BS in Environmental and Sustainability Sciences (ESS) Curriculum Map

Likely term course will be taken	Course	Credits	Suggested Pre/co-requisits	Course Description	GOAL 1. Provide students with the knowledge of concepts, theories, and tools to explain and manage environmental systems, both natural and human-made, in pursuit of sustainability			GOAL 2. Train students in methods and modes of inquiry that lead to well-substantiated decisions on sustainability			GOAL 3. Prepare students for careers in research, management, and innovation on sustainability			GOAL 4. Develop articulate, conscientious leaders and problem solvers who are committed to contributing to their fields and society			GOAL 5. Provide students with a broad foundation of knowledge and skills and cultivate a commitment to lifelong learning		
					1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2	5.3
					Demonstrated ability to critically evaluate human impacts on the planet's natural systems	Demonstrated ability to critically evaluate sustainability of urban environments	Ability to apply relevant impact assessment tools for sustainability management	Apply the scientific method as well as competence in numeracy including data collection and analysis	Skills in systems and design thinking, including participatory and deliberative methods of stakeholder engagement	Ability to assess sustainability challenges from global, cross-border, national, and local perspectives	Apply sustainability knowledge and methods to one or more domains of application (e. g. business, energy, finance, policy, international relations, urban development, and more)	Demonstrate skills for adaptability in the rapidly evolving fields of environment and sustainability, critically assessing and applying state-of the art knowledge, approaches, and techniques	Demonstrate professional and ethical responsibility in areas such as business, government, civil society, research, and international relations/cooperation	Produce and deliver written and oral presentations and communicate with specialists and non-specialists using appropriate media and technology	Think critically and creatively, conceptualizing real-world problems from different perspectives	Work productively in diverse teams and solve problems collaboratively	Use common software and information technology to pursue inquiry relevant to their academic and professional fields, and personal interests	Weigh evidence and arguments and appreciate and engage in diverse modes of inquiry that are characteristic of historical, cultural, political, economic, and quantitative disciplines	Properly document and synthesize existing scholarship and data, keep current with developments, conduct independent research, and discover and learn new material on their own
F1	ESS 101 Introduction to Environmental and Sustainability Sciences	3	None	The course introduces the basic principles of environmental and sustainability sciences, including the structure and functioning of ecosystems and their physical and biogeochemical cycles. The course will also examine these ecosystems within the context of complex socio-ecological and socio-technical systems. Specific topics include biodiversity, water, soil, land and air resources, human population dynamics, food and industrial production, and waste and toxicity. Topics will be supplemented by Armenia- and Caucasus-specific cases.	I	B			B	B		B			B	B	B	B	B
F1	ESS 102 Modes of Inquiry in Environmental and Sustainability Sciences	3	ESS 101 (co)	The course introduce various methods of inquiry used in the field of Environmental and Sustainability Sciences. It aims to equip students with tools and critical thinking skills to investigate, analyze, and address complex challenges through use of quantitative, qualitative, and hybrid approaches. Topics will include formulating hypotheses, designing research and experiments, collecting and analyzing data, and communicating results. Students will engage in hands-on exercises and case studies to enhance their practical skills. They will also develop abilities to critically evaluate existing research.				B	B	I		B	B	B	B				
S1	ESS 1xx Biology for ESS	3		The course focuses on the interconnectedness of living organisms and offers insights into the diversity, distribution and abundance of life on Earth. The course provides the foundations for understanding the complex relationships that form throughout our planet, understanding the behavior of living systems from the level of cells up to whole organisms and ecosystems. Students will learn to assess the impact plants, animals, fungi, and microbes have on their ecosystem and vice versa.	B		B	B		B				B			B	B	
S1	ESS 1xx Biology Lab	1	ESS 1xx Bio (co)	This Lab course is a companion to ESS 1xx Biology and Ecosystems. Through laboratory, computational and field work students will learn the skills to design, carry out and analyze the data from biological and ecological research.	B	B	I	I			B		B	B					
F1	ESS 1xx Chemistry for ESS (or equivalent alternative)	3	None	The course introduces the basic concepts of chemistry, including bonding, molecular structure, chemical reactions, thermochemistry, and chemical kinetics. The course will connect and use these basic concepts to understanding our environmental processes including biogeochemical cycles, pollution, food systems, consumer goods, toxicity, climate change, and more.	I	I	B	I		B	B		A				A	I	
