NAZARBAYEV UNIVERSITY
SCHOOL OF ENGINEERING AND DIGITAL SCIENCES

Bachelor of Engineering in Civil Engineering

Nazarbayev University

Degree requirements for the AY 2020-2021 Graduation Cohort

	Abbr/ Number	Courses	Credits ECTS
Major requirements (210 ECTS)	BENG 124	Engineering Mathematics I (or MATH 161)	6
	BENG 117	Engineering Mechanics (or PHYS 161)	6
	BENG 145	Occupational & Environment Health and Safety (or ENG 100)	6
	BENG 122	Engineering Materials (or ENG 102)	6
	BENG 126	Programming for Engineers (or ENG 101)	6
	BENG 225	Engineering Mathematics II (or MATH 162)	6
	BENG 201	Engineering Economy (or Fundamentals of Entrepreneurship and Management)	6
	BENG 147	Introduction to Fluid Mechanics and Thermodynamics (or ENG 100)	6
	BENG 148	Engineering Practice (or ENG 100)	6
	BENG 114	Introduction to Electrical Systems (or PHYS 162)	6
	BENG 228	Engineering Mathematics III (or ENG 200)	6
	ECE 217	Structural Analysis I (or CEE 200 (MAE 200))	6
	ECE 216	Civil Engineering CAD	6
	ECE 302	Civil Engineering Materials	6
	ECE 215	Survey	6
	ECE 479	Structural Analysis II (or CEE 203)	6
	ECE 218	Environmental Chemistry	6
	ECE 210	Soil Mechanics	6
	BENG 219	Control System (or MAE 303)	6
	ECE 219	Hydraulics or (CEE 305)	6
	ECE 318	Structural Design-Concrete	6
	ECE 405	Environmental Engineering (or CEE 202)	6
	ECE 307	Engineering Geology and Rock Mechanics	6
	BENG 405	Project Management	6
	ECE 404	Construction Technologies and Processes	6
	ECE 319	Structural Design-Steel	6
	ECE 319	Engineering Hydrology	6
	ECE 306	Geotechnical Design (or CEE 303)	6
	ECE 472	Water and Wastewater Treatment Processes (or CEE 350)	6
	ECE 416	Highway Engineering	6
	ECE 303	Construction Management and Practice	6
	ECE 401	Capstone Project 1	18
	ECE 478	Capstone Project 2	6
Specific Electives (30 ECTS)		Discipline Elective 1	6
		Discipline Elective 2	6
		Discipline Elective 3	6
		Discipline Elective 4	6
		Discipline Elective 5	6
Internship		Internship	12
General NU requirements (18 ECTS)	HST 100	History of Kazakhstan	6
	KAZ XXX	Kazakh Language Course	6
	KAZ XXX	Kazakh Language Course	6
Total credits			**270**

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List of CEE Elective courses

1. ECE 420 Modern Information Technology in Construction
2. ECE 421 Behaviour and Design of Structural System
3. ECE 422 Prestressed Concrete Design
4. ECE 423 Structure and Properties of Concrete Materials
5. ECE 214 Geomatics
6. ECE 481 Individual Research Projects in Civil Engineering I
7. ECE 427 Individual Research Project in Civil Engineering II
8. ECE 482 Solid and Hazardous Waste Management
9. ECE 473 Environmental Systems

The following elective courses from CEE's undergraduate program may be also selected by students who entered in fall 2016 or 2017.

10. CEE 450 Behavior and Design of Structural System
11. CEE 451 Prestressed Concrete Design
12. CEE 452 Advanced Structural Mechanics
13. CEE 453 Applied Soil Mechanics
14. CEE 454 Foundation Engineering
15. CEE 350 Water and Wastewater Treatment Processes
16. CEE 455 Solid and Hazardous Waste Management
17. CEE 456 Membrane Separation Processes
18. CEE 457 Air Quality Management
19. CEE 351 Application of Geomatics in CE
20. CEE 458 Modern IT in Construction
21. CEE 459 Water Systems and Structures
22. CEE 460 Water Supply and Distribution Management
23. CEE 352 Structure & Properties of Concrete Materials
24. CEE 461 Traffic Engineering and Management
25. CEE 462 Pavement Design and Performance
26. CEE 463 Individual Research Project in CEE 1
27. CEE 464 Individual Research Project in CEE 2

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DETAILED COURSE DESCRIPTIONS

Year 1, Fall Semester

Course Title 6 ECTS	**Engineering Mathematics I**
Course Descriptor	*This module will cover:* 1. Differential and Integral calculus of real valued functions of single variable. 2. Sequences, infinite series and power series. 3. Elements of linear algebra: matrices, Eigen functions. 4. Vector algebra and three-dimensional analytic geometry. 5. Polar and Cartesian coordinates
Course LOs	1) Articulate scientific reasoning utilizing the formalism of differential calculus of single variable functions. 2) Demonstrate advanced skills on integral calculus. 3) Assemble mathematical techniques concerning series and matrices for solving engineering problems. 4) Analyze geometrical problems with vector algebra. 5) Compute analytically mathematical problems with the help of mathematical software. 6) Appraise numerically mathematical tasks using mathematical software.

