyd 514D, Hyd 543D**. These courses are described below in Table 2.

Overview of Online Professional Masters Degree in Hydrology

This 30-credit course-work only Professional Master of Hydrology degree is intended to provide on-campus and distance education (DE) students with much of the coursework that our thesis-based MS students take. This is a coursework-only degree that requires no independent study or thesis. This would replace the hydrology program's Independent Study Option. On-line students will not be required to participate in laboratory and field components of classes such as **ERTH 440**, but remote participation in computing labs is feasible and expected. Graduate credits earned by students pursuing or who have obtained a Graduate Certificate in Hydrology at NM Tech can be applied towards the professional Masters of Hydrology Degree. All Professional Masters Degree students must take: **ERTH 440D** (3 Cr; Table 2), Twenty-one credits of graduate classes in Hydrology (Table 2). Examples of available distance education courses could include: **HYD 507, HYD 510, HYD 511, HYD 513, HYD 514, HYD 516, HYD 520, HYD 534, HYD 546, HYD 547, HYD 550, HYD 558, HYD 560, or HYD 562**. Six credits of elective classes outside of the Hydrology Program (Table 3). Examples of available distance education elective classes that could include: **MGT 462, MGT 472, GEOL 512, MATH 586, TC 505, TC 575, GEOP 555, GEO 503**. Some of these classes are listed in Table 3.

Hydrology Certificate and Professional Masters students must maintain a B average (3.0 GPA) in order to remain in good academic standing. Courses completed with a grade below a C must be retaken.

Table 2. Hydrology Program Distance Education Classes

Class Number	Class Name	Description
ERTH 440D	Hydrological Theory and Field Methods, 3 cr. (Prerequisite: MATH 132, PHYS 132 122)	Fundamentals of hydrological flow and transport will be presented. Precipitation, runoff processes, and flood generation. Capillarity, unsaturated flow, and infiltration. Laws of flow in porous media, hydraulic storage, and flow to wells
HYD 507D	Hydrogeochemistry, 3 cr, 3 (Prerequisite: CHEM 122; Pre or Corequisite: EARTH 440)	Offered fall semester. The thermodynamics and aqueous chemistry of natural waters, with emphasis on groundwater. Chemical equilibrium concepts, surface chemistry, redox reactions, and biochemistry. The interaction of water with the atmosphere and geologic materials. Basic concepts applied to problems of groundwater quality evolution, water use, and groundwater contamination. Shares lecture with EARTH 407, with additional expectations for graduate credit.
HYD 510D	Quantitative Methods in Hydrology, 3 cr.	Offered fall semester. Introduction to the methods of mathematical physics used in hydrologic science. Presented in the context of mathematical models of water and energy balances, fluid flow, and heat & solute transport. Application to aquifers, the vadose zone, land-surface runoff, rivers, and the atmospheric boundary layer. Methods span advanced engineering calculus, including numerics and differential equations. Use of software (Matlab, Maple) or problem solving and solution presentation. Programming with Matlab.
GEOL 512D	Introduction to Geographic Information Systems, 3 cr	An introduction to the concepts of geographic information systems (GIS). Theoretical background to GIS; introduction to the nature and analysis of spatial data. ArcView and/or ArcGIS.
HYD 511D	Groundwater Hydrology, 3 cr. (Prerequisite: EARTH 440)	Offered alternate spring semesters. Study of the occurrence, movement, and chemical and isotopic composition of groundwater. Hydrogeologic properties. Groundwater recharge and stream/aquifer interaction, flow net and hydrograph analysis. Groundwater exploration using geologic and geophysical methods. Groundwater in different geological, climate, and physiographic regimes. Characterization of groundwater using stable isotopes and major ion analysis. Physics of flow to wells, steady- state and transient solutions to well hydraulics equations, image well theory, responses of aquifers to perturbations. Role of groundwater in contaminant migration and heat transfer. (Shares lecture with EARTH 411, with additional expectations for graduate credit)

HYD 513D	Watershed Dynamics & Ecohydrology, 3 cr. (Prerequisite: EARTH 440)	Offered alternate spring semesters. Processes governing hydrological flow rates and pathways through watershed systems: hillslope runoff production and in-channel flood routing. Emphasis on physical mechanisms and their treatment in models, as well as observations made in the field. Interactions between terrestrial plants and water, nutrients, and light resources in semiarid ecosystems and riparian zones. Vegetation induced flow roughness, ecohydrological processes and dynamics, and simple numerical models.
HYD 514D	Vadose Zone Hydrology, 3 cr. (Prerequisite: EARTH 440)	Offered alternate fall semesters. Physics of unsaturated flow in porous media, multiphase flow, potentials and water retention, unsaturated hydraulic conductivity, transient flow problems. Mathematical modeling of variable-density flow. Analysis of slope stability, drainage through mine tailings and rock piles, hazardous waste migration, soil moisture controls on evapotranspiration and vegetation growth.
HYD 547D	Hydrological Modeling, 3 cr. (Prerequisites: EARTH 440, HYD 510)	Analysis and synthesis of issues in hydrologic science. Related engineering problem solving. Conceptual modeling process: model conceptualization and parameterization, model diagnosis, testing and validation, and model prediction. Conceptual models for testing scientific hypotheses, assimilating data, developing policy, and solving engineering design and operational problems. Development of simple, two-dimensional groundwater flow models using Matlab. Applications to groundwater flow and contaminant transport problems using MODFLOW GMS software.
HYD 562	Fluvial Geomorphology, 3 cr. (Prerequisite: EARTH 440)	Interactions of water and sediment flow in fluvial systems. Sediment transport rates and particle size dependence. Physical controls on channel morphology, bedforms, and microhabitat distribution. Hydraulic geometry and bank-full flow analysis, with implications for floodplain development. Basin morphometric relationships with climate and flood routing. Case studies of fluvial system response to disturbances such as wildfire, avulsion, land use change, climate change, and stream restoration
GEOL 503	Introduction to Soils, 3 cr. (Prerequisites: EARTH 202 and 403; or consent of instructor)	Introduction to soil formation, pedogenic processes, and soil description and mapping techniques. Shares lecture and labs with EARTH 405 with additional expectations for graduate credit.

