

VT Water-Related Graduate Courses

See Virginia Tech Graduate Catalog for more information.

BIOL 6064: TOPICS IN FRESHWATER ECOLOGY

Readings and discussion in a specific area of freshwater ecology, including species interactions, and community level functions. Topics will vary, and course may be taken for credit more than once.

BSE 5214: ADVANCED TOPICS IN WATERSHED MANAGEMENT

An interdisciplinary exploration of advanced topics in watershed management. Reading, discussion, summary and presentation of current research in the areas of water quality and watershed management. Topics will be built around a semester theme that will vary by semester; the course may be repeated up to three times.

BSE 5224G – ADVANCED FIELD METHODS IN HYDROLOGY

Site characterization: surveying, channel and floodplain mapping, land use, electronic data acquisition. Techniques for measuring surface and subsurface hydrological processes: water flow, hydrologic conductivity, precipitation, evaporation. Sampling techniques: surface water, groundwater, and soil pore water sampling. In-situ monitoring: automatic samplers, data loggers, water quality sondes. Laboratory analyses: GLP practices, selection of analytical method, calibration, QA/QC.

BSE/CEE 5244: ADVANCED GIS IN HYDROLOGIC ANALYSIS

Advanced GIS course focusing on raster analysis with particular application to the issues associated with hydrologic analysis. Application and evaluation of algorithms for terrain analysis, watershed characterization, and hydrologic analysis and modeling as implemented in GIS. Digital elevation data sources and error assessment. Approaches to GIS/model integration and application.

BSE 5364: STREAM RESTORATION

Stream restoration practices related to channel dynamics, sediment transport, impact of human activities, aquatic habitat improvements, and design and assessment. Inspecting, classifying, identifying and measuring river features of channel morphology to predict river reaction to human activities and watershed change.

BSE 5404: AGRICULTURAL NONPOINT SOURCE POLLUTION

Assessment and management of agricultural nonpoint source pollution (NPS). Precipitation, runoff, erosion, pollutant fate and transport, and best management practices. Application of Total Maximum Daily Loads and water quality standards. Pre: Background in physical, chemical, biological, and soil factors affecting the environment and in environmental regulations.

CEE 5100: STORMWATER TREATMENT

Stormwater quality. Basic traps, basins, and filters. Stormwater treatment. Basic vegetative control systems. Mechanistic role of wetland. Best management practices. Monitoring, sampling, analysis, and maintenance methods. Pre: Graduate standing.

CEE 5125 and 5126: ENVIRONMENTAL ENGINEERING DESIGN

5125: Design of wastewater treatment facilities for the reduction and elimination of organic and inorganic pollutants; 5126: Design of water treatment facilities for the production of potable waters from surface and groundwater systems.

CEE 5134: ENGINEERING ASPECTS OF WATER QUALITY

The application of biological, chemical, and physical principles of water quality to engineering problems in surface waters.

CEE 5244 ADVANCED GIS IN HYDROLOGIC ANALYSIS

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CEE 5304: ENVIRONMENTAL FLUID MECHANICS

The first part of the course will be devoted to basic concepts and equations of fluid motion. The remainder of the course will be concerned with the theory of incompressible viscous and inviscid fluids. Selected applications will be drawn from environmental and water resources topics.

CEE 5314: RIVER MECHANICS AND SEDIMENT TRANSPORT

Sediment properties; critical stress; bed-form regimes in alluvial streams; depth-discharge relations for rivers; bed load and suspended load movement; river stability; flow in bends; river training.

CEE 5334: ANALYSIS OF WATER RESOURCES SYSTEMS

Introduction to quantitative hydrology. Diverse computational aspects within watersheds. Methods and models used to examine components of hydrologic cycle. Risk analysis and statistical probability in hydrology. Comprehensive models for watershed management and urban hydrology.

CEE 5344: SURFACE WATER-GROUNDWATER INTERACTION

Interaction (exchange) of surface water with groundwater at watershed, reach, sediment-patch scales including bidirectional hyporheic flows. Focus on streams and rivers, consideration of lakes. Steady and unsteady exchange hydraulics including laminar and turbulent flows. Exchange benefits and engineering goals including heat transfer, nutrient processing, and contaminant attenuation. Engineering applications including conjunctive use of surface water and groundwater resources and impact of groundwater pumping on rivers. Field methods.