Course Title 6 ECTS	**Engineering Mechanics**
Course Descriptor	This module consists of application of Newton's Laws to equilibrium of particle and rigid body and reactions developed internally and externally due to application of the loads and study of simple mechanical planar motion of a particle through consideration of forces, work, energy and momentum and its conservation using different coordinate systems.
Course LOs	1) Identify equilibrium conditions for a particle and rigid body. 2) Evaluate internal forces and moments developed in the rigid body due to external loading. 3) Apply the fundamentals of kinematics of particle in planar motion in different coordinate systems. 4) Analyze and evaluate motion of particle using work-energy and impulse-momentum concepts.

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Course Title 6 ECTS	**Occupational, Environmental Health and Safety**
Course Descriptor	The module covers: • Introduction to Risk Management: Hazards Identification, Risk Assessment (Hazards Analysis) and Risk Control (including probabilities lectures) • Occupational Health and Safety: Occupational Health Hazards, Ergonomics, Human Health Risk Assessment, Health and Safety Practice, Hazardous Chemicals, Personal Protective Equipment • Environmental Health and Safety: Environmental Hazards, Indoor and Ambient Air Quality, Soil Pollution, Water Pollution, Solid Waste Management (including Hazardous Waste), Noise Pollution, Environmental Auditing And Impact Assessments, Guidelines, Standards And Regulations.
Course LOs	1) Identify what is Hazard, Risk, Barriers & Mitigation measures and perform hazard identification exercises 2) Apply Qualitative, semi-Quantitative and Quantitative/Probabilistic Risk Analysis methods 3) Identify and analyze the effects of toxic substances on health and the environment and how to implement appropriate environmental control measures 4) Develop employee health programs that will improve health in the work environment 5) Describe Occupational Hazards and explain the use of Personal Protective Equipment

Course Title 6 ECTS	**Engineering Materials**
Course Descriptor	The module covers the fundamentals of materials science and engineering. These include the understanding of the material structure from the atomic to micro to macro levels. The effects of the structure and the processing techniques on the material properties will be discussed. These concepts will be illustrated using metals to allow students to utilize the knowledge for materials selection in common engineering applications.
Course LOs	1) Explain the influences of microscopic structure and defects on material properties, including dislocation and strengthening mechanisms 2) Design and control heat treatment procedures to achieve a set of desirable mechanical characteristics for common metals 3) Evaluate the applications and processing of common engineering materials including metals & their alloys 4) Utilize the knowledge in materials selection processes taking further considerations of the economic, environmental and social issues

Course Title 6 ECTS	**Programming for Engineers**
Course Descriptor	This is an introductory course for programming essential for Engineering undergraduate study. The module would focus on the development of programming skills that can be directly applied to solve engineering problems where the computer is part of the system, or is used to model a physical or logical system. This module introduces programming as a tool for solving engineering problems through C and Java programming languages. This is an introductory course providing foundational programming to Chemical, Mechanical, Civil and Electrical Engineers.
Course LOs	1) Develop programming solutions to open ended engineering problems. 2) Infer alternate solutions to programming problems. 3) Develop software specifically using C and Java programming languages. 4) Apply knowledge of programming to solve practically relevant engineering problems. 5) Use the object-oriented concepts to write optimal and efficient codes.

Year 1, Spring Semester

Course Title 6 ECTS	**Engineering Mathematics II**
Course Descriptor	This module will cover: The calculus of multivariate functions The calculus of vector-valued functions Fourier series Elementary complex variable theory
Course LOs	1) Be able to differentiate a large array of multivariate functions using partial differentiation and the various partial derivative chain rules. 2) Use different functions, series and optimization methods. 3) Integrate scalar and vector fields along contours in three-dimensional space. 4) Express a line integral as a double integral, area integral as a triple integral. 5) Use *Mathematica/SAGE* to aid calculations and visualization.

