# WATER RESOURCES SCI/TECH (WATR)

**WATR 5111 Graduate Seminar**
**Credit:** 1 (1-0-0)
This course provides students an opportunity to explore current topics in water resources science and technology, along with guest presentations by experts in the field. Students will research topics before class and participate in discussions. Students may engage in "Point-Counter Point" debates. Students will participate in a small-group cooperative research project based on a selected topic of the seminar from which a scientific report will be written. Results of the research will be orally presented by the group.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5214 Nexus of Water, Energy, and Food**
**Credits:** 2 (2-0-0)
This course provides an overview of the basic climatic, environmental, geologic, and economic factors affecting sustainable use of water in energy development and agriculture in an arid environment. Focusing on arid South Texas and U.S. Mexico border areas, students will examine water use and disposal in oil and gas production, use of water in energy and agricultural production, cross-border issues, and water needs in a rapidly urbanizing border environment. Discussion will emphasize sustainable use challenges and opportunities, such as advances in recycling, desalination, and environmental consequences of development.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5305 Research Project**
**Credits:** 3 (0-0-3)
Students will complete a research project. This course provides students working on a project an overview of the important concepts of research design, data collection, statistical and interpretative analysis, final report preparation and presentation. Students will use quantitative and qualitative methods to frame meaningful questions and conduct credible research. They will gain an overview of research intent and design, methodology and technique, format and presentation, and data management and analysis using common statistical methods. The course will develop each student's ability to use their knowledge and data collected through research to become more effective.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5306 Thesis**
**Credits:** 3 (0-0-3)
This course is designed to develop understandings, skills, and outlooks to conduct original, independent research and scientific publication in the field of water resources science and technology. Student will develop research plans that will state the problem and research questions, outline a research strategy and experimental approach, detail method of data collection, interpretation, and validation, and outline the method of documenting results and conclusions. Student are expected to conduct an extensive and appropriate literature search relating to the research. Students will conduct research by collecting data through an appropriate experimental protocol, and then analyze that data according to techniques appropriate for the type data collected and to answer the research questions. Students will then draw conclusions answering the research questions and make recommendations. Each student will produce a thesis document that can also be published in part or whole in a peer reviewed research journal.