F1	ESS 1xx Chemistry Lab	1	ESS 1xx Chem	The course trains students in laboratory techniques and working with equipment common to chemistry laboratories to understand the underlying concepts covered in the lecture course.	B	B	I	I			I		A	I		I	I	I	
S1	ESS 1xx. Statistics (or equivalent alternative)	3	None	The course covers the basic principles of statistics and their applications in environmental and sustainability sciences. Topics will include foundational concepts (such as mean, median, variance), probability, studying various types of distributios (normal, Poisson, binomial, etc.), correlation and regression, as well as conducting parametric and non-parametric statistical tests.	I	I		I			B	B	I	I	I		I	A	A
S1	ESS 1xx Environmental and Natural Resource Economics (or equivalent alternative)	3	ESS 101 (co)	The course covers the fundamental economic concepts and analyses with a focus on natural resources and the environment. Topics include regulation of pollution, relationship between environmental care and economic well-being, natural resource markets (oil and gas, raw materials, critical minerals), and common goods (e.g. fisheries), and externalities. The course will also cover topics on political economy, market system analysis, and value chain analyses.	I	I	I		I	I	I	I			I		A	A	
F2	ESS 1xx. Environmental Geology	3	None	The course provides an overview of geology, introducing topics that showcase the relationship between Earth's geological processes, natural resources, and human activities. The course will include chapters on geological history, geochemical cycles, fluvial processes, plate tectonics, rock formations, mineral and energy resources, soil formation and erosion, hazards caused by geologic forces, health and land-use. The students will also learn how to assess the potential impact of resource extraction on the environment and local communities.	I	I	A	A		A		I							
F2	ESS 1xx. Environmental Geology Lab	1	ESS 2xx Env Geo (co)	The course provides the students with hands-on experience to supplement the knowledge gained in ESSxxx. They will learn to identify and classify the most common rock types and minerals. The students will also learn to interpret geological maps and cross-sections, analyzing sedimentary deposits and fossils.	A	A		A	I	I	I	A	A	A		I	A		
F2	ESS 1xx. GIS and Remote Sensing	3	None	This course is meant to introduce students to geographic information systems (GIS) and spatial analysis: setting up, analyzing, visualizing, and solving problems using data and maps. With advancements in the information technologies more and more industries are relying on GIS to analyze and visualize data. This course will look at applications of GIS in environmental sciences, public health, sustainable transportation planning, land use mapping, telecommunications, hydrology, meteorology, police dispatching, crime patterns, etc. The course will also look at remote sensing technologies like satellite imagery, LiDAR, GPS, and the role they play in collecting and analyzing data. Another aim of this course is to spark interest in different types of students: from students interested in learning about GIS, to future professionals in fields regularly using GIS, to data enthusiasts and software developers.			I	I	I	A	A	A	I			I	A	I	
S2	ESS 203. Environmental Monitoring	3	ESS 101, ESS 102, ESS xxx Chem or ESS xxx Bio or ESS xxx Env Geo	The course presents general procedures, methods, theories, and techniques in the monitoring of different environments. Contamination of air, water, soils, and food will be discussed with the emphasis on instrument selection and quality control, including documentation, calibration, and sample management. Classical monitoring schemes, as well as new and innovative techniques will be compared and evaluated. Local and regional data will be introduced and analyzed. The course will emphasize the methods of scientific inquiry, including planning and designing monitoring, sampling, biological and physical-chemical analytical methods, data generation, analysis of long-term environmental trends, and effective presentation of the final results. Instructor-led discussion, along with reading, data-mining, presenting, written, and practical assignments.	A	A	I			I		I						A	A
S2	ESS 2xx. Environmental Monitoring Lab/Field	1	ESS 203 (co)	This lab course applies and test knowledge learnt in ESS203. The course will include field trips to identify species, calculate biodiversity indices, conduct measurements of air, water and soil quality, and compare the measurements to environmental and health norms. Samples taken during field trips will be brought to the lab for further tests. Students will be familiarized to instrument calibration, standardization of sampling methods, keeping field and lab logbooks, and reporting.	A	A	A	A		A	A	A	A	A		I	A		

F2	ESS 2xx. Climate Science and Politics	3	ESS 101 , ESS 1xx Economics for ESS	The course covers climate change, one of the greatest challenges facing humanity today, from a multidisciplinary perspective to understand its causes and consequences as well as needed responses. The course will explore the science, economics, and politics of climate change. Key international and Armenia and Cacucasus-specific literature, case studies, and social and political movements around climate change will be reviewed and discussed. The course will require students to participate in a simulated multi-stakeholder and multinational negotiations on addressing climate change.	I	I	I			I	I		A	I					A
