Description of the Civil Engineering Courses

INCI 4000. INTRODUCTION TO ARCHITECTURE. Three credit hours. Three hours of lecture per week.

The significance of architecture in relation to culture, the development of construction technology, and to the sociopolitical structure of the times. Relationship between the architect and the civil engineer in modern society. Elements of architectural design. Architectural analysis of different types of buildings. Anatomy of the building.

INCI 4001. GEOMATICS I. Three credit hours. Two hours of lecture and three hours of laboratory per week. Prerequisites: (INGE 3012 or INGE 3809 or INME 3809) and (MATE 3031).

Study of measurement of distances, angles and elevations; use of traverse and leveling equipment; measurement of traverses. Traverse, area, coordinates, elevation and subdivision computations. Systematic and random errors analysis.

INCI 4002. GEOMATICS II. Three credit hours. Two hours of lecture and three hours of laboratory per week. Prerequisite: INCI 4001. Corequisite: INGE 3016.

Study and application of topographic surveys; earthworks; control surveys (horizontal and vertical); coordinate systems; construction surveys; special topics in geomatics; software applications.

INCI 4005. AGRICULTURAL SURVEYING. Three credit hours. Two hours of lecture and one-three hour laboratory per week. Prerequisites: INGE 3011 and (MATE 3172 or MATE 3174 or MATE 3005 or MATE 3143).

Use and care of surveying instruments; measurement of distances, angles, areas, and volumes; subdivision of land; differential and profile leveling, topographic surveying and mapping, interpretation of aerial photographs; elements of legal land surveying.

INCI 4007. HIGHWAY LOCATION AND CURVE DESIGN. Three credit hours. Two hours of lecture and three hours of computation per week. Prerequisite: INCI 4002.

Highway location surveys; study and design of simple and compound circular, parabolic, and transition curves; earthwork; special project.

INCI 4008. INTRODUCTION TO ENVIRONMENTAL ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisites: (INGE 4015 or INQU 4010 or INGE 4010) and (QUIM 3002 or QUIM 3042 or (QUIM 3132 and QUIM 3134)).

Water and wastewater treatment, water quality measurement, and wastewater pollution effects on receiving waters; solid waste management and air pollution control.

INCI 4011. STRUCTURAL STEEL DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4021.

Basic methods of stress analysis and design of structural steel elements subjected to elastic and non-elastic stresses due to axial, bending and shearing loads.

INCI 4012. REINFORCED CONCRETE DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4021 and INCI 4035.

Basic methods of stress analysis and design of reinforced concrete elements subjected to bending, shear, combined bending and axial loads.

INCI 4018. TOPOGRAPHIC PRACTICE. Four credit hours. Six weeks during the Summer. Prerequisite: INCI 4078.

Field work, computations and drawing related to land surveying and subdivision, topography, meridian determination, triangulation, leveling, lay out of highway curves, and construction work.

INCI 4019. CIVIL ENGINEERING SEMINAR. One credit hour. One hour of lecture per week. Prerequisites: 40 credits approved in INCI or authorization of the Director of the Department.

Presentation and discussion of topics on Civil Engineering by students, faculty members or guest speakers.

INCI 4021. STRUCTURAL ANALYSIS I. Three credit hours. Three hours of lecture per week. Prerequisites: INGE 4012 and INCI 4095.

Basic principles and theorems of structural analysis; strain energy concepts; simple structures; trusses; graphic statics; influence lines.

INCI 4022. STRUCTURAL ANALYSIS II. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4021.

Analysis of statically indeterminate structures using prismatic and non-prismatic elements by the methods of slope-deflection and moment distribution. Approximate analysis of multistory structures.

INCI 4026. HIGHWAY ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisites: INCI 4137 and INCI 4007.

Classification, planning and administration of highway systems. Geometric design; traffic engineering; subgrade structure; flexible and rigid pavement design.

INCI 4028. GEOMETRIC DESIGN OF HIGHWAYS. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4007.

Traffic characteristics and highway capacity; elements, criteria, controls and guide values for geometric design; cross section elements; highway types and access controls; intersection design elements and procedures; grade separation and traffic interchanges.