Table 3. Elective Classes for Professional Masters Degree Students

Class Number	Class Name	Description
MGT 462	Systems, Risk, and Decision Analysis, 3 cr.	Analysis of systems and managerial decisions under conditions of risk or uncertainty. Optimal project evaluations and ranking of alternatives using expected value and expected utility criteria. Topics include risk sharing, Bayesian revision of probabilities, value of information, and preference assessment procedures.
MGT 472	Production and Operations Management, 3 cr.	Application of quantitative methods to problems encountered in management. Problem solving emphasis with extensive use of applications software. Topics include linear and integer programming, forecasting, queueing theory and simulation.
GEOL 512D	Introduction to Geographic Information Systems, 3 cr.	An introduction to the concepts of geographic information systems (GIS). Theoretical background to GIS; introduction to the nature and analysis of spatial data. ArcView and/or ArcGIS.
MATH 586	Spatial Variability and Geostatistics, 3 cr.	Introduction to spatial and temporal variability. Stationary and intrinsic random fields, variograms and estimation. Kriging, co-kriging, and simulation of random fields. Conditioning and conditional simulation. Indicator kriging and simulation. Applications from hydrology, mining, petroleum engineering, and other fields of science and engineering. (Intro to Prob. & Stats Prereq).
TC 505	Science Writing, 3 cr.	This course provides an overview of science writing genres designed to reach multiple audiences (e.g., specialists, policymakers, students, the public), with an emphasis on nonspecialist audiences. The course is useful both to students pursuing a career as a professional science or technical writer and to students in the sciences hoping to improve their communication skills. Course topics include, but are not limited to, popular science writing (e.g., writing for mainstream magazines and newspapers) and public information (e.g., press releases, websites, science blogs, informational videos). The course involves a service-learning project providing students with opportunities for publication.
TC 575	Communication in the Sciences, 3 cr.	Advanced communication writing courses linked to science disciplines, focusing on graduate and professional genres (e.g., conference abstracts, journal articles, and conference presentations). Emphasis on communicating technical information to a variety of audiences.
GEOL 503	Introduction to Soils, 3 cr.	Introduction to soil formation, pedogenic processes, and soil description and mapping techniques.

Online Program Information and Requirements

Online programs are open to applicants with a bachelors degree in any of the natural sciences or engineering disciplines (e.g. earth science, civil engineering, biology, chemistry). Students taking online classes should expect to take 18-24 months to complete the program.

New Mexico Tech Distance Education Program Department

Questions related to access and use of the distance education program can be found online at:

<http://act.nmt.edu/distance/>

Or by contacting the Distance Education Department:

Student support:

Call toll-free 866-644-4887

Technical support and DE studio:

local: 575-835-6277

toll-free: 866-357-2779

RHepler@admin.nmt.edu

Attending Courses on Line:

In order to login into the class portal and participate in a lecture, go to the following web site:

<https://nmt.instructure.com/login/canvas>

Applying to NM Tech Graduate Program

Before you can take Distance Education classes at NM Tech, you must be admitted to the graduate program either as a "Special Graduate Student" or a "Part Time graduate student". Please contact the Graduate Office (575-835-5513; graduate@nmt.edu) to learn how to apply to the NM Tech graduate program. Once you have been admitted, you will obtain a Student ID (a number starting with 900). The You can take up to 12 credits as a "Special Graduate" Student. The application processes is faster for Special Graduate students but eventually you'll need to be converted to a "Part Time" graduate student before receiving your certificate or professional masters degree. You must be registered during the semester you receive your Hydrology Certificate or Professional Masters Degree. Special graduate application forms can be found at the following link:

<https://www.nmt.edu/gradstudies/docs/Special%20Graduate%20Application.pdf>

In order to be admitted as a part time graduate student, you must apply to NM Tech through the GRADCAS™ website (<https://gradcas.liaisoncas.org/>).

Once you are admitted, your 900 number will be sent to you via the US mail. Alternatively, you'll need to call the graduate office to obtain your 900 number if time is an issue. The graduate school number is 575-835-5513. Once you have your 900 number you can register for the distance learning classes you wish to take.

<http://www.nmt.edu/registration-information>

It takes *at least* one month to complete through the admissions process.

Navigating the Course Portal

Once you have created your account and paid for your class, you can proceed to the course portal.

<http://act.nmt.edu/distance/>

Questions not answered by this brochure can be directed to:

Mark Person, Professor of Hydrogeology, mark.person@nmt.edu,
575-517-7578 (cell)