교과목 개요(Smart City 프로그램)

CE501 Advanced Mechanics of Materials
The lecture provides fundamental concepts for modeling the macroscopic behavior of solid and fluid given that each of them is a continuous medium. Specific contents include tensor analysis, Eulerian and Lagrangian description, stress, strain, constitutive equations, Hookean solid and Newtonian fluid.

CE502 Advanced Soil Mechanics
This course deals with fundamental characteristics of soil behavior, shear strength, consolidation theory for drainage-installed soft ground and some field performance of embankment on soft clay. Several analytical methods of consolidation theories are explained and their results are discussed. The analytical results are compared with those obtained in the field measurements.

CE504 Advanced Environmental Chemistry
The goal of this course is to understand the concept of advanced chemistry and develop the ability of application for the identification of chemical phenomena occurred in natural and engineered environments. The course will provide basic knowledge to properly conduct important environmental researches and to fully understand environmental problems in hazardous waste treatment, wastewater treatment, and contaminated soil and groundwater remediation.

CE505 Applied Mathematics
This course introduces fundamental mathematical techniques related to applied mechanics, dealing with vectors, tensors, analysis of vector fields, matrix and linear equations, eigen-value problems, linear spaces, linear operations, functionals, variational and approximate methods, complex variables, conformal mapping, Fourier transformation and Laplace transformation, etc.

CE514 Advanced Structural Dynamics
This course covers single- and multiple-degree-of-freedom vibration problems, normal mode superposition methods, modal analysis and matrix formulation of vibration problems, natural frequency and mode, principle of D'Alembert, Newton's second law, principle of virtual work, and Lagrange's equations for systems of particles and for rigid bodies.

CE515 Mechanics of Composite Materials
This course introduces materials and their applications, anisotropic elasticity, failure theories, hydrothermal behavior, 3-D stress analysis of laminates, hybrid composites and advanced topics, design principles for bracings and members subjected to torsion, design of composite beams, columns, and beam-columns, behavior and design of shear, and semi-rigid and moment connections.

CE516 Finite Element Analysis
The course covers the fundamental theory of Finite Element Methods and its application in structural engineering. It includes shape functions, stiffness matrix, direct methods, variational method, weighted residual method, assembly of stiffness matrix and solution of equilibrium equations, static and dynamic analysis, linear and non-linear problems, and computer programming.

CE518 Reliability Analysis of Structures
This course introduces probability and statistics, extreme value distributions, probability of failure, reliability, reliability index, failure modes of structures, reliability of structures, system reliability, Monte-Carlo simulation, and load and resistance factor design.

CE519 Bridge Engineering & Design
This course covers design code, influence line, load, the Rahmen bridge, the slab bridge, and the PS concrete box-girder bridge.

CE520 Introduction to Smart Structure Technology
This course offers an introduction to the emerging technologies in smart structure systems and the application of smart structures technologies to civil infra-structures. Contents of lectures include the concepts of smart materials and their properties, advanced sensors, signal / information processing, structural health monitoring method, control theories (passive / semiactive / active) and their applications to civil infra-structures. Students will gain understanding of the state-of-the-art smart structures technologies through lectures and laboratory tests and have chances to work on their application to civil infra-structures.

CE530 Geophysical Exploration for Energy Resources
The course objectives are to introduce the student about near-surface geophysical methods for energy exploration and environmental applications; to deliver basic understanding of geophysics of porous media; and to familiarize the student with some measurement techniques of geophysical methods via laboratory tests and with some signal processing techniques, such as time and frequency domain analyses, forward and inverse problems, and tomography.

CE531 Geotechnical Experiments
This course deals with transducer characteristics, calibration, direct shear test, triaxial test (UU, CU, and CD), permeability test (fixed wall, flexible wall), consolidation test, free-free resonant column test, small-strain triaxial test, impact echo test, vibration monitoring, and cross-hole tests.

CE532 Rock Engineering with IT
This course covers an introduction to stress analysis, the physical properties of rock, underground stresses, laboratory and field instrumentation, model studies, rock mass properties, excavation and blasting, and the discussion of a number of rock mechanics field applications associated with civil, mining, and petroleum engineering, and geoscience.

CE533 Site Investigation and IT based Monitoring
This course deals with site investigation plan, boring method, SPT, CPT, DMT, Field Vane Test, PMT, refraction survey, cross-hole test, SASW test and also includes in situ monitoring plan, equipments and case studies.

CE534 Analysis of Soil Behavior by IT
This course focuses on the critical state theory. Based on the theory, some models to describe the soil behavior are discussed. Especially, Cam-Clay model and its design properties are deeply explained. Upper and lower bound theories are also dealt with to calculate the bearing capacity of foundations.

