

Description of Graduate Courses

INCI 6005. WATER AND WASTEWATER TREATMENT (II). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of Department Director.

The process of treating water and wastewater; design of facilities for treatment of water for municipal and industrial use; principles for treatment of municipal and industrial wastewater; application of unitary processes in the design of treatment plants to meet industrial effluents guidelines.

INCI 6006. GROUNDWATER HYDROLOGY (II). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of Department Director.

Fundamentals of groundwater hydrology: well hydraulics, groundwater quality, surface and subsurface factors affecting groundwater, and seawater intrusion.

INCI 6008. WATER RESOURCES SYSTEMS (II). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of Department Director.

Systems theory and operation research for solving typical water resources problems quantitatively and qualitatively; aspects of engineering economics, the concepts of the discount rate, methods of project evaluation, stochastic and deterministic simulation.

INCI 6009. WATER AND WASTEWATER TREATMENT LABORATORY (II). Three credit hours. One hour of lecture and six hours of laboratory per week.

Physical, chemical and biological processes in the treatment of water and wastewater. Waste analysis, biodegradation, and wastewater characterization.

INCI 6015. SANITARY ENGINEERING MICROBIOLOGY (BD). Three credit hours. Two hours of lecture and one three-hour laboratory per week.

Biochemical reactions induced by microorganisms, emphasizing microbiological processes related to water and wastewater treatment and to environmental pollution control.

INCI 6016. STOCHASTIC HYDROLOGY (BD). Three credit hours. Three hours of lecture per week. Prerequisite: authorization of Department Director.

Probability theory applied to hydrology; extreme value distribution; recurrence and frequency analysis; stochastic simulation of the hydrological process; hydrological models.

INCI 6017. STRUCTURAL MECHANICS (I). Three credit hours. Three hours of lecture per week.

Advanced theories of mechanics of materials are discussed with emphasis on topics most relevant to the civil engineering structures. The selection includes thin-walled cross sections subject to unsymmetrical bending and torsion, Mohr's circle for second moments of area, shear center of monosymmetric and unsymmetric sections, beams on elastic foundation, curved beams, thin shells of revolution subject to axisymmetric loading, and the limit states associated with fatigue, fracture and creep. Case studies on metal roof systems, long span beams, and liquid storage tanks are used to augment the theory.

INCI 6018. FINITE ELEMENT ANALYSIS OF STRUCTURES (II). Three credit hours. Three hours of lecture per week. Prerequisite: Authorization of the Director of the Department.

The finite element method and its application in the analysis of structures with elastic and non-linear behavior and in the determination of buckling loads, element development for the solution of unitary stress and strain problems in flexion of plates, thin and thick shells, axisymmetric shells, and solids.

INCI 6019. DESIGN OF STEEL STRUCTURES (I). Three credit hours. Three hours of lecture per week. Evaluation of current specifications for the design of structural members under axial, flexure, torsional, and combined axial and flexural loadings; design of plate girders and rigid frames; plastic design of gable and multistory frames; design of connections for fatigue loading.

INCI 6020. OPTIMIZATION IN STRUCTURAL DESIGN (II). Three credit hours. Three hours of lecture per week.

Application of linear programming to the optimization of the design of steel and reinforced concrete frames subject to gravitational and lateral loads.

INCI 6021. THEORY OF ELASTICITY. Three credit hours. Three hours of lecture per week. Prerequisites: INCI 6017 or authorization of the Director of the Department.

Presentation of the theory to analyze stresses and strains in three-dimensional elastic solids presuming constitutive elastic equations. Formulation of models based on differential equations for the explicit solution of simple problems in the classic literature. Study of alternate formulations of virtual work and its changes due to variations in displacements and forces, small and large deformations, and fundamentals of thermoelasticity.

INCI 6022. DESIGN OF EARTHQUAKE RESISTANT STRUCTURES. Three credit hours. Three hours of lecture per week. Prerequisite: Authorization of the Director of the Department.