Course Title 6 ECTS	**Engineering Economy**
Course Descriptor	This course gives the student an understanding of how the use of capital is perceived by individual stakeholders in project economic analysis. The course answers the questions, why and how a financial feasibility assessment is performed, who should be involved, where and when it should be performed, what data should be used and how financial assessments should be presented. Additionally, this course will involve creative cost control discussions and introduction to Value Engineering (VE) methodology.
Course LOs	1) Evaluate decision making processes for project feasibility 2) Use economic decision making tools, including present worth, annual worth, benefit cost analysis, capitalized costs, rate of return, payback/breakeven analysis 3) Apply the principles of Value Engineering through team led projects 4) Evaluate basic economic and financial principles and their effects on project economics (supply/demand, inflation, cost of capital, depreciation and tax considerations)

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Course Title 6 ECTS	**Introduction to Fluid Mechanics and Thermodynamics**
Course Descriptor	This course provides to the engineering student an introduction to the basic principles of Fluid Mechanics and Thermodynamics, and how to apply them to analyze an engineering problem. It includes an introduction to Fluid Mechanics (fluid properties, conservation laws applied to fluid flow, Bernoulli equation, dimensional analysis, flow visualization, integral flow analysis and fluid transport through pipes) and Engineering Thermodynamics (first/second laws of thermodynamics and their applications).
Course LOs	1) Identify the properties of a fluid and classify fluids in categories. Calculate stress/strain of a Newtonian fluid and pressure/density/temperature of an ideal gas. 2) Calculate the pressure variation and compute the force on an immersed surface due to the presence of a static fluid. 3) Characterize fluid flow (laminar, turbulent, compressible, etc.) and use dimensional analysis to obtain the dimensionless groups associated with a physical problem and applies similarity to relate the conditions of the prototype with its model. 4) Perform a Control Volume Analysis and apply the Conservation Laws (mass, momentum, energy, Bernoulli equation) to analyze a problem (e.g., losses in pipes). 5) Explain and apply the first law of thermodynamics in closed and open systems.

Course Title 6 ECTS	**Engineering Practice**
Course Descriptor	It is the introductory lecture class for year 1 students. The course focuses on introduction to engineering and engineering disciplines, engineering ethics, communication skills, study skills and problem solving skills, design, computing skills, and fundamentals of engineering science.
Course LOs	1) Identify the various disciplines and the role of engineer in the society 2) Explain career planning in engineering 3) Explain engineering ethics 4) Implement schematic approach for engineering problem solving and engineering design 5) Illustrate engineering communication skills by writing technical reports and applying computer skills 6) Search for information via traditional and online sources

Course Title 6 ECTS	**Introduction to Electrical Systems**
Course Descriptor	The aim of the course is to provide an introduction to the principles of electrical and electronic engineering, to develop problem solving skills and to develop basic body of knowledge to serve as a foundation for more advanced studies in electrical and electronic engineering. Course content: Circuits: Electrical quantities, Kirchhoff's laws, resistive, capacitive and inductive circuits, transients, Thévenin and Norton equivalent circuits, steady state sinusoidal analysis, three phase circuits, frequency response, Bode plots and resonance. Analogue electronics: Operational amplifiers, summers, differentiators, integrators, filters. Digital electronics**:** Boolean algebra, Logic circuits
Course LOs	1) Apply electrical engineering principles and applications 2) Demonstrate ability to use the circuit theory and analyze analogue and digital electronic systems, magnetic circuit and transformers 3) Construct and analyze simple R-L-C, operational amplifier, and logic circuits 4) Use computer aided design tools to design and simulate electrical and electronic circuits

Year 2, Fall Semester

Course Title 6 ECTS	**Engineering Mathematics III**
Course Descriptor	*This module will cover:* Differential equations of first- and second-order Series solution of differential equations Laplace transforms and its application to the solution of initial value problems Some of the important special functions used in engineering. Introduction to probability and mathematical statistics
Course LOs	1) Solve a large class of first- and second-order differential equations analytically using standard techniques. 2) Model simple physical situations encountered in engineering using first- and second-order differential equations. 3) Use Laplace transform techniques to solve first- and second-order initial value problems. 4) Recognize and work with a number of the higher transcendental functions of mathematics. 5) Recognize and apply the fundamental axioms of probability. 6) Recognize and work with a range of discrete and continuous random variable probability distributions functions. 7) Calculate confidence intervals and understand when to use the Student t- and chi-squared distributions. 8) Develop skills in Mathematics.

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Course Title 6 ECTS	**Structural Analysis I**
Course Descriptor	The module provides the students with fundamental analysis methods which they can apply to analyze and design a range of statically determinate structures. More specifically students will be able to analyze the beam, column and frame; to determine the deflection; and to perform stress/strain analysis.
Course LOs	1) identify the fundamental mechanics used in structural analysis 2) apply the principle of equilibrium on different structures 3) evaluate the internal actions in statically determinate structures 4) evaluate the deflections in statically determinate structures 5) examine the stress and strain for structural elements 6) examine the stability of structural elements 7) apply computer software in structural analysis

Course Title 6 ECTS	**Civil Engineering CAD**
Course Descriptor	This module will introduce the basic concepts of civil engineering design with an emphasis on technical solutions as well as project impact on the environmental, social and economic factors. Specifically, students will learn basic civil engineering theories, CAD tools, and design process for infrastructure projects such as tall buildings, highways, bridges, dams, tunnels, and land development. Basic concepts of site-investigation, ground improvement, and urban infrastructures issues will also be introduced. Individual and team-based design projects will also be given, which will include feasibility study, engineering evaluation of site, and layout design of lots, buildings, streets, sewers, etc.
Course LOs	1) Apply the basic design process to civil engineering infrastructures (tall buildings, highways, bridges, dams, tunnels, etc.). 2) Explain the basic concepts of site characterization and ground improvement. 3) Use computer software to prepare civil engineering drawing. 4) Interpret civil engineering drawings. 5) Explain the impact of engineering solutions in socio-economic and environmental context.