CE536 Design of Smart-City Underground Structures
Highly skilled engineers from various disciplines are required to achieve an economical tunnel and underground space design that can be safely constructed while meeting environmental requirements. This course covers design and construction methods, an understanding of excavation methods, and conditions of underground space construction essential to good designs of smart city underground structures.

CE539 Earth Retaining Structures for Smart-City
This course includes earth pressure theory, site investigation, designs of retaining wall, sheetpile wall, braced excavation, diaphram wall, reinforced earth, and soil nailing. The performance monitoring of earth structures will also be covered.

CE541 Sustainable Infrastructure Systems Engineering
This course provides methodologies on planning, operating and maintaining urban infrastructure systems. It covers optimization methodologies for individual facilities considering full life cycle, maintenance and management methodologies for city infrastructure systems, and finally for optimized green city implementation.

CE545 Data, Decision and System Analysis
Advanced course in data-driven decision making related to applications of artificial intelligence techniques to transportation system analysis. Topics included but not limited to bayesian statistics, computational statistics, machine learning and DNNs. Both manned and unmanned mobility cases will be explored. Students are encouraged to bring their own case studies.

CE547 Transportation System analysis and Operations
This course provides methodologies on transportation systems analysis and operations. It covers fundamental theories on transportation systems, transportation system analysis techniques, and methodologies to manage and operate transportation systems in efficient and safe ways.

CE551 Soft Computing Techniques for Engineering Design
This course deals with various numerical and combinatorial optimization techniques for solving engineering and structural design problems. This course puts emphasis on the most recent AI (artificial intelligence) and soft computing-based optimization techniques such as neural networks, deep learning, fuzzy logic, and evolutionary computation (EC) as well as classical optimization techniques.

CE553 IT for Smart City
This course deals with basic IT technologies which will be used in Smart City. Various communication systems, especially wireless communication techniques for smart sensor network, will be studied and the technologies which can implement location based service among the USN-based services will be also dealt with.

CE554 Mechanical Design of Civil Robot
This course deals with mechanical design methodologies of various robots. Robot manipulator, Legged robot, wheeled robot, micro/nano robot will be studied in the view point of mechanical design.

CE558 Introduction to Civil Robotics
This course is targeted to familiarize graduate students with applied robotics other than EECS and ME. This course helps students understand general civil robotics issues and apply robot techniques to civil engineering application area. Specifically the students can understand fundamental principles of robotics by simulating their application world with robotics simulation tool.

CE560 Smart and Green Environmental Design
This course explores innovative principles and techniques for Environmental Pollutions, Energy Problems, Water and Waste Treatments, Transportation Problems, CO2 Emission to make smart and green urban infrastructure and other forms of built environment.

CE563   Modeling Autonomous Driving and Intelligent Transportation Systems
This course deals with the modeling of autonomous driving and Intelligent Transportation Systems which is one of the core components of Smart City. It includes traffic theory, ITS architecture, simulation modeling and control. Especially, it seeks to combine modern AI techniques with transportation technologies for traffic prediction, signal control, and autonomous vehicles control.

CE564 Technology and the Smart City
This course introduces students to the concept of the "smart city", the relationship between urban development and technological development, and a wide range of interfaces between the physical and informational layers of the city. This course will challenge students to critically examine how smart cities are proposed, designed, and implemented. Students will learn to analyze the social, economic, political, and practical problems unique to cities that technologies are meant to address, and why some attempts succeed while others fail.

CE571 Environmental Engineering Laboratory
This course deals with theories and experiments related to the manufacture of physical, chemical and biological reactors, operational and experimental plans, scale-up problems, and analysis / application of environmental data.

CE572 Environmental Microbiology and Biotechnology
This course will offer lecture series on environmental microbiology and its application in environmental biotechnology. The main topics dealt in the class will include microbial physiology and ecology and their application in biotechnical practices including bioremediation and bioenergy production. This course will also provide an introduction to state-of-art techniques used in microbiology research, including qPCR, next-generation sequencing, metagenomics, and single-cell technology.

CE573 Advanced Membrane-based Water Treatment
This course will offer the advanced knowledge on the fabrication, separation theory, and state-of-art applications of membranes related on water and wastewater treatment processes.

CE577 Integrated Water Resources Management
This study is designed to review fundamental principles of water and environmental management and their applications for sustainable development. Natural processes combined with human activities in watersheds determine the inherent quality of the management. That is, by responding to changing social, economic and environmental needs or impacts, one can gradually achieve better and sustainable water resources management. In this context, this course is organized to provide principles of both physical systems and human-related systems in a integrated framework.

CE579 Hazardous and Industrial Waste Treatment
This course consists of clean technologies, reduction technologies, intermediate and final waste disposal technologies in hazardous and industrial waste management. It also includes purification technologies for contaminated soil and groundwater. Term projects are required for all students.