Study of the parameters used for the selection of a Design Earthquake, development of ground spectra, elastic and inelastic design spectra. Design of structures using the capacity method. Introduction to base isolation systems.

INCI 6023. ANALYSIS OF STRUCTURES OF COMPOSITE MATERIALS. Three credit hours. Three hours of lecture per week. Analysis of the mechanical and physical properties of composite materials from the micromechanical to the macromechanical level. Laminate analysis including failure theories. Analysis, design, and optimization of structural elements and of concrete reinforced with composite materials. Study of the manufacture of components and analysis of connections between elements.

INCI 6025. PLAIN AND REINFORCED CONCRETE (II). Three credit hours. Three hours of lecture per week.

Brief review of the theories used in the design of concrete and the factors affecting the properties and behavior of the material and of the test specimen; behavior of plain concrete under different types of environment and of loading; critical review of ultimate strength; behavior of reinforced concrete members and relation between results of research and current specifications for design.

INCI 6026. REINFORCED CONCRETE STRUCTURES (I). Three credit hours. Three hours of lecture per week. Prerequisite: INCI 6025.

Continuation of INCI 6025. Ultimate strength and behavior of statically indeterminate reinforced concrete structures; floors, slabs; specifications.

INCI 6027. ADVANCED STRUCTURAL PROBLEMS (BD). Three credit hours. Three hours of lecture per week.

Advanced design of complex structural projects.

INCI 6029. DESIGN OF STRUCTURES FOR DYNAMIC LOADS (II). Three credit hours. Three hours of lecture per week.

Free vibrations; forced vibrations and transient response of structures having one or more degrees of freedom; damping and inelastic action; nature of dynamic loading from earthquakes and bomb blasts; methods of analysis and criteria for designing earthquake-resistant and blast-resistant structures.

INCI 6030. ANALYSIS OF STRUCTURAL SYSTEMS IN THE NON-LINEAR REGIME (BD). Three credit hours. Three hours of lecture per week.

Nature of the problem of non-linear behavior. Tangent stiffness method. Structures on elastic foundations. Soil and structure interaction.

INCI 6031. ADVANCED SOIL MECHANICS I (II). Three credit hours. Three hours of lecture per week.

One-dimensional consolidation; advances in consolidation theories; secondary consolidation; precompression; three-dimensional consolidation; sand drains; distribution of stresses in a soil mass; computation of settlements.

INCI 6032. MEASUREMENT OF SOIL PROPERTIES. Two hours of lecture and one three hour laboratory per week.

Study and practice of the measurement of stress strain and consolidation properties of soils including tests such as one-dimensional consolidation, direct shear, and triaxial tests. Practice in sample preparation, testing details, sources of error, analysis and interpretation of results, and report preparation is included.

INCI 6037. APPLIED SOIL MECHANICS (BD). Three credit hours. Three lectures per week. Application of soil mechanics to earth pressure and retaining walls; foundations of buildings; stability of earth slopes; braced cuts; settlement and contact pressure; seepage.

INCI 6038. FOUNDATION ENGINEERING (I). Three credit hours. Three hours of lecture per week.

Case histories of projects in foundation engineering; design and construction procedures for foundations, embankments and other civil engineering earthworks.

INCI 6045. PAVEMENT DESIGN (I). Three credit hours. Three lectures per week.

Traffic loads, climatic effects, stresses in pavements, flexible pavement design, rigid pavement design, skid resistance, construction practices and maintenance.

INCI 6046. URBAN TRANSPORTATION PLANNING (II). Three credit hours. Three hours of lecture per week.

Urban travel characteristics and trends; basic urban transportation studies, including origin, destination surveys, inventory, use studies, parking studies, and transit surveys; application of transportation, economic, land use data in estimating future travel; planning arterial street and expressway systems, off street parking, and transit systems; coordination of city planning and transportation engineering; metropolitan transportation administration and finance.