Course Title 6 ECTS	**Civil Engineering Materials**
Course Descriptor	A successful student will be able to understand the mechanical behaviors of various civil engineering construction materials including aggregate, Portland cement and Portland cement concrete, asphalt cement and asphalt concrete, masonry, and woods. They will also be able to apply material properties to design and analyze the civil engineering structures.
Course LOs	1) Apply knowledge of properties and characteristics of materials to identify materials suitable for civil engineering applications. 2) Evaluate the performance of civil engineering materials through the use of experimental techniques and analytical methods. 3) Explain commercial and economical drives in specifying certain civil engineering materials for particular projects. 4) Assess health and safety issues and the environmental impact of civil engineering materials. 5) Apply appropriate codes of practice and industry standards to specify civil engineering materials and propose quality control procedures.

Course Title 6 ECTS	**Surveying**
Course Descriptor	This course will give students the knowledge of the art, science, and technologies used in the surveying, including determination of positions above, on, or beneath the earth's surface. Students will gain the ability to understand and apply methods and use instruments to make measurements and collect data for determining horizontal distances; differences in elevation and direction; angular differences; determining locations on the earth's surface; and calculating areas and volumes. The student will develop their own and utilize pertinent computer tools in calculating, analyzing, and correcting data. Students will be introduced to the science of geodesy and the art of cartography; traverse and control surveys; Global Navigation Satellite Systems (GNSS); surveying technology and methods; land surveys and deed descriptions; and using maps and geographic information systems (GIS) to turn survey data into useful information.
Course LOs	1) Explain how GIS collects, store, retrieve, transform and display spatial data from the real world for a particular set of purposes. 2) Know the fundamental knowledge about distance measurement, levelling, angle measurement, surveying errors and adjustments. 3) Complete logical field notes from surveying operations, whether recorded manually or with automatic data collection methods. 4) Know how to use survey equipment's to measure angles and distances. 5) Work closely in a team for finishing the assigned fieldwork and use appropriate safety procedures for personal protection and proper handling of equipment.

Year 2, Spring Semester

Course Title 6 ECTS	**Structural Analysis II**
Course Descriptor	The module provides the students with fundamental analysis methods which they can apply to analyze and design a range of statically determinate structures. More specifically students will be able to analyze the beam, column and frame; to determine the deflection; and to perform stress/strain analysis.
Course LOs	1) identify the equilibrium and constraint conditions in structural system 2) apply the principle of equilibrium and geometry compatibility on different structures 3) evaluate the internal forces in statically indeterminate structures 4) evaluate the structural system subjected to movable loads 5) construct stiffness matrix for structural system 6) use computer software to analyze statically indeterminate structures

Course Title 6 ECTS	**Environmental Chemistry**
Course Descriptor	The module is essential for an undergraduate Civil Engineering program, since it is a prerequisite for further courses related to environmental engineering area, i.e. environmental engineering, water and wastewater treatment processes, electives. This course will give the students fundamental knowledge on environmental chemistry. It will include chemistry principles, cycles of chemicals in environment, reactions, kinetics, equilibria, electrochemistry, and chemistry of environmental processes.
Course LOs	1) Apply knowledge on chemistry theories, laws and definitions 2) Interpret scientific vocabulary and terminology 3) Develop skills allowing to recognize the usefulness, and limitations, of the existing scientific techniques 4) Explain environmental processes

Course Title 6 ECTS	**Soil Mechanics**
Course Descriptor	The content of the module includes physical description and classification of soils and explanation of the material behavior in common loading conditions: one dimensional compression and shear loading mode. The influence of underground water condition on soil behavior is presented using the concept of effective stress and seepage flow theory.
Course LOs	1) Explain classification system of soil and know how to conduct soil classification experiment; 2) Apply the concept of effective stress and know how to calculate effective stress and pore ware pressure at a depth below a ground surface; 3) Recall the characteristics of underground seepage flow, draw flow net and measure seepage velocity in the laboratory; 4) Explain compression behavior of soil and know how soil-settlement-related properties can be obtained from conducting an odometer test; 5) Analyze shear behavior of soil and know how shear strength of soil can be obtained from conducting a direct shear test; 6) Present technical data in a written form of a laboratory report and/or in an oral presentation.