CEE 5354 (GEOS 5814): NUMERICAL MODELING OF GROUNDWATER

Theory and practice of numerical techniques are developed and applied to fluid flow and transport in groundwater flow systems. Governing equations are formulated using FD and FE techniques with appropriate BC's and IC's. Additional topics include: model conceptualization and grid design in multidimensional systems; practical applications of numerical models including calibration, validation, and prediction; concepts and techniques of advective transport using particle tracking and dispersive transport. Introduction to MODFLOW, MODPATH, MT3D, and others.

CEE 5374: DYNAMICS GROUNDWATER

The theory of dynamics of fluids in porous media; fluid and matrix properties; transport equations; boundary and initial value problems; flow of immiscible fluids; dispersion.

CEE 5384: TRANSPORT PROCESSES IN WATERWAYS

Advanced treatment of the mechanics of open channel flow, including uniform flow, gradually varied flow, channel transitions, and unsteady flow. Independent research project.

CEE 5714: SURFACE WATER QUALITY MODELING

Use, analysis, and development of water quality models for lakes, rivers, and estuaries. Emphasis on model calibration, verification, and post-audit analysis. Lab portion will develop and apply an eutrophication model for an estuary using existing data.

CEE 5724 ENVIRONMENTAL MONITORING AND SAMPLING

Experimental design and sampling techniques for environmental analysis, including environmental monitoring techniques and statistical principles for planning monitoring locations and frequencies at environmental sites such as landfills, rivers, lakes, and the atmosphere. Development of monitoring strategy; examination of sampling techniques for various sample types.

CEE 5734: URBAN HYDROLOGY AND STORMWATER MANAGEMENT

Development of methods and numerical models for computing surface runoff from developing watersheds; hydraulics of combined sewer systems; urban non-point source pollutant load calculations and best-management practices; control strategies for regional stormwater management; detention basin design for control of urban floods and non-point source pollutants.

CSES 5314: WATER QUALITY FOR PROFESSIONALS

Global water resource sustainability and management. Current water quality policies. Physical, chemical, biological, and anthropogenic factors affecting water quality, fate and transport of contaminants in water. Approaches of water quality risk assessment. Water treatment and management technologies.

CSES 5604: ENVIRONMENTAL SCIENCE CONCEPTS FOR PROFESSIONALS

Physical, chemical, and biological principles and processes that are central to human-environment interactions. Emphasizes air and water resources and the role of energy in human and natural systems. Major U.S. environmental legislation and regulations.

CSES 5854: ADVANCED WETLAND SOILS

Wetlands soils as components of natural landscapes: biogeochemistry, hydrology, geomorphology, hydric soil indicators, and wetland functions under various land uses. Soil and hydrologic factors important to wetland delineation and jurisdictional determination. Mitigation of wetland impacts with emphasis on restoration and creation. Outdoor lectures at local wetlands and a two-day long field trip to observe and identify wetland soils are mandatory.

CSES 5864: ADVANCED WETLAND SOILS AND MITIGATION

Wetland soils as components of natural landscapes and their interactions with hydrologic systems. Hydric soil identification and delineation, preparation of wetland water budgets, restoration of damaged wetlands, and creation of compensation wetlands. Utilization of advanced soil information systems and GIS/GPS in wetlands study. Constructed wetlands for nutrient removal and acid mine drainage treatment.

FIW 5534G: ADVANCED WETLAND ECOLOGY AND MANAGEMENT

Introduction to the variety of wetland systems found in North American, with emphasis on eastern and mid-Atlantic wetland systems. Origin and processes of formation of wetlands, functions and values of wetlands, wetland delineation, wetland classification, regulatory processes affecting wetlands. Objective of management and techniques used to protect and/or manipulate wetland systems for wildlife and other human needs.

FIW 5624G: ADVANCED MARINE ECOLOGY

Marine organisms; biological, ecological, chemical and physical processes of marine ecosystems in open-sea, coastal, and benthic environments; research methods and models in marine ecosystem stimulation; fisheries in a dynamic ecosystem; human interference and conservation.

FIW 5814: STREAM HABITAT MANAGEMENT

Application of stream ecology, fish biology, hydrology, and hydraulics to the protection, restoration, and enhancement of stream habitats and fauna. Major emphasis on stream habitat evaluation, regulated stream flow, biotic, integrity, and watershed management.