INCI 6047. TRAFFIC ENGINEERING (I). Three credit hours. Two hours of lecture and one two-hour discussion, computation or field period per week.

City and highway traffic surveys and designs; accidents, congestion, delay, speed, volume density, parking, channelization, lighting, traffic control and routing, signs, signals and markings, urban traffic consideration in city planning; driver reactions and habit patterns.

INCI 6048. TRANSPORTATION SYSTEMS ANALYSIS (II). Three credit hours. Three hours of lecture per week.

Principles and techniques of systems analysis and mathematical programming are presented and applied to economic, physical planning, and the evaluation and operation of transportation facilities. Mathematical models are used to examine problems related to optimum efficiency of transportation systems and modes. Operations research methods of linear programming, non-linear programming, network analysis, queueing theory, and simulation are studied.

INCI 6049. TRANSPORTATION SYSTEMS EVALUATION (II). Three credit hours. Three hours of conference per week.

The course is designed to provide graduate students with knowledge of evaluation studies and methods employed in planning the proper function and character of transportation facilities, and of the broad administrative policies such

as transportation needs, finance, and economics that affect the planning, design, and programming of transportation systems. The course contents give attention to the application of basic techniques in engineering economic evaluation and the assessment of user and non-user impacts of transportation improvements.

INCI 6050. ADVANCED TRANSPORTATION SYSTEMS ANALYSIS (On demand). Three credit hours. Three hours of lecture per week. Prerequisite: INCI 6048.

Advanced topics in transportation and demand analysis; transportation economy; resource models; techniques for the design and generation of alternatives in transportation systems.

INCI 6051. MASS TRANSPORTATION SYSTEMS. Three credit hours. Three hours of lecture per week.

Study of concepts related to the planning and operation of mass transportation systems in urban areas. Discussion and comparison of diverse modes of mass transport. Detailed study of urban rail systems.

INCI 6055. CONSTRUCTION COSTS ESTIMATES. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of construction cost-estimating techniques during the different phases of the construction process. Development and application of knowledge and skills necessary to estimate costs in a construction project.

INCI 6057. THEORY OF ELASTIC STABILITY (II). Three credit hours. Three hours of lecture per week.

Bending of prismatic bars subjected to axial and lateral loads; buckling of compression members on the elastic and inelastic ranges; lateral buckling of beams, and torsional buckling.

INCI 6059. MODELING OF URBAN STORM DRAINAGE (I). Three credit hours. Three hours of lecture per week.

Application of hydrologic and hydraulic principles to the analysis, design, and management of urban drainage and small watersheds; computer modeling and simulation; effects of spatial and temporal rainfall variabilities; overland flow; runoff from highways; storm sewers, culverts, and other related drainage structures.

INCI 6060. POLLUTANT TRANSPORT (I). Three credit hours. Three hours of lecture per week.

Point and non-point source pollutants; the Streeter Phelps equation; analysis of the transport problem in streams and estuaries; finite element approach to system analysis; ocean outfalls; pollutographs and loadgraphs; universal equation of soil conservation, mathematical model for pollutants handling.

INCI 6061. SEDIMENT TRANSPORT I. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Introduction to sediment transport. Hydrodynamics of fluid-particle systems. Initiation of particle motion. Relation of bedforms to flow regime. Design of stable channels and live bed stable channels. Bedload and suspended sediment transport. Local scour in channels measurement of sediment transport.

INCI 6063. COMPUTER HYDROLOGIC MODELING (II). Three credit hours. Three hours of lecture per week.

Emphasis on computer hydrologic modeling. Application of the Hydrologic Cycle's components to the development of precipitation-runoff models. Individual watershed processes are analyzed and their integration to computer models studied. Model selection and calibration techniques, with special attention to error analysis, are also studied. Students are exposed to actual problems of using Hydrologic Models. Class projects include applications to real cases.

INCI 6064. ADVANCED CONCRETE TECHNOLOGY (BD). Three credit hours. Three hours of lecture per week.