F2	ESS 2xx Circular Economy	3	ESS 101 , ESS 1xx Economics for ESS	The course covers global efforts to transition from a linear to circular economy. Industrial economies have primarily operated under a linear model of "take-make-waste," where resources are extracted to make products that eventually end up as waste and removed from the material and energy flows of the economy. This approach has had severe environmental consequences for our planet. Over the past few decades, there is greater emphasis on transitioning to a system where material and energy flows are increasingly circular. This system of circular economy is based on three principles: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature. What are the choices and strategies by suppliers, designers, businesses, policymakers and all of us as consumers that will help transition to a circular, regenerative economy? The course focuses on addressing this question. The course also offers tools to analyze circular business models.	A	A	A				A			A			I	A	
after S2	ESS 211. Sustainable Cities	3	ESS 101	The course will introduce the concept of sustainable cities—places where there is human prosperity, social equity, and environmental health. This will be examined within the larger context of urban aspirations including green or eco-cities, smart cities, creative cities, resilient cities, and more. Special emphasis will be placed on the concepts and tools necessary to address the environmental sustainability of cities including its resource metabolism, ecology, and built environment impacts. Specific topics may include transportation, land use, energy, water, biodiversity and more. The course will also examine the role of integrated and inclusive urban planning and governance. Students are expected to collect, analyze and present data as well as assess the merits of analyses by others.		A	I	I	I	I	A		A				I	I	I
after S2	ESS 230. Water (project-based)	3	ESS 101, ESS 102	The course uses a project-based learning approach to examine water from various perspectives including ecological, human health, resource stewardship, economic, and legal/political. Topics to be covered include water supply, use, and recycling in agriculture, manufacturing, mining, energy, and domestic life; potential for resource efficiency and optimization; water quality and types of water pollution, methods of testing and monitoring water quality and conditions of freshwater ecosystems; water purification and wastewater treatment; water planning and management tools/models including those for watersheds, surface, and ground water resources; new technologies, such as desalination, to access freshwater; and international and national laws on water.	A			A	I		A					A			A
after S2	ESS 220. Sustainable Food Systems (project based)	3	ESS 101, ESS 102	The course uses project-based learning approaches to understand food systems, including their economics and environmental sustainability aspects. Students will also become familiar with primary agricultural resources and inputs, production technologies, post-harvest handling, and food waste, logistics, and marketing. They will also become familiar with developments in the food industry such as genetically modified organisms, organic agriculture, fair trade, and approaches to reduce food loss. Students will carry out projects related to sustainable food systems.	B	B	B	B	B	I	I	A	I	I	I	I	I		I
after S2	ESS 240. Solid Waste in Circular Economy (project based)	3	ESS 101, ESS 102	The course uses a project-based learning approach to understand and implement waste minimation or elimination. Students will explore principles of sustainable waste management from environmental, technological, social, and business viewpoints. The course could cover various types of waste, including food, packaging, plastics, paper, clothes, electronics, and more. The course will focus on the circular economy solutions discussing waste reduction strategies, green product design, reuse and recycling practices, zero-waste lifestyle, waste-to-energy, composting, biogas production, and more. Field visits to waste treatment facilities may be part of the course.	B	B	B	B	B	I	I	A	I	I	I	I	I		I
after S2	ESS 250 Biodiversity: Conservation and Restoration (project-based)	3	ESS 101, ESS 102	The course uses a project-based learning approach to develop basic quantitative, qualitative, and management skills for biodiversity conservation and restoration. The course will cover the theory and practice of managing endangered species and the conservation and restoration of habitats and species populations. The course will emphasize how to apply science and the scientific method in the conservation and restoration of biodiversity.	A		I	A	I		I	A	I			A	A	A	
after S2	ESS 2xx. Sustainable Energy (project-based)	3	ESS 101, ESS 102	The course focuses on sustainable generation and use of energy. Topics will include identifying, evaluating and managing sustainable energy use and generation in homes, buildings, industry, cities, and nationally. Specific topics shall include energy efficiency, lighting, centralized renewable energy generation, distributed renewable energy generation, smart grids, e-transportation, energy storage, as well as sustainable energy policies. Students will have an understanding of sustainable energy from the environmental, economic, and social perspectives. Students will be evaluated based on individual or group projects and written examinations.		I		I	B	B	A		A			A	I	I	
