Civil Engineering Ph.D.

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<td>Thesis</td>
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**Course Definitions**

**CLE 600 Thesis (Non-credit)**
Program of research leading to PhD thesis degree, arranged between a student and the faculty member.

**CLE 690 Seminar (Non-credit)**
This is a Non-credit course. The widening of students perspective and awareness of topic of interest to civil engineers through seminar offered by faculty, guest speakers and graduate students.
Elective Courses

CLE 601 Systems Engineering  (3,0) 3

CLE 611 Environmental Geotechnics  (3,0) 3

CLE 612 Advanced Soil Mechanics II  (3,0) 3
Basic fundamentals, shear strength of soils, unsaturated soils, application of shear strength theory, soil stability problems, de-watering of excavations.

CLE 613 Numerical Modelling in Geomechanics  (3,0) 3
A brief review of some fundamental methods in numerical modeling with emphasis on finite element formulation. Development of constitutive laws for geotechnical materials including linear or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elasto-plastic models based on the critical state soil mechanics theory. Employment of a finite element computer program for the analyses of a geotechnical engineering problem. Discussion of the new developments in numerical modeling of geotechnical problems including modeling of dynamic problems and new constitutive models.

CLE 614 Soil Dynamics  (3,0) 3
Vibration of elementary systems, wave propagation in elastic, layered, saturated media, behavior of dynamically loaded soils, theories for vibrations of foundations, design of dynamically loaded foundations, prediction of soil response to earthquake motion, determination of dynamic soil properties, liquefaction of soils and soil subsidence due to earthquake.

CLE 621 Design of Hydraulic Structures  (3,0) 3
Design of hydraulic structures such as weirs, reservoirs, dams etc. Engineering of irrigation systems including canals and rivers. Economy of different hydraulic structures.

CLE 622 Water Quality Management  (3,0) 3

CLE 631 Advanced Concrete Technology  (3,0) 3
Types of cements; the composition and potential usage. Effect of properties and composition of cements, aggregates, admixture and curing of various mechanical properties of fresh and hardened concrete. Compressive, tensile, fatigue and impact strengths. Mechanical behaviour of concrete. Shrinkage and volume changes, creep, durability, thermal and acoustic properties, permeability of concrete.

CLE 632 Durability of Building Materials  (3,0) 3

CLE 633 Assessment, Repair and Strengthening of Structures  (3,0) 3

CLE 641 Bridge Construction Techniques  (3,0) 3
CLE 642 Advanced Structural Design  (3,0) 3
Theory of plasticity and its application to structural design. The behavior of steel structures beyond the elastic limit and till collapse. Study of component parts of frames: methods of predicting strength and deformation in the plastic range. Plastic design of multistorey frames. Comparison of conventional design methods with plastic design techniques.

CLE 643 Prestressed and Prefabricated Systems  (3,0) 3
Introduction to prefabrication. State of the art and trends of prefabrication in Turkey and elsewhere. Types of prefabricated elements, and construction technologies. Connection details. Large panel, sandwich panel, dry wall, reinforced and unreinforced masonry, tunnel formwork, framed structures, etc. Principles of prestressing design, Simple beams, I, T and Box Sections, design criteria for buildings and bridges. Pre- and post-tensioning concepts, code requirements.

CLE 644 Matrix Methods  (3,0) 3
Matrix methods of structural analysis in two and three dimensional bar structures. Stiffness properties of plane trusses, plane frames, grids, space trusses and space frames. Study of computer programming techniques. Applications to selected problems.

CLE 661 Construction Quality, Productivity & Safety  (3,0) 3
Factors affecting productivity, method study, work measurement. Quality management. The development of quality philosophy, the use of quality assurance, the importance of quality managers, using quality improvement techniques, quality management in construction. Safety and health. Hazards of construction and their prevention. Safety policy and safe construction.

CLE 662 Construction Risk Management  (3,0) 3
Risk analysis and management, quantitative techniques for project risk analysis, application of risk management, information technology for risk management, risk in estimating, management financial risk in major construction projects, contract strategy, dealing with risk in contracts, tenders-the risk to clients and contractors, case studies.

CLE 663 Construction Cost Analysis and Bidding Strategy  (3,0) 3
Introduction to Bidding, basic principles of quantity surveying and method of measurement, unit rates for construction work, methods of approximate estimating, contractor selection, contractual arrangements and documentation, bid preparation and the cost of resources, contract clauses and their effects on cost, preliminaries.

CLE 664 Construction Productivity Management  (3,0) 3
Factors Affecting Productivity: Design factors, regulatory factors, environmental factors, management factors, site factors, labor factors. Method Study: 3 dimensional models, layout diagram, string diagram, outline process charts, flow process chart, multiple activity chart, photographic/video methods. Work measurement: Time study, field rating, productivity rating, foreman delay survey, factor model.

CLE 665 Environmental Management Systems  (3,0) 3