Microstructure, physical and mechanical properties of concrete; strength-porosity relation, failure modes, and behavior of concrete under various stress states; fiber reinforced cementitious composites: types, mechanical properties, applications, and mixture proportions; fiber-reinforced shotcrete: applications and field performance; fiber reinforced plastics (FRPs): applications for repair, rehabilitation, and reinforcement.

INCI 6065. ENGINEERING PROJECT (I, II). Three to six credit hours.

Comprehensive study of a specific civil engineering problem selected so as to integrate the knowledge acquired in the graduate program of study. This project fulfills one of the terminal requirements of the Master of Engineering Program and will be governed by the norms established for this purpose.

INCI 6066. RESEARCH THESIS (I, II). One to six credit hours.

Research in the field of civil engineering and presentation of a thesis.

INCI 6068. PAVEMENT MANAGEMENT. Three credit hours. Three hours of lecture per week.

Development of systematic methods to evaluate and administer existing pavements for highways and airports. Analysis of existing pavement defects, structural capacity, safety, and geometry. Development and application of statistical models, optimization techniques, and analysis of rehabilitation techniques for existing pavements. Field project required.

INCI 6069. SOIL DYNAMICS (BD). Three credit hours. Three hours of lecture per week.

Introduction to the terminology and notation used in the analysis of dynamic systems. Discussion of dynamic soil properties and wave propagation theories in soils. Design of foundations in seismic regions, theory of machine vibrations, and the problem of soil liquefaction in granular soils. Description of laboratory dynamic tests and analysis of the data obtained from them.

INCI 6070. CONSTRUCTION ADMINISTRATION AND INSPECTION. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of the concepts and processes related to the administration and inspection of construction projects. Discussion of the organization and scheduling of a project, applicable laws and regulations, specifications, quality control, safety, and other administrative aspects.

INCI 6076. PHYSICO-CHEMICAL TREATMENT OF WATER (I). Three credit hours. Three hours of lecture per week. Theory and application of physico-chemical unit processes for the removal of pollutants from water and wastewater; substitution of biological treatment by physico-chemical processes; problems and technology of wastewater reuse for drinking purposes.

INCI 6077. PLANNING AND SCHEDULING CONSTRUCTION PROJECTS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of the concepts of planning and scheduling construction projects. Emphasis on division of the project into activities and the estimation of their duration; bar charts; development of networks by CPM and PM and their analysis using PERT. Scheduling with limited resources and resource leveling and the use of the schedule as a project control mechanism.

INCI 6078. SHEAR STRENGTH OF SOILS. Three credit hours. Three hours of lecture per week.

Studies of the physico-chemical properties of soils and the mechanisms of shearing resistance. Discussion of residual shear strength, Hvorslev's parameters, drained and undrained shear strength, and long-term shear strength.

INCI 6080. ANALYSIS AND DESIGN OF DEEP FOUNDATIONS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Analysis and design of single and grouped piles subjected to axial and lateral forces, drivability analysis, and practical recommendations for pile driving. Design and interpretation of load test considering negative skin friction effects, and design of drilled shafts.

INCI 6085. ADVANCED MATHEMATICAL METHODS IN CIVIL ENGINEERING. (BD). Three credit hour. Three hours of lecture per week.

Advanced calculus; optimization methods, estimation theory; sampling theory; queuing theory; application of spread sheet and data base programs in microcomputers.

INCI 6086. STATISTICAL METHODS IN WATER RESOURCES. Three credit hours. Three hours of lecture per week.

Application of probabilistic methods to problems in water resources. Study of the probability distributions of rainfall and runoff processes. Analysis of random variables and hypothesis testing; frequency analysis of extreme events; correlation and regression analysis in water resources; fundamentals of uncertainty and risk analysis.

INCI 6087. CONSTRUCTION COST ENGINEERING AND FINANCIAL MANAGEMENT. Three credit hours. Three hours of lecture per week. Study of techniques and technologies required to achieve success in construction projects through improved cost control. Fundamental concepts related to cost control, financial management, advanced engineering economics, accounting, project control systems, and cash flow analysis applied to construction. The use of computer software for cost control and accounting will be explained.