Course Title 6 ECTS	**Control Systems**
Course Descriptor	This is a core module. It covers the use of mathematical modeling for the analysis of system dynamics. The students' ability and creativity in the subject will be developed through lectures, HW assignments, and computer laboratory exercises.
Course LOs	1) Explain the concept of modeling dynamic systems and the use of different representations 2) Derive mathematical models of various dynamic systems 3) Represent the system in various forms such as block diagrams, transfer functions and state space descriptions 4) Use the system models to study the behavior in the time and frequency domains 5) Use modern computer tools to simulate and analyze dynamic system behaviors

Course Title 6 ECTS	**Hydraulics**
Course Descriptor	This course will give students the knowledge on hydraulics, hydrostatics, principles of fluid flow, behavior of real fluids, flow in pipes and closed conduits, open channel flow, pressure surge in pipelines, sediment transport, computational hydraulics, river and canal engineering
Course LOs	1) Explain fundamentals of hydraulic systems, free surface, uniform, gradually varied and rapidly varied flows principle, 2) Explain terminology applied to hydraulic principles, of principles governing fluid flow, flow in pipes and conduits 3) Analyze pipe and channel flow and to design the hydraulic engineering system 4) Apply software tools for hydraulic system modelling

Year 3, Fall Semester

Course Title 6 ECTS	**Structural Design – Concrete**
Course Descriptor	The objective of this module is to prepare students for entry level structural engineering employment by providing them with abilities to design reinforced concrete structures. It is a direct application of preceding modules: Structural Analysis I&II. This module will provide the basic design techniques for students to be ready for the succeeding module: Capstone Design. This module provides students with abilities to design reinforced concrete structural members such as beams, columns, slabs and foundations. Design procedures are based on the European Code 2 for Concrete. The mechanics underlying the code design procedures are evaluated as well as their application to practical design problems.
Course LOs	1) Identify the common construction material used in concrete structures 2) Critically evaluate mechanics underlying the design code 3) Perform structural design by using mathematics, mechanics and structural analysis tools 4) Design structural elements following design codes and engineering practices independently 5) Solve practical design problems with uncertainties

Course Title 6 ECTS	**Environmental Engineering**
Course Descriptor	Environmental engineering fundamentals are essential for an undergraduate Civil Engineering program. Environmental engineering is a relatively new field of study in civil engineering. Pollution issues became evident in the 20th century as surface waters became polluted with untreated industrial and municipal wastes. Disease outbreaks were common. These issues have been largely addressed in western society, but in developing countries, access to clean water and adequate sanitation remain as significant public health issues. This course will give the students fundamental science and principles of environmental engineering. It will include the control of water, soil and atmospheric pollution, provision of safe water supply, the proper disposal/recycle of wastewater.
Course LOs	Apply fundamentals and principles of environmental engineering. Integrate concepts of fundamental sciences and environmental engineering to propose/develop technologies/processes to meet desired needs of society. Evaluate different types of information sources Interpret results of analysis Create strong teams of professional Justify the value of teamwork to accomplish complex tasks.

Course Title 6 ECTS	**Engineering Geology and Rock Mechanics**
Course Descriptor	The content of the module will explain about the common geological processes in nature that lead to the formation of different rock types and rock structures, description and classification of rock materials and rock masses, mechanical properties and failure of intact rock and rock mass.
Course LOs	1) Describe the formation processes of different rock types in nature; 2) Describe the common geological structures when strata were deformed by earth movements; 3) Explain denudation processes and their influences to the landscapes of the earth; 4) Analyze rock fissures/discontinuities and their effects on the mechanical characteristics of rocks; 5) Describe common physical and mechanical properties of intact rock and how these properties can be measured in laboratory; 6) Evaluate in situ residual stresses in rock masses.

Course Title 6 ECTS	**Project Management**
Course Descriptor	The purpose of this module is to introduce theoretical and practical perspectives to project management and understanding of project management principles. The module introduces students to five basic process groups of the Project Management Body of Knowledge (PMBOK) guide and ISO 21500, namely, the Initiation, Planning, Execution, Monitoring and Control and Closing of projects. Students will learn people skills; practices and processes for more effective project management and how to apply project management tools to ensure planned time, budget, and performance are achieved per project owner requirement.
Course LOs	1) Explain the process of project management and its application in delivering various successful projects; 2) Develop the scope of work, cost estimate, and baseline plan for project evaluation; 3) Identify the resources required for a project to produce a work plan and resource schedule; 4) Analyze project risk factors and develop risk management plans.

Course Title 6 ECTS	**Construction Technologies and Processes**
Course Descriptor	This course addresses application of new technologies for management of design and construction and its impact on time, cost, and quality of project as well as various types of field technologies and means and methods of construction. The measurement and forecasting of productivity in construction engineering for labor and equipment, quality assurance and control in design and construction, concept of sustainable design and construction, and total building commissioning are topics of this course.
Course LOs	1) critically evaluate technologies that are appropriate for field, laboratory, and office processes related to design and construction. 2) critically evaluate appropriate means and methods and materials for construction projects. 3) create design, construction, and operation documents. 4) perform standard performance analysis for infrastructure and engineering systems. 5) evaluate fitness for purpose. 6) critically assess the impact of civil infrastructures systems on health, safety, welfare, sustainability and the environment.