INCI 4032. SOIL MECHANICS II. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4139.

The theory of consolidation; settlements and contact pressure; stress analysis; stability of slopes; soil compaction and stabilization.

INCI 4035. CIVIL ENGINEERING MATERIALS. Three credit hours. Two hours of lecture and one three-hour laboratory per week. Prerequisite: INGE 4001.

Engineering application of the physio-chemical properties of materials; aggregate fundamentals; selection of materials, and their structural behavior; test principles and methods applied to concrete, steel, wood, aluminum, asphaltic and other construction materials, failure analysis; specifications.

INCI 4048. PLANNING AND SCHEDULING OF CONSTRUCTION PROJECTS. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4055.

Planning and scheduling of construction projects using CPM and PERT methods, sequence networks, bidding strategy, use of computers for project scheduling.

INCI 4049. FOUNDATIONS ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4139.

Evaluation of subsoil conditions as they affect the choice of type of foundation. Analysis and dimensioning of shallow and deep foundations in sands and clays. Study of lateral earth pressures. Analysis and dimensioning of retaining walls.

INCI 4051. GEODESY I. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4002. Triangulations, spherical coordinates computation.

Legendre's theorem, traverses, leveling, and orthometric and dynamic elevations.

INCI 4052. GEODESY II. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4051.

The shape of the earth, the spheroid and ellipsoid; dimensions of the ellipsoid; radius of curvature in the prime vertical plane and in the normal section at any azimuth; computation of angles and distances on the ellipsoid; the geodesic line.

INCI 4055. CONSTRUCTION ENGINEERING AND MANAGEMENT I. Three credit hours. Three hours of lecture per week. Prerequisite: INGE 3016.

Study of the construction project lifecycle process from the initial conceptual design phase of a project through to the completion of the pre-construction phase with emphasis on the project management aspects of the lifecycle.

INCI 4056. CONSTRUCTION ENGINEERING AND MANAGEMENT II. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4055.

Study of the construction project lifecycle process from the initial steps of the construction phase of a project through to the project closeout with emphasis on the construction engineering and project management aspects of the lifecycle.

INCI 4057. CIVIL ENGINEERING PRACTICE. Three credit hours. Thirty-five hours per week for seven (7) or more weeks during the Summer or its equivalent during the semester. Prerequisite: authorization of the Director of the Department.

A course organized in cooperation with private industry or government to provide the student with practical experience in Civil Engineering. The work performed by the student will be jointly supervised by the Academic Department and an appropriate official from the cooperating organization. An oral and written report will be required from the student upon completion of the project.

INCI 4059. GEODETIC ASTRONOMY. Three credit hours. Two hours of conference and one two-hour laboratory per week. Prerequisite: INCI 4051 and ASTR 4005.

Geodetic methods for determining latitude, longitude, and azimuth of second and third order.

INCI 4061. LEGAL ASPECTS I. Three credit hours. Three hours of lecture per week. Pre-requisite: third year students.

Laws of the Board of Examiners of Engineers, Architects, Surveyors and Landscape Architects of Puerto Rico, the College of Engineers and Surveyors of P.R. (CIAPR), Code of Ethics of the CIAPR, etc.

INCI 4062. LEGAL ASPECTS II. Three credit hours. Three hours of lecture per week. Corequisite: INCI 4002.

A study of those laws of Puerto Rico which rule land ownership, land transfer, and land use.

INCI 4071. ADJUSTMENT COMPUTATION I. Three credit hours. Three hours of lecture per week. Prerequisites: INCI 4051 and (MATE 3063 or MATE 3185).

Theory and analysis of random errors, normal distribution, adjustment of simple triangulation and leveling networks by condition and observation equations, least squares.

INCI 4072. ADJUSTMENT COMPUTATION II. Three credit hours. One lecture and two two-hour periods of computation per week. Prerequisite: INCI 4071.

Solution of normal equations; Cholesky's method; adjustment of leveling and triangulation networks; method of variation of coordinates; Lagrangian multipliers; trisection and intersection adjustment.