INCI 6088. ENGINEERING GROUND IMPROVEMENT. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of the methods of ground and site improvement to mitigate construction problems under poor engineering conditions. Description of design techniques for dewatering systems and ground improvement techniques applied to diverse systems including compaction, preloading, vertical drains, admixtures, grouting, reinforced earth, insitu densification, stone columns, slurry trenches, and relevant uses of geotextiles.

INCI 6089. ADVANCED STRUCTURAL DYNAMICS. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 6029 or authorization of the Director of the Department.

Variational formulation of the equations of motion and of the equations of motion in state space, including the use of complex eigenvalues and eigenvectors. Study of free and forced vibrations of continuous systems using the frequency response method. Introduction to nonlinear vibrations and to wave propagation in unidimensional finite, semi-infinite, and infinite media.

INCI 6090. GEOMETRIC DESIGN OF HIGHWAYS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of geometric design concepts and policies used to design highways and streets, at-grade intersections, grade separations, interchanges, and other ground transportation facilities. Application of design control and criteria and consideration of the safety and operational effects of the roadway and roadside elements, the sight distance, the horizontal and vertical alignment, and other elements of the design of roads of different functional classification.

INCI 6098. REHABILITATION OF REINFORCED CONCRETE STRUCTURES (BD). Three credit hours. Three hours of lecture per week.

Discussion of the available techniques to compute the maximum load capacity of a structure, estimates of expected gravity and lateral loads, and determination of the actual safety factor of the structure under the imposed load.

Reinforced concrete pathology and prognosis of the problems caused by materials' defects, construction problems, and inadequate design. Techniques for strengthening structural elements. Presentation and discussion of typical cases.

INCI 6099. CONSTRUCTION METHODS AND EQUIPMENT. Three credit hours. Three hours of lecture per week.

Study of construction methods and equipment for civil engineering projects. Selection, layout, and organization of construction installations, equipment, and resources. Analysis of cost, operation, and productivity of equipment and construction methods. Field trips are required.

INCI 6100. STRUCTURAL COMPONENTS IN GEOTECHNICAL ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Analysis and design of individual and combined foundations, mat foundations, cantilever retaining walls, and pile caps. Rigid and flexible method of analysis of combined and mat foundations will also be studied.

INCI 6105. EARTH PRESSURES AND SHALLOW FOUNDATIONS. Three credit hours. Three hours of lecture per week.

Application of soil mechanics concepts to earth pressure and retaining structures, foundations of Graduate Catalogue 2020-2021 187 buildings, sheet piles, braced cuts, settlement, and contact pressures. Analysis and design of shallow foundations, retaining structures, sheet piles, and braced cuts.

INCI 6106. TEMPORARY STRUCTURES IN CONSTRUCTION. Three credit hours. Three hours of lecture per week. Prerequisite: Authorization of the Director of the Department.

Study of the fundamental concepts related to the selection, design, and layout of temporary structures needed in construction. Safety issues, prefabricated and customized structures, use of pumps during construction, ramps, runways, and scaffolding, and design and analysis of frameworks for concrete structures will also be discussed.

INCI 6107. DURABILITY OF CONSTRUCTION MATERIALS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Development of the analysis and design skills necessary to build public work in challenging environments. Study of the construction materials' lifecycle to provide a high level of expertise in areas such as: cement chemistry, aggregate science, binder technology, microstructure, and transportation mechanisms in concrete, concrete durability, alternative materials, durability of noncement based materials, and material's performance.

INCI 6108. ROAD SAFETY ANALYSIS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of the analytical methods used to estimate and analyze the safety effects and the relationships between different elements and characteristics of drivers, vehicles, traffic flow, and highway design. Analysis of crash, traffic and roadway inventory databases, the consideration of human factors and driver responses to risk perception. Application of conventional safety modeling techniques and methods for identifying hazardous locations and recognize causes for different crash types.