Year 3, Spring Semester

Course Title 6 ECTS	**Structural Design – Steel**
Course Descriptor	The objective of this module is to prepare students for entry level structural engineering employment by providing them with abilities to design steel structures. It is a direct application of preceding modules: Structural Analysis I&II. This module will provide the basic design techniques for students to be ready for the succeeding module: Capstone Design. This module provides students with abilities to design steel structural members such as beams, columns, slabs and foundations. Design procedures are based on the European Code 3 for Steel. The mechanics underlying the code design procedures are evaluated as well as their application to practical design problems.
Course LOs	1) Identify the common construction material used in steel structures 2) Critically evaluate mechanics underlying the design code 3) Perform structural design by using mathematics, mechanics and structural analysis tools 4) Design structural elements following design codes and engineering practices independently 5) Solve practical design problems with uncertainties

Course Title 6 ECTS	**Engineering Hydrology**
Course Descriptor	This module focuses on understanding of the water cycle, watershed modeling and prediction analysis for the civil engineering applications. This course will give knowledge on hydrology, concepts of watershed analysis, precipitation, infiltration, evaporation, runoff, detention, hydrograph routing, water delivery, flood routing, groundwater flow, integrated surface groundwater modelling and sustainable water management.
Course LOs	1) Explain fundamentals of the earth's hydrologic cycle such as precipitation, evaporation and transpiration, runoff, infiltration and ground water and an exploration of anthropogenic effects on the hydrologic cycle 2) Describe hydrology related terminology and governing laws and equations, formulas that describe land-atmosphere interactions, movement of water in subsurface environments 3) Analyze contaminant transport in groundwater systems, streamflow generation, surface water flow dynamics, urban runoff and flood control 4) Apply software tools for hydrology modelling and prediction analyses

Course Title 6 ECTS	**Geotechnical Design**
Course Descriptor	This course will focus on geotechnical design of shallow and deep foundations, including spread footings, mats, driven piles, and drilled piers. Coverage includes bearing capacity, settlement, group effects, and lateral load capacity of the various foundation types. Additional topics include retaining structures, slop stability, subsurface exploration, construction of deep foundations, and analysis of geotechnical structure using numerical method (FEM). Pre-reqs. Soil Mechanics (Core 2).
Course LOs	1) explain material behavior and site characterization; 2) explain the mechanics for geotechnical structures; 3) solve engineering problems; 4) apply mathematics and mechanics on geotechnical design; 5) design geotechnical structures; 6) apply computer software for analysis geotechnical structures.

Course Title 6 ECTS	**Water and Wastewater Treatment**
Course Descriptor	This module focuses on understanding and applications of water and wastewater treatment processes. The module builds upon previously developed concepts introduced in mathematics, physics, chemistry and thermodynamics. An elementary knowledge of material and energy balance is assumed. This course will give students the knowledge on softening, coagulation, flocculation, sedimentation, granular filtration, adsorption, membrane separation, ion exchange, biological treatment, chlorination, ozonation, UV radiation.
Course LOs	1) Explain fundamentals of water/wastewater treatment processes 2) Describe terminology applied to water and wastewater treatment processes, key design parameters and units 3) Design water/wastewater treatment systems 4) Develop team work principles to solve problems.

Year 4, Fall Semester

Course Title 6 ECTS	**Capstone Project I**
Course Descriptor	Capstone Project in the School of Engineering is designed to be reflection of a culminating set of personal, academic, and professional experiences. Students work in teams to apply and synthesize knowledge and skills acquired during the course of their undergraduate education to solve design, construction and operational problems with real world constraints and of relevance to industry.
Course LOs	1) Explain the underpinning knowledge of science and mathematics, and associated engineering disciplines in civil engineering applications; 2) Carry out the feasibility study in civil engineering applications; 3) Create innovative design in civil engineering applications; 4) Synthesize economic, social and environmental context of civil engineering projects in design; 5) Explain the professional practice in civil engineering.

Course Title 6 ECTS	**Highway Engineering**
Course Descriptor	This course will introduce the student to the fundamentals of highway engineering from planning and design to operations. This module will cover the basic theory and practice in sufficient depth to promote basic understanding while also ensuring wide coverage of all possible topics deemed essential to students. This module will introduce the economic, political, social and administrative dimensions of the subject. In line with its main task, it covers central topics such as geometric, junction and pavement design while ensuring an adequate grasp of theoretical concepts such as traffic analysis and economic appraisal.
Course LOs	1) Estimate pavement design loads. 2) Identify the elements critical to successful pavement design. 3) Prepare new flexible and rigid pavement designs using current design procedures and materials 4) Apply the fundamentals of horizontal alignment including super-elevation and super elevation transition in design. 5) Apply the fundamentals of vertical alignment design. 6) Design elements of roadway intersections and interchanges.