FREC/CSES 5144 WATERSHED HYDROLOGY

Physical concepts of hydrological processes that affect age, origin, and flowpaths of water from hillslope to waterslope to watershed scales. Analysis of current and historical research methods. Hydrological science as an interdisciplinary topic.

FREC/WATR 5244 ADVANCED HYDROINFORMATICS

Analysis and examination of hydrologic data using basic statistics in computer programming. Calculation and interpretation of flow frequency and duration, hydrologic analysis of geospatial digital terrain data, and implementation and analysis of simple hydrologic models. Advanced methods of temporal and spatial hydrologic data visualization using computer programming.

FREC 5334: PLANT WATER RELATIONS

Properties and status of water in the plant and thermodynamics in relation to water and solute movement; measuring water deficits and drought tolerance; and transpiration and stomatal action.

FREC 5354: SOIL SCIENCE AND BIOGEOCHEMISTRY

Foundations of soil science and biogeochemistry. Concepts in soil and landscape evolution; elemental cycling; soil-plant-microbe interactions; soil sampling and analysis; and relationships among physical, chemical, and biological properties and processes.

FREC 5374G: ADVANCED FORESTED WETLANDS

Classifications, jurisdictional delineation, and management options of forested wetlands. Relationship of hydrology, soils, and vegetation to ecosystem processes, societal values, and management with regard to environmental and legal considerations and best management practices. Emphasis is on forested wetlands in the southern U.S. but national and international wetlands are included. Data analysis, interpretations, and report for field trips are required for graduate credit.

FREC 5784G: ADVANCED WETLAND HYDROLOGY AND BIOGEOCHEMISTRY

Water flows creating wetland hydrologic regime. Hydrologic controls on wetland processes. Linkages between hydrology and biogeochemical cycles. Carbon, nitrogen, phosphorus, and other element cycles within and across wetland boundaries. Field methods to assess hydrologic regime and biogeochemical cycles. Ecosystems services from hydrologic and biogeochemical processes. Applications of wetland hydrology and biogeochemistry in wetland restoration, delineation, and creation.

FST 5634G: ADVANCED EPIDEMIOLOGY OF FOOD AND WATERBORNE DISEASES

Overview of causes, transmission, and epidemiology of major environmental, food, and waterborne diseases. Outbreak and sporadic detection, source tracking, and control of pathogens. Overview of the impact of food-borne outbreaks on regulatory activities at the national and international level.

GEOG 5134 / GEOS 5844: INTERDISCIPLINARY ISSUES AND ETHICS IN WATER RESOURCES

Analysis of issues and ethics related to water resources, water as a hazard upon human (infrastructure, economy) and ecological (rivers, groundwater) systems, water and vector borne disease, climate change, dams, and eutrophication. Development of proficiency in demonstrating the multidimensionality of water resources.

GEOS 5804: QUANTITATIVE HYDROGEOLOGY

Rigorous mathematical and physical concepts of fluid flow in porous geological media. The course will focus on the mechanics of groundwater flow in one, two, and three spatial dimensions. Boundary conditions and analytical solutions to subsurface and vadose-zone flow problems will be explored and solved analytically. The mechanics of horizontal and vertical deformation of aquifers due to applied pumping stress will be taught from first principles. Includes problems dealing with steady and transient groundwater flow, Biot's equations and three-dimensional consolidation theory.

GEOS 5804G: ADVANCED GROUNDWATER HYDROLOGY

Physical principles of groundwater flow, including application of analytical solutions to real-world problems. Well hydraulics. Geologic controls on groundwater flow.

GEOS 5814 (CEE 5354): NUMERICAL MODELING OF GROUNDWATER

Theory and practice of numerical techniques are developed and applied to fluid flow and transport in groundwater flow systems. Governing equations are formulated using FD and FE techniques with appropriate BC's and IC's. Additional topics include: model conceptualization and grid design in multidimensional systems; practical applications of numerical models including calibration, validation, and prediction; concepts and techniques of advective transport using particle tracking and dispersive transport. Introduction to MODFLOW, MODPATH, MT3D, and others.

GEOS 5834: CHEMICAL HYDROGEOLOGY

Study of solute transport in geologic systems. Focus on processes of advection, dispersion, mineral dissolution and precipitation, chemical reactions and microbially-mediated reactions. Includes use of hydrogeochemical models to simulate chemical transport in geologic systems.