INCI 6109. PRODUCTIVITY ANALYSIS AND SIMULATION IN CONSTRUCTION. Three credit hours. Three hours of lecture per week.

Study of the techniques and technologies used to manage productivity and methods of improvement in construction. Study of productivity measurement including work sampling, crew balance charts, process charts, and flow diagrams. Application of simulation to construction to illustrate how discrete event simulation can be used for productivity studies and for the design of complex and dynamic operations.

INCI 6115. PROGRAMMING METHODS IN CIVIL ENGINEERING (BD). Three credit hours. Three hours of lecture per week.

Implementation of numerical methods and algorithms for the solution of linear and non-linear systems of equations. Development and implementation of design systems and computer graphics (CAE/CAD). A comprehensive programming project will be required.

INCI 6116. HYDROLOGICAL AND HYDRAULIC MEASUREMENT METHODS. Three credit hours. One hour of lecture and one six-hour workshop per week.

Utilization of field equipment, sampling techniques, and data analysis for hydrological and hydraulic applications. Field work is required.

INCI 6118. BIOREMEDIATION: PRINCIPLES AND APPLICATIONS. Three credit hours. Three hours of lecture per week.

Design and management of bioremediation projects. Topics in bioremediation include site characterization, project management, subsoil microbial systems, biotransformation pathways of hazardous contaminants, and bioremediation technologies to solve environmental problems. The relationship among the physiological traits of microorganisms, the physicochemical properties of the contaminants, and the nature of the remediation environment will be emphasized.

INCI 6119. DATA ANALYSIS AND MODELING OF TRANSPORTATION SYSTEMS. Three credit hours. Three hours of lecture per week. Prerequisite: authorization of the Director of the Department.

Study of the variety of analytical tools that are regularly applied to data collected for transportation research studies. Emphasis on the use of model estimation methods as well as software packages helpful in the analysis of data for improving research in transportation engineering.

INCI 6125. UNSTEADY FLOW IN CLOSED CONDUITS. Three credit hours. Three hours of lecture per week.

Study of the principles of unsteady flow in closed conduits, wave propagation and its causes. Derivation of the equations that describe unsteady flow and its limitations. Discussion of the numerical methods for computer solution of unsteady flow problems. Consideration of boundary conditions and methods for controlling unsteady flow. Development of computer programs for transient unsteady flow simulation.

INCI 6127. UNSTEADY FLOW IN OPEN CHANNELS. Three credit hours. Three hours of lecture per week.

Detailed study of the St. Venant equations for unsteady open channel flow. Derivation of the differential of shallow-water equations. Modern methodologies to solve unsteady open-channel flow problems using computers. Applications to surge problems and dam breaks and introduction to methods of flow routing. Development of computer programs and use of well-known software to solve real life applications.

INCI 6130. PEDESTRIAN AND BICYCLE TRANSPORTATION. Three credit hours. Three hours of lecture per week.

Study and analysis of current practices related to the planning, design, operation, and maintenance of pedestrian and bicycle facilities. Identification of access and mobility needs and challenges of pedestrians and cyclists and their integration in the development of safe and sustainable transportation infrastructure systems.

INCI 6150. SLOPE STABILITY. Three credit hours. Three hours of lecture per week.

Study and analysis of soil and rock slope stability including the aspects of design and stabilization within a geotechnical framework.

INCI 6205. CONSTRUCTION CONTRACTING FOR ENGINEERS AND CONSTRUCTION PROFESSIONALS. Three credit hours. Three hours of lecture per week.

Study of the fundamental principles for contracting in the construction industry including topics such as: legal obligations for the parties, formation principles, contracts for architectural and design services, construction contracts, subcontractor agreements, description of commercial terms.

INCI 6206. PRECAST CONCRETE CONSTRUCTION. Three credit hours. Three hours of lecture per week.