after F2	ESS 2xx Environmental and Sustainability Governance	3	ESS 101 or ESS xxx Climate Change	The course will engage students to understand, critically review, and when possible utilize the environmental and sustainability governance systems at various levels including international (conventions, treaties, bilateral agreements, etc. and their implementation mechanisms), national (constitution, laws and regulations as well as implementing agencies), local (regulations and implementing agencies), and corporate (ESG, carbon reporting, and utilization of similar policy tools). The course will offer a survey of the field as well as focus on specific cases and levels to strengthen students ability to understand and utilize the governance systems to improved sustainability outcomes.	A	A	I		A	A	I	I	A	A				A	
after S2	ESS 2xx. Environmental and Sustainability Modeling	3	ESS 101, ESS 102, ESS 1xx Economics for ESS, ESS xxx Statistics	The course focuses on skills to develop and apply models in the context of environmental and sustainability sciences and management. Model development, calibration, uncertainty analysis and validation will be introduced through lectures and practical classes. The strengths and weaknesses of different modeling approaches will be examined. The course is designed for students with relatively little mathematical experience.	A	A	I	A	A	A		A				I	A		A
after S2	ESS 2xx. Sustainable Transportation (project-based)	3	ESS 101, ESS 102	The course uses a project-based learning approach to identify transportation solutions (for people or goods) that are based on sustainbility prinicples, including decarbonization and environmental-friendliness, improved human health and safety, and wider accessibility of services to all groups in society. Students will examin the infrastructure, energy, land, water, air, biodiversity, and regulatory implications of their solutoins. They will also asses the impacts of their solutions on the quality of life and health of humans, social inclusivity, and economic prospects.		A		A	A		A	A	A			A		A	A
after S2	ESS 2xx. Resilience Planning and Management	3	ESS 101	The course explores the fundamentals, principles, and approaches of disaster and reslience management and planning. Students study natural and human-made disasters, looking at tools available for prevention, preparedness, response, recovery, and mitigation. Topical investigations include: an overview of disaster management, the range of physical and human impacts, the role of decision-makers and the general public, and structural and non-structural techniques in this quantitative science course. Armenia-specific cases and scenarios are also considered and discussed.	A	A	I	A	A	A	A	A	A						
after S2	ESS 2xx. Environmental and Sustainability Assessment Tools	3	ESS 203 Env Monitoring	The course covers the tools to assess and mitigate the environmental and social impacts of products, operations, projects, and policies. This course will discuss the tools available and commonly used, e.g., Environmental Impact Assessment (EIA), Cumulative Impact Assessment (CIA), Strategic Environmental Assessment (SEA), and economic cost-benefit analysis (CBA), and Life-Cycle Assessment (LCA). The course will also highlight the role of ecosystem services valuation as a relatively new concept that can enhance the effectiveness of decision-making tools introduced in the course.	A	A	A	A		A	A	A	A		A				

after S2	ESS 2xx. Internship/Fieldwork (3 units for BA)	3	At least Junior standing	The course is practice-based, offering students internship or practicum assignments, where they are expected to integrate and apply the knowledge and skills gained in the ESS program into a professional setting. Students will have specific scopes of work, which they will carry out during their internship under the direction of course faculty and a practitioner mentor. Students function as part of the professional team of the host institution, participating in meaningful real-world projects and reflecting on their experiences. Specific reporting and deliverables will be required.						A	A	A	A	A	A	A	A		
S4	ESS 2xx. Capstone	3	Senior standing	The course requires students to use their accumulated knowledge and skills to solve real-world problems or advance key research directions. During their capstone, students will follow the entire project/research cycle, which includes: identifying and defining a challenge, design a process/approach to address the challenge (subject to critical review and evaluation), collect information needed for analyzing or solving the challenge, analyzing findings, recommending solutions, next steps, or action steps. At the end of the semester, students will submit a full report on their work and present their findings.	A	A	A	A	A	A	A	A	A				A	A	A
after S2	ESS 290. Special Topics	3	Varies	The course covers a selected topic of current interest. Topics to be announced prior to course registration.																
after S2	ESS 299. Independent Studies	3	Student must have completed 30 credits of courses. Also, requires instructor/program chair approval.	This course is designed to permit students to design and complete a research project or other academic or professional approved activity under the supervision of an instructor for credit. The course will address a special area of interest of the student and instructor outside the standard offerings of the program and have interdisciplinary or research components. The course must include a syllabus or a study plan and evidence of learning equivalent to respective credits. Independent study courses are subject to approval of the instructor and Program Chair.															