Course Title 6 ECTS	**Construction Management and Practice**
Course Descriptor	This course introduces the students to the basic fundamentals of construction project management from pre-construction, planning, execution, site operations, to close out of projects. The course will cover at a high level the principles of Construction Project Management including estimating, planning, scheduling, equipment ownership and productivity, project cost controls, and change order management.
Course LOs	1) explain the history and basic concepts of construction management 2) create project integration and execution plans 3) apply planning, scheduling, and control skills for a simulated construction project 4) manage project changes 5) apply critical thinking to social, business and technical issues associated with construction projects

Year 4, Spring Semester

Course Title 18 ECTS	**Capstone Project II**
Course Descriptor	Capstone Project in the School of Engineering is designed to be reflection of a culminating set of personal, academic, and professional experiences. Students work in teams to apply and synthesize knowledge and skills acquired during the course of their undergraduate education to solve design, construction and operational problems with real world constraints and of relevance to industry. This course is a continuation of ECE 401 Capstone Project I.
Course LOs	1) Explain more in-depth knowledge of science and mathematics, and associated engineering disciplines in civil engineering applications; 2) Carry out more detailed engineering analysis and design in civil engineering applications; 3) Verify the engineering or design hypothesis by means of experimental testing, software tools or other processes in civil engineering; 4) Present the research findings in civil engineering in a professional format.

Course Title 6 ECTS	**Elective - Modern Information Technology in Construction**
Course Descriptor	This course will be focused on the theory of information systems, advanced spreadsheet modeling, relational database management systems, Building Information Modeling, and other state-of-the-art ICT tools relevant with construction management and civil engineering. Upon course completion, the student will be able to understand the need and challenges of information integration in the AEC industry. It will enable them developing fundamental understanding towards and basic skills of information modeling using spreadsheets and relational databases. Students will be able to work with the basic and advanced Building Information Modeling techniques and be able to prepare and use a building information model for construction project planning, design, construction and operational phases; and will have a basic knowledge of mobile and/or cloud applications in the construction industry.
Course LOs	1) Explain the concept of construction information systems, spreadsheet modeling and relational databases. 2) Apply the BIM techniques in a variety of analysis, design and construction problems of building and other types of civil engineering structures 3) Perform the sustainability analysis of buildings in relation to selected dimensions such as energy and water use, etc. using BIM enabled IT tools. 4) Effectively use the portable/mobile BIM applications for construction industry.

Course Title 6 ECTS	**Elective - Behaviour and Design of Structural System**
Course Descriptor	The objective of this module is to provide students with abilities to conduct structural analysis and design as a whole system. It is a synchronization of previous modules: Structural Analysis I&II, Structural Design Concrete and Structural Design Steel. This module will deepen the knowledge in structural analysis and design delivered in structural engineering core modules, and prepares students for graduate level study in the structural engineering. This module covers a wide range of critical topics in structural analysis and design including structural load resisting system; structural stiffness, stability and integrity; nonlinearity and plastic collapse mechanism; introduction to finite element methods and innovative structural systems.
Course LOs	1) Design structure as a whole system following design codes and engineering practices independently 2) Synthesis structural engineering problems 3) Conduct appropriate level of analysis and design for structural systems 4) Critically evaluate the obtained analysis and design results for structural systems 5) Create innovate and improvement for structural systems

Course Title 6 ECTS	**Elective - Prestressed Concrete Design**
Course Descriptor	The objective of this module is to prepare students for entry level structural engineering employment by providing them with abilities to design prestressed concrete structures. It is a direct application of preceding modules: Structural Analysis I&II and an extension of the module: Structural Design Concrete. This module will provide the basic design techniques for students to be ready for the succeeding module: Capstone Design. This module provides students with abilities to design prestressed concrete structural members. Design procedures are based on the European Code 2 for Concrete. The mechanics underlying the code design procedures are evaluated as well as their application to practical design problems.
Course LOs	1) Identify the common construction material used in restress concrete structures 2) Critically evaluate mechanics underlying the design code 3) Perform structural design by using mathematics, mechanics and structural analysis tools 4) Design structural elements following design codes and engineering practices independently 5) Solve practical design problems with uncertainties

Course Title 6 ECTS	**Elective - Structure and Properties of Concrete Materials**
Course Descriptor	This module introduces the relationships between the microstructure and the macro properties and characteristics of Portland cement concrete (PCC) systems; a thorough understanding of the early-age, mechanical property development, and durability characteristics of Portland cement-based systems. This course enable student to build up the ability to practice sound materials engineering in the field of Portland cement material systems.
Course LOs	1) Explain PCC material systems. 2) Apply the relationships between the microstructure and the macro properties and characteristics of Portland cement concrete systems 3) Evaluate early-age, mechanical property development, and the durability characteristics of Portland cement-based systems. 4) Apply sound materials engineering in the field of Portland cement material systems