Study of precast concrete, the benefits of prefabrication and its applications. Emphasis of the use of precast concrete for innovative and modern designs. Development of expertise in precast construction philosophy, principles, and systems. Study of precast detailing, stability, and key issues such as fire resistance and sustainability.

INCI 6207. PROCUREMENT OF INFRASTRUCTURES. Three credit hours. Three hours of lecture per week.

Study of the engineering, technical and organizational issues related to the procurement of infrastructure. Analysis of the scientific principles, practical information, decision-making, pecuniary as well as socio-economic aspects of civil engineering infrastructures. Discussion of sector profiles and developments, issues and options, planning principles, as well as practices, funding and cost recovery of public works.

INCI 6208. BUILDING CONSTRUCTION SYSTEMS. Three credit hours. Three hours of lecture per week.

Study of the general characteristics of building materials, codes and standards, and construction methods pertaining to soils, foundations, wood, masonry, concrete, steel, and cladding and roofing systems. Discussion of the fundamental aspects of mechanical and electrical systems for buildings.

INCI 6209. ENVIRONMENTAL IMPACT ANALYSIS. Three credit hours. Three hours of lecture per week.

Description of environmental assessment fundamentals. Planning of the environmental assessment process including impact identification, environmental assessment indicators, prediction and assessment of impacts on environmental, social, economic, and cultural settings. Evaluation of alternatives including methods of decision making and preparation of environmental documents.

INCI 6306. SEEPAGE AND CONSOLIDATION. Three credit hours. Three hours of lecture per week. Prerequisites: Authorization of the Director of the Department.

Principles of steady state and transient seepage flow in soils, governing differential equations for unconfined and confined seepage flow problems. Graphical, analytical, and numerical solutions of seepage flow in homogeneous and layered soils with both isotropic and anisotropic permeability. Classical one-dimensional consolidation theory; the use of consolidation theory to analyze and interpret laboratory and field tests; analysis and design considerations. Extended theories of consolidation, nonlinear finite strain, Biot's consolidation theory, and generalized consolidation theory.

INCI 6335. GRADUATE SEMINAR (BD). One credit hour. One hour of seminar per week.

Presentations and discussions in the areas of graduate studies and research. Faculty members, graduate students, and visiting lecturers will participate in this course.

INCI 6555. STORMWATER RUNOFF MANAGEMENT. Three credit hours. Three hours of lecture per week. Prerequisite: Authorization of the Director of the Department.

Study of the hydrologic, environmental, and economic aspects of stormwater runoff management systems design. Volume determination for the design, study of quality and pollutant loading, and treatment of this stormwater runoff. Design of swales and detention ponds, financial planning of stormwater management systems, and rural area storm water management.

INCI 6995. SPECIAL PROBLEMS (I, II). One to six credit hours.

Research and special problems in Civil Engineering.

INCI 6996. PRACTICE IN CIVIL ENGINEERING. Zero to three credit hours. Zero to three hours of internship per week.

Practical experience in civil engineering jointly planned between the department and the collaborating organization.

INCI 6997. SPECIAL TOPICS. One to six credit hours. One to six hours of lecture per week.

Special topics in Civil Engineering and related areas.

INCI 8024. STRUCTURAL RELIABILITY. Three credit hours. Three hours of lecture per week.

Study of reliability theory and its applications in structural design, risk and sensibility analysis, and code revision. Detailed presentation of level I and level II reliability analysis and an introduction to level III analysis. Discussion of the fundamentals of stochastic processes and load modeling.

INCI 8080. ADVANCED ANALYSIS OF STEEL STRUCTURES. Three credit hours. Three hours of lecture per week.

Study of advanced design theories for steel structures. Analysis of current design specifications for structural members and connections in rigid and semi-rigid frames.

INCI 8999. DOCTORAL RESEARCH AND THESIS. Nine to eighteen credit hours.

Research and presentation of a thesis which constitutes a significant contribution to the field of specialization of the student.