University of Colorado Denver
Department of Civil Engineering
Hydrologic, Environmental, and Sustainability Engineering (HESE)

COURSE PLANNING WORKSHEET

Student Name _____

Master of Science (M.S.) and Master of Engineering (M.Eng.) degrees require 30 semester hours of graduate study, including 6 semester hours for the master's thesis, or 3 semester hours for the master's report—the latter of which is required for M.Eng. students. The HESE program achieves breadth by requiring at least one course from each of the three areas below, and depth by taking two additional courses in one area. Remaining courses may be chosen from the list of HESE graduate electives or chosen in consultation with the academic advisor.

This worksheet applies to HESE students matriculating in August 2024 (or later).

	Semester	Grade
Hydrology and Hydraulics □ *breadth ≥1* □ *depth ≥3*		
CVEN-5333 Surface Water Hydrology		
CVEN-5334 Groundwater Hydrology		
CVEN-5335 Vadose Zone Hydrology		
CVEN-5426 Pipe Network and Sewer Design		
CVEN-5427 Storm Water System Design		
Environmental Engineering □ *breadth ≥1* □ *depth ≥3*		
CVEN-5402 Contaminant Fate and Transport		
CVEN-5404 Water and Wastewater Treatment		
CVEN-5434 Biological Treatment Processes		
Sustainability Engineering □ *breadth ≥1* □ *depth ≥3*		
CVEN-5405 Life Cycle Assessment		
CVEN-5460 Sustainable Urban Infrastructure		
CVEN-5520 Structural Engineering and the Ocean Environment		
Graduate Electives ← *see list on reverse*		
Research Credits*		
CVEN-5950 Master's Thesis (1 of 2)		
CVEN-5950 Master's Thesis (2 of 2)		
or CVEN-5960 Master's Report		

Advisor (Signature) _____ Date _____

* M.Eng. students are required to complete the 3-credit hour Master's Report (not the 6-credit hour Master's Thesis).

HESE Course Descriptions

CVEN-5333 Surface Water Hydrology. Fundamentals of hydrology emphasizing surface water processes. Topics include the hydrologic cycle, frequency analysis, drought management, flood routing, rainfall-runoff relationships (rational method, unit hydrograph, and hydrologic software) and hydrologic design. *Prerequisite:* CVEN-3313 Fluid Mechanics (or equivalent).
CVEN-5334 Groundwater Hydrology. Topics include groundwater occurrence, hydrologic cycle and budget, interactions with surface waters, principles of groundwater flow, well hydraulics, well field design, regional flow systems, water and pollutant chemistry, computer modeling and groundwater management. Emphasis is on quantitative analysis methods for groundwater resource inventory, design and management. *Prerequisite:* CVEN-3313 Fluid Mechanics (or equivalent).
CVEN-5335 Vadose Zone Hydrology. Engineering analysis of the vadose zone, the unsaturated porous media linking the earth surface to groundwater. Darcy's law for flow. Richards equation for moisture content. The advection-dispersion equation for solutes. Analytical solutions and numerical modeling applied to infiltration, evaporation, drainage, and subsurface remediation. *Prerequisite:* CVEN-3313 Fluid Mechanics (or equivalent).
CVEN-5402 Contaminant Fate and Transport. Provides unified understanding of fundamental physical, chemical and biological processes that govern the transport and fate of pollutants in environmental systems—water, air and subsurface. The course focuses on multimedia modeling and model solution methods. The course also introduces exposure and risk assessment techniques. *Prerequisite:* ENGR-1130 Chemistry for Engineers (or equivalent).
CVEN-5404 Water and Wastewater Treatment. Water and wastewater treatment, including aqueous chemistry (equilibrium, reaction kinetics, redox reactions, and acid-base equilibria), physicochemical processes (sedimentation, filtration, adsorption, membrane separation), and biological processes (applied microbiology, reactor configuration, waste-to-energy technology). *Prerequisite:* ENGR-1130 Chemistry for Engineers (or equivalent).
CVEN-5405 Life Cycle Assessment. This course covers cradle-to-grave systems thinking and analysis with a primary focus on environmental life cycle assessment (LCA) methods. The students will learn the various steps in conducting a process-based LCA such as defining the goal and scope, building a life cycle inventory, life cycle impact assessment, and interpretation. For a broader life cycle perspective, Economic Input-Output LCA (EIO-LCA) will be introduced. Emphasis will also be placed on framing the LCA analysis around attributional (technology/process) versus consequential (policy/decision) focus as applicable to environmental and sustainability issues. Mathematical techniques for uncertainty and sensitivity analysis, such as Monte Carlo simulation will be covered. Students will be exposed to several LCA case studies.
CVEN-5426 Pipe Network and Sewer Design. Design of pressurized pipe networks for water supply and sanitary sewers for wastewater collection. Topics include the civil engineering design process, estimation of water and wastewater design loads, pump selection, service reservoirs, lift stations, and relevant software. Design project and field trip required. Includes graduate-level analysis, modeling, or reflection on the refereed literature. *Prerequisite:* CVEN-3313 Fluid Mechanics (or equivalent). *Corequisite:* ENGR-1100 Fundamentals of Computational Innovation (or equivalent).
CVEN-5427 Storm Water System Design. This course covers urban watershed analysis, design rainfall and hydrologic losses, flood frequency and design event, rational method for peak runoff prediction, street hydraulic capacity and safety, culvert hydraulics, street inlet collection system, and storm sewer system design and flow analysis. Includes graduate-level analysis, modeling, or reflection on the refereed literature. *Prerequisite:* CVEN-3323 Hydrosystems Engineering (or equivalent).
CVEN-5434 Biological Treatment Processes. Theory and application of biological processes used in water quality engineering, with an emphasis on state-of-the-art water pollution control and waste-to-energy technologies. Initial lectures introduce microbial energetics, diversity, and kinetics. The reminder of the course will involve the application of fundamental principles to treatment and energy recovery processes, including bioreactor configurations and design considerations.
CVEN-5460 Sustainable Urban Infrastructure. This course takes a systems approach to urban infrastructures that deliver critical materials to cities, primarily water, energy, transportation, buildings, and food systems. The focus is on the current state of sustainable development, cities, and infrastructure systems, exploring sustainability strategies and measuring their effectiveness, and analyzing implementation and diffusion of sustainability strategies.
CVEN-5520 Structural Engineering and the Ocean Environment. This course explores the design of structures for coastal and ocean resilience within the broader context of climate change adaptation. The following subjects will be introduced: coastal and oceanic wave dynamics; hydrodynamic forces on coastal structures and methods for attenuation; analysis and design of floating structures. *Prerequisites:* MATH-2421 Calculus III and CVEN-3121 Mechanics of Materials (or equivalents).

HESE Graduate Electives ← *any HESE course listed above, or:*
ARCH-5330 Sustainable Systems I
ARCH-5450 Sustainable Design Practices
CEMT-5234 Sustainable Construction
CVEN-5381 Introduction to Geographic Information Systems
CVEN-5633 Sustainable Transportation Systems
ENVS-5280 Environmental Hydrology
ENVS-5757 Urban Climate and Air Quality
GEMM-6000 21st Century Global Energy Issues and Realities
GEMM-6200 Environmental, Regulatory, Legal & Political Environment in the Energy Industry
GEMM-6240 Environmental, Social, Governance (ESG) Trends in Energy & Commodities
GEOG-5060 Remote Sensing I: Introduction to Environmental Remote Sensing
GEOG-5335 Climate Change & Society
GEOG-5757 Urban Climate and Air Quality
URPL-5040 Urban Sustainability
URPL-6555 Transportation, Land Use, and the Environment