**Restrictions:** Undergraduate level students may not enroll.
**Repeat Status:** Course may be repeated 1 time(s).

**WATR 5312 Water Laws, Rules and Policy**
**Credits:** 3 (3-0-0)
This course provides an introduction to local, state, and federal rules and regulations relevant to water. Students will receive an introduction to the history and function of water laws, rules, and policies and how they are created, including the roles of the three branches of government and the public. Relevant U.S. and Texas laws, rules, and policies governing water resources will be reviewed and evaluated in detail, including the Clean Water Act, Endangered Species Act, and National Environmental Policy Act. Students will examine federal, state and local approaches to water allocation, pollution control, and resource management on private and public lands, public waters, for groundwater, and for other beneficial uses serving society. Students will explore the challenges of law making and regulatory processes and discuss alternative strategies for water pollution control and resources management, including sustainability models, voluntary approaches, real-time information feedback, and new technology applications, sanctions, and economic incentives and other market-based mechanisms. The student will become familiar with the political environment within which water laws and public policy are created, including the roles of science, opinion, and influence.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5314 Pollutants in Environmental Systems**
**Credits:** 3 (3-0-0)
This course provides advanced study of the fate of contaminants in natural, disturbed, and man-made water systems. Study will focus on pollutants of concern to public and environmental health, including toxic chemicals, industrial discharges and spills, endocrine disruptor chemicals, methyl mercury, pesticides, sediment-borne contaminants, and other contaminants. Impacts, emergency response, safety advisories, impact on water supplies, and natural remediation processes will be explored, including biodegradation, thermodynamics, aeration, bioaccumulation, state change reactions, acid-base equilibria, speciation, solubility, redox chemistry, dilution, and sequestration.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5315 Advanced Municipal and Industrial Wastewater Treatment and Recycling Systems**
**Credits:** 3 (3-0-0)
This course provides students instruction on water treatment technologies that are rapidly advancing the state of the art in pollution control. Taking advantage of San Antonio's proximity to oil fields, students will be exposed to innovative technologies coming into use through research and proof of concept testing directed at finding solutions to water resource impacts and usage during energy extraction, especially resulting from hydrologic fracturing processes. They will have an opportunity to explore compact modular treatment works now addressing unique pollution treatment requirements of specific industries and locations where a "one size fits all" approach to treatment of effluents no longer exists. With even the most difficult to address pollutants, such as boron, now subject to economically attainable treatment processes, treatment industry norms are being expanded more rapidly than ever thought possible. New strategies for advanced recycling of gray water wastes, as well as innovative uses of black water and industrial effluents will be explored. Students will have an opportunity to visit field locations where new oilfield and industrial directed technologies are being used.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5320 Statistical Methods in Research**
**Credits:** 3 (3-0-0)
This course provides an introduction to the basic concepts, application, meaning, use in water resources science, and practice of statistics, including graphical analysis, probability distributions, hypothesis testing, regression techniques, analysis of variance, quasi-statistical methods, and communicating statistical analysis and probabilities. Students will practice by solving basic research problems common in water science by using the various statistical methods covered in the course.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5322 Wastewater Treatment for Direct and Indirect Uses**
**Credits:** 3 (3-0-0)
This course examines the technologies required to produce safe drinking water and pretreated water for human uses and manufacturing from treated wastewater, surface, and groundwater sources. Course content includes study of the chemical and physical basis for using treatment media, including filtration, clarification, cartridge filtration, bag filtration, membrane filtration, silt dispersants, biocides, acids, scales inhibitors, sulfite compounds, ultraviolet irradiation and softening. Course content includes examining the characteristics of feed water contaminants and the fundamental principles of ion exchange water purification using ion exchange technology. Additional topics include in-depth problems that arise in the five steps of water production: mixing, flocculation, coagulation, sedimentation, filtration, and disinfection. Students will expand their understanding of the chemistry involved in the disinfection of water and special treatment processes for taste and odor, water stabilization, and associated issues.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5325 Natural and Constructed Green Systems for Wastewater Management**
**Credits:** 3 (3-0-0)
This course provides Students will learn about using constructed green biological systems to manage raw and treated waste streams from runoff, combined sewer overflows, and treatment facilities across urban and rural landscapes. Students will examine best practices in restoration of wetlands, riparian zones, and other natural areas in a watershed that may function in bioremediation of wastes and augment municipal and industrial treatment. Work will include assessing the effectiveness and value of natural ecologic functions in maintenance of healthy watershed systems and water sustainability. Students will learn from practicing professionals about recent advances in urban and multiple use planning that incorporate extensive use of greenways and other green infrastructure for management of water distribution, wastes, and sustainable water systems, as well as support local agriculture and industry.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5330 Water Resources Science and Technology Internship**
**Credits:** 3 (0-0-3)
Students taking this course conduct specialized work on an individual basis, that includes training and actual practice working in a water resources science or water technology related for profit business, government agency, municipal agency, or nonprofit organization in the area of industrial water technology or water resource management. Students will be engaged in supervised experiential learning, under the direction of a university faculty member and employees of participating organizations. Students will have the opportunity to be involved in activities such as data collection, analysis, report writing, and plant, field or laboratory experiences.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5335 Desalination Processes and Emerging Technologies**