Course Title 6 ECTS	**Elective - Application of Geomatics in Civil Engineering**
Course Descriptor	This course will teach students to work with GNSS data, to process satellite data and apply data from the civil engineering projects. Students will be introduced to several Remote Sensing and GIS software tools to work with satellite data. The student will develop their own projects with combined applications of satellite and geodesy datasets. The course will strive to instill an appreciation for the work performed by surveyors, geodesists, and geographers, cartographers and their importance to practice of civil engineering.
Course LOs	1) Process Satellite data, including: downloading the satellite data for the targeted research area, preprocessed the satellite data, atmospheric noise corrections, geo-referencing, raster and shapefiles preparations. 2) Apply Remote Sensing and GIS software tools for the civil engineering projects 3) Evaluate different data layers, including the processed satellite and field collected data with identification errors and uncertainty analysis, calibration and verification of the processed data 4) Prepare professionally engineering drawing, maps and reports from the processed data

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Course Title 6 ECTS	**Elective - Membrane Separation Processes**
Course Descriptor	Over the past decades, with significant increase in the demand for fresh and clean water due to tremendous growth in human population and various activities, desalination and wastewater treatment techniques have become an increasingly important alternative source of clean water. Among commonly used processes, membrane separation is the most efficient technology. Currently membranes are used for water treatment, power generation, beverages'/pharmaceuticals' concentration, in bioreactors and medical applications, etc. Hence, membrane filtration became a very important laboratory tool and industrial process. This course will give the students deep knowledge on different types of membrane separation processes, i.e. reverse osmosis, nanofiltration, ultrafiltraton, microfiltration, forward osmosis, membrane distillation, etc.
Course LOs	1) Explain membrane processes terminology 2) Design components of a membrane process to carry out a specific separation 3) Evaluate membrane processes on factors such as simplicity, reliability, cost 4) Identify the types of experimental data needed for the calculation of membrane parameters 5) Interpret trends in membrane research

Course Title 6 ECTS	**Elective - Individual Research Project in Civil Engineering I**
Course Descriptor	The course is a student centered research project and is structured to establish tasks to individual students. Student will learn how to coordinate contribution to research and dissemination, identify specific problems or design issues, carry out structured analysis of the problems and investigation of solutions, communicate ideas and outcomes, conceptual design, design planning & development. This course will allow students to know how to conduct real research or practical engineering investigation under a close supervision of a faculty member in the Civil Engineering Department. Students are required to apply and synthesize civil engineering related knowledge and skills in order to provide a viable solution to the problems.
Course LOs	1) Discuss the core ideas and key findings gained from a literature review on a specified topic (Background/Introduction) 2) Utilize specific experimental tools or software related to the performed research (Materials and Methods) 3) Clearly present his/her research findings or proposed research within the context of other research studies in the field (Results and Discussion+ Oral Presentation) 4) Propose an idea for a future research study related to the performed research (Conclusion) 5) Demonstrate knowledge and understanding of underpinning science and mathematics, and associated engineering disciplines (Q&A after Oral Presentation)

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Course Title 6 ECTS	**Elective - Individual Research Project in Civil Engineering II**
Course Descriptor	This course is a continuation of "Individual Research Project in Civil Engineering 1" which allows more time to further develop knowledge and skills in the chosen topic. In line with the "Individual Research Project in Civil Engineering 1", this course focuses on application, synthesis and development of knowledge and skill in the program. Building upon previously acquired and developed civil engineering knowledge, this course will allow students to get a further exploration on real research or practical engineering problem in Civil Engineering. Students are required to integrate civil engineering related knowledge and skills in order to provide a viable solution to the problems. The aim is to provide students an opportunity to handle a practical engineering problem or a research topic. Students are required to present the findings in a professional format.
Course LOs	1) conduct a more extensive and in-depth literature research and generate research and engineering ideas; 2) develop a viable solution to solve the identified engineering problems or to further the research findings by employing the latest technology and knowledge (e.g., analytical, numerical, experimental methods) 3) draw conclusion based on the results and findings 4) present the solution, findings and recommendations in a professional format

Course Title 12 ECTS	**Summer Internship**
Course Descriptor	This module will provide an opportunity for students to develop the professional skills and gain initial experience of application of theoretical knowledge in real engineering work.
Course LOs	1) Relate engineering principles and/or experiments to industry practices as well as solutions of practical problems in professional settings 2) Communicate and function effectively within industry systems and practices 3) Assume the professional, ethical and social responsibilities in industrial settings 4) Evaluate the appropriateness of acquired techniques, skills, and modern engineering tools, as well as reflect on the work experience and its implications for continuous improvement