NR 5204 WATER CONFLICT & MANAGEMENT

Freshwater conflict issues and management for environmental sustainability professionals. Amount, quality, and distribution of freshwater in the US and globally. Major US and global water management agencies and programs. Impacts of local needs, cultures, and laws on water conflict. Case studies of water management and water conflicts in US and globally. Water conflict management. Water refugees. Restricted to online Virtual Campus students.

NR 5214 URBAN WATER SYSTEMS

Urban water systems and planning challenges for sustainability professionals. Case studies of contemporary urban water problems and solutions from North America and globally. Water, hydrology, green infrastructure, and rapid urbanization. Water and emergency management. Connection of urban water system to the regional landscape. Restricted to Virtual Campus students.

NR 5244 INNOVATING WATER PARTNERSHIPS

Water partnership tools for sustainability professionals. Regulating, financing, planning, and delivery of typical and alternative water sector projects. Technical aspects of the storm, clean, and drinking water sectors, regulatory and legislative issues, funding and financing challenges and innovations needed for partnerships. Strategies and governance of partnerships. Restricted to Virtual Campus students.

NR 5264 WATERSHED STEWARDSHIP

Watershed stewardship theory and practices for sustainability professionals. Identification, mapping, evaluation of peri-urban and rural watershed characteristics. Watershed threat assessment and restoration planning. Stewardship programming promoting water quality monitoring, public education, and advocacy. Restricted to Virtual Campus students.

NR 5284 COASTAL AND MARINE MANAGEMENT

Science, management, planning, and policy for sustainability professionals working in coastal and marine environments. Social, economic, and environmental interactions that cause coastal and marine system problems. National and international policy. Coastal zone management strategies and marine spatial planning. Restricted to Virtual Campus students.

UAP 5064G: ADVANCED POLLUTION CONTROL PLANNING AND POLICY

Planning and policy aspects of managing residuals and environmental contaminants and their effects on human health and environmental quality. Technical and economic factors involved in management of water quality, air quality and solid and hazardous wastes, toxic substances, and noise. Implementation of pollution control legislation, policies, and programs at federal, state and local levels.

UAP 5134G: ADVANCED LAND USE AND ENVIRONMENT: PLANNING AND POLICY

Environmental factors involved in land use planning and development, including topography, soils, geologic hazards, flooding and stormwater management, ecological features and visual quality. Techniques for conducting environmental land inventories and land use suitability analyses. Policies and programs to protect environmental quality in land use planning.

UAP 5214: TOPICS IN NATURAL RESOURCES AND NATURAL HAZARDS PLANNING

Concepts, theory, and practice of resilience-based, climate-change integrated natural resources management and hazards planning. Effects of land, water, soil, and ecosystem management on quality of life for present and future generations. Natural resources and natural hazards planning process and tools for local communities and policies at state and federal levels. May be repeated for a maximum of 9 credit hours.

UAP 5414: NATURAL RESOURCES PLANNING TOPICS

The natural resource planning process as implemented by federal public lands and water resources agencies in the U.S. Public participation, environmental impact assessment, and resource evaluation methods used in planning and decision-making. Applications to resources planning in developing countries. May be repeated with different topics for a maximum of 9 credits.

WATR 5004 SEMINAR IN WATER SCIENCE AND SOCIETY

Interdisciplinary seminar on contemporary issues in water science and society. Critical evaluation, comparison, and discussion of effective science communication, current research issues, findings, and interdisciplinary approaches in water science, policy, and management.

WATR 5614G: ADVANCED WATERSHED ASSESSMENT, MANAGEMENT, AND POLICY

Multidisciplinary perspectives of assessment, management, and policy issues for protecting and improving watersheds ecosystems. Topics include: monitoring and modeling approaches for assessment, risk-based watershed assessment, geographic information systems for watershed analysis, decision support systems and computerized decision tools for watershed management, policy alternatives for watershed protection, urban watersheds, and current issues in watershed management.

WATR 5464G ADVANCE WATER RESOURCES POLICY AND ECONOMICS

Economic theory and methods to explain water use decisions. Efficiency, equity, and ethical considerations in U.S. water policy. Analysis of water markets, climate change, and environmental flows from diverse stakeholder perspectives.

WATR 6004 WATER QUALITY IN AQUATIC ECOSYSTEMS

Classification and biophysical characteristics of aquatic ecosystems and processes. Fundamentals of water quality and aquatic biogeochemistry. Drivers and consequences of water quality, including implications for policy and management. Case studies of research in water quality assessment.