**Credits:** 3 (3-0-0)
This course takes advantage of proximity to one of the first desalination plants located inland and using saline groundwater for freshwater production. Students will learn about the full range of desalination technologies in use and under development. Instruction will include an in-depth look at membrane systems, microfiltration, distillation, atmospheric water generation, reverse osmosis, forward osmosis, brine disposal, and electrodialysis, solar desalination, and small-scale desalination solutions. Students will participate in a field trip to a production scale desalination facility where they will discuss desalination technologies and plant operations with practicing operators and technical experts.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5345 Environmental Impact Assessment of Water Resources**
**Credits:** 3 (3-0-0)
This course provides for study of the theory, science, rules and requirements, and practice of environmental impact assessment on aquatic ecosystems and watershed function. Students will have the opportunity to conduct example environmental impact reviews and ecological assessments of water resources and produce sample environmental impact statements and reports. Practicing professionals in the field of environmental impact review will address the class. Students will participate in a small-group cooperative research project from which a scientific report will be written. Results of the research will be orally presented by the group to the class as a scientific report/paper.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5350 Groundwater Management and Field Investigations**
**Credits:** 3 (3-0-0)
This course provides an introductory course on the chemical and biological characteristics of groundwater, groundwater assessment, and management, aquifer storage technologies, life underground, value to society, and the interactions of surface water and groundwater with the geologic environment. Topics include microbial processes, water quality sampling techniques, capacity, flow rates, living communities, aquifer mapping, and modeling, recharge rates and projections, remote sensing techniques, impact of energy production activities, uses, role in society and economic value, and the fate of chemicals, contaminants, and dissolved components in water. Students will have an opportunity to explore groundwater through use of simple demonstration models and field visits to locations where groundwater management activities are currently underway. The course will include field activities.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5355 Institutions and Their Role in Water Resources Management**
**Credits:** 3 (3-0-0)
Students will learn about federal, state, and local institutions and agencies responsible for or advocating management of water resources and the development of the policies, laws, and regulations governing water use, distribution, and public health and safety. Students will learn about one or more institutions, with presentations and detailed review by actual top executive leaders from the institution or agency under discussion. Student projects will involve taking turns researching the presenter's institution and the person's role, and then introducing the presenter to the class. Students will be required to work in groups investigating in detail one institution, a challenging matter currently being addressed by the institution, how the institution has or will solve the challenge, and make a presentation to the class about what they learn. Institutions that students will learn about from top leadership may include the Texas Water Development Board, San Antonio River Authority, Edwards Aquifer Authority, the U.S. Environmental Protection Agency, San Antonio Water System, Texas Parks, and Wildlife Department, The Nature Conservancy, the Hill Country Alliance, the U.S. Army Corps of Engineers, Underground Water Conservation Districts, U.S. Geological Survey, Texas State Soil, and Water Conservation Board, Friends of Blue Hole, and the Natural Resource Conservation Service.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5360 Water Resources Sustainable Use and Conservation Policy and Practice**
**Credits:** 3 (3-0-0)
This course investigates water resources science and resource management from the perspective of its value to human society and sustainability. Water has unique properties that make it essential for sustaining all life on Earth, which gives this natural resource a major historic and future role in development of society. The hydrologic cycle is explored as it exists from high above the Earth's surface to miles beneath it. The geology of water's availability to human society is explored, as well as the role of surface water and aquifers in shaping landscapes and human inhabitation. Students explore the influence of climate on water, distribution, and availability of safe drinking water, and pollution of water in the past and current social and economic context of civilization through history. Water issues will be discussed in the context of meeting current and future needs of society. Where possible, examples relevant to Texas will be emphasized.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5365 Water Policy Institution Internship**
**Credits:** 3 (0-0-3)
This course provides students opportunity to serve in a supervised capacity at an institution legally responsible for managing or regulating water resources, or at an institution that advocates on behalf of citizens or professionals on water resource matters. Students will be involved in a variety of substantive roles in actual practice of significance to the institution, while under the direction of a university faculty member and an on-site supervisor/mentor. This course allows students to take their educational experience beyond theories of policy formation and water science. They become personally and professionally involved in actual application of techniques in policy development, technical analysis and evaluation, advocacy and stakeholder processes, and regulatory challenges affecting water resources today. Upon completion of the course, students will understand the complex environment within which water resource management and public policy operates, including the roles of science, managers, and stakeholders.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5370 US-Mexico Borderlands and Interjurisdicitional Water Issues and Policies**
**Credits:** 3 (3-0-0)
Students will study interjurisdictional policy and scientific water management issues in the U.S.-Mexico border region. Water there are shared bi-nationally, with rivers flowing from one country to the other or forming the international boundary. Students will learn about efforts protecting and restoring watersheds and water quality in these rivers. Adequate drinking water and basic sanitation services requires collaborative bi-national, multi-jurisdictional planning efforts. They will examine the significant and complex challenges in shared watersheds that are exacerbated by high population growth rates and impacts from climate change. Students will explore the full range of water-related issues along the border and compare them with interjurisdictional water and transboundary lakes issues elsewhere in the world.

**Restrictions:** Undergraduate level students may not enroll.

**WATR 5371 Independent Study**
**Credits:** 3 (3-0-0)
This course is designed to give graduate-level students the option to pursue studies outside of the prescribed coursework. Students must be supervised while performing the study that is substantially different from the thesis/research topics, and will be required to submit a research report to demonstrate the learning outcome of an independent study. Students considering pursuing an independent study should identify for themselves their area of interest and approach a faculty member appropriate to this area of interest to act as faculty supervisor, with whom he or she has already taken at least one class.

**Restrictions:** Undergraduate level students may not enroll.