CE580 Structural Pattern Recognition for Statistical Health Monitoring
Structural Health Monitoring(SHM) is a process chart evaluates and asses the safety and integrety of a structural system based on measured data this caurse deals with various structural pattern recognition tools required for SHM

CE590 Elastoplastic Analysis and Design of Structural Systems
This course provides fundamental knowledge of continuum mechanics and plastic modeling of engineering problems. Various kinds of plastic models are explained, and the implementation will be discussed in the form of variational method.

CE596 Special Topics in Structural Engineering Design for U-Space
Learn basic design principles, theories and methodologies related to U-space structures through discussions with invited speakers

CE597 Special Topics in Geotechnical Engineering Design for U-Space
This course deals with methods to solve geotechnical engineering problems related with U-Eco city construction. Especially, the students learn U-Geotechnical design concepts to prevent any natural or manmade disasters caused by failures of geotechnical structures. This course is possible to give a subtitle to deal with methods to mingle geotechnical problems with U-concepts.

CE598 Special Topics in Environmental Engineering Design for U-Space
In this lecture, students can analyze the cause of local and global environmental problems of 21 century and learn how to develop and design environmental technologies which can provide basic understanding on the solutions to protect and overcome natural and environmental disasters due to the local and global environmental problems.

CE599 Special Topics in U-Space Construction IT Design
This course is targeted to familiarize CEE graduate students with applied robotics other than EECS and ME. This course helps students understand general civil robotics issues and apply robot techniques to civil engineering application area. Specifically the students can understand fundamental principles of robotics, HRI (Human-Robot Interaction), and problem solving techniques using them.

CE611 Inelastic Analysis of Reinforced Concrete Structures
This course covers creep and shrinkage in RC structures, thermal effects and analysis of RC structures, limit design and yield line theory, application of fracture mechanics to concrete structures, and nonlinear analysis by Finite Element Method.

CE614 Stability of Structures for Smart-City
To reserve the stability of structural members subject to axial load together with lateral loads, the structural behavior of each member is analyzed and, in advance, the corresponding critical load to be resisted is calculated. Various structural members such as beam-column, rigid frame, ring and arched members are considered, and the exact understanding for the background of design codes is achieved on the basis of structural stability.

CE617 Earthquake Engineering
This course covers the mechanism of earthquake occurrence, tectonic plate theory, engineering characteristics of earthquake, seismic hazard analysis, earthquake ground motion, response spectra, dynamic responses of structures subjected to earthquake, nonlinear structural responses, frequency domain analysis, preventive design of structures

(buildings, bridges, and underground structures), soil-structure interaction, probabilistic earthquake risk analysis, and earthquake mitigation and management.

CE619 Vibration Control of Structures
This course introduces the theory of structural passive and active control, applications to vibration isolation, damping treatment, and dynamic absorbers, application to tall buildings, cable-stayed bridges, and tension structures, design of classical feedback control systems for civil structures, and simulation studies using customized computer software.

CE631 Advanced Numerical Soil Mechanics
This course discusses the applicable numerical methods to geotechnical problems. The geotechnical problems that are dealt with in this course are seepage, consolidation, displacements of retaining and underground structures, excavations, embankment, etc. The numerical analysis methods such as the finite difference method (FDM), the finite element method (FEM), the boundary element method (BEM), and the discrete element method (DEM) are used to solve the geotechnical problems.

CE633 Advanced Soil Dynamics
This course deals with elastic wave propagation(bar, infinite media, half space), site investigation using elastic waves, dynamic soil properties, nondestructive test and evaluation, vibration criteria, monitoring and control, and machine foundations.

CE636 Geotechnical Earthquake Engineering & Design
This course deals with performance based seismic design code, earthquake ground motion, soil liquefaction, evaluation of dynamic soil properties, seismic design of various geotechnical structures.

CE637 Theory of Geophysics
This course covers the principles of elastic and electromagnetic waves, applied to geophysical characterization, to understand the interaction of soil and water, conduction and diffusion, elastic wave in soil, electromagnetic wave in soil, wave velocity and attenuation, elastic and electromagnetic wave measurements in laboratory, and their applications.

CE672 Smart City Environmental Unit Processes
This course is to discuss about physico-chemical principles of environmental engineering processes including process principles, theories, equations and applications. This course will give emphasis on process principles rather than unit operations. This is because an understanding of process mechanisms and control variables is fundamental for the effective application of unit operations to accomplish specific treatment objectives.

CE781 Advanced Topics in Civil and Environmental Engineering
This course aims to deliver special topics in the field of civil and environmental engineering.

CE960 M.S. Thesis Research

CE966 Seminar (M.S.)

CE980 Ph.D. Thesis Research

CE986 Seminar (Ph.D.)