INCI 4078. TOPOGRAPHIC DRAWING. Two credit hours. One hour of lecture and three-hour laboratory or computation per week. Prerequisite: INCI 4002.

The plane table, drawing, interpretation and utilization of topographic maps; volume computation.

INCI 4079. PHOTO INTERPRETATION. Three credit hours. One lecture and two two-hour periods of computation or laboratory per week. Prerequisite: GEOL 4015.

Analysis and interpretation of patterns in aerial photography: color tones and vegetation, geologic formation, erosion, soil and rock types, drainage, and other engineering works.

INCI 4081. PHOTOGRAMMETRY I. Three credit hours. Three hours of lecture per week. Prerequisites: INCI 4002 and INCI 4135.

Geometry of aerial photographs, determination of distances and coordinates, elevations by radial displacement, stereoscopy, and parallax.

INCI 4082. PHOTOGRAMMETRY II. Three credit hours. One hour of lecture and two two-hour periods of computation or laboratory per week. Prerequisite: INCI 4081.

Flight planning and photographic control; theory of stereo plotters of the second and third order; introduction to analytical photogrammetry.

INCI 4085. THEORY OF MAP PROJECTIONS. Three credit hours. Three hours of lecture per week. Prerequisites: INCI 4051 and (MATE 3063 or MATE 3185).

Mathematical analysis of map projections, the Lambert conformal conic projection of Puerto Rico.

INCI 4086. INTRODUCTION TO PHYSICAL GEODESY. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4071.

The shape of the earth, the geoid, gravimetry, Stokes' theorem applied to the determination of the shape of the earth, isostatic equilibrium.

INCI 4087. SPECIAL SURVEYS. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4002.

Techniques and equipment used in topographic surveys, hydrography, mine surveys, optical tooling, electronic distance measurements.

INCI 4088. CARTOGRAPHY. Three credit hours. Three hours of lecture per week.

History of maps; scales and projections, symbols; map reproduction, map types and their uses.

INCI 4095. MATHEMATICAL METHODS IN CIVIL ENGINEERING. Two credit hours. Two hours of lecture per week. Prerequisite: INGE 3016 and (MATE 3063 or MATE 3185).

Numerical and statistical methods applied in the solution of Civil Engineering problems using computers.

INCI 4125. INTRODUCTION TO LAND INFORMATION SYSTEMS. Three credit hours. Two hours of lecture and one two-hour laboratory per week. Prerequisite: MATE 3171 or MATE 3005 or MATE 3143.

Methods for the acquisition and conversion data to be used in a Land Information System (LIS) for later analysis. Different types of data structures, including databases in a LIS. Emphasis in vector-based systems. Observe the benefits of a land information system in Puerto Rico.

INCI 4135. ELEMENTS OF OPTICS AND REMOTE SENSING IN GEOSPATIAL SCIENCE. Three credit hours. Three hours of lecture per week. Prerequisite: FISI 3172 or FISI 3162.

Principles of geometrical optics and remote sensing applied to Geospatial Science. Acquisition, handling, and interpretation of geospatial data acquired at different portions of the electromagnetic spectrum.

INCI 4136. APPLIED STATISTICS FOR CIVIL ENGINEERING. Two credit hours. Two hours of lecture per week. Prerequisite: MATE 3063 or MATE 3185.

Application of probability and statistical theory in civil engineering. Probability fundamentals; continuous and discrete distributions; point and interval estimation; test of hypothesis; multiple regression.

INCI 4137. INTRODUCTION TO TRANSPORTATION ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4136.

Basic concepts in transportation: demand, service and equilibrium; transportation planning process and economics; components, operation and design of transportation systems.

INCI 4138. WATER RESOURCES ENGINEERING. Three credit hours. Three hours of lecture per week. Prerequisites: INGE 4015 or INQU 4010 or INGE 4010.

Hydrologic measurements; hydrographs; probability theory applied to hydrologic computations; well hydraulics; capacity of reservoirs and stability of dams; hydraulics of open channels and of pressure conduits; flood control; legal and economic aspects of water resources.

INCI 4139. INTRODUCTION TO GEOTECHNICAL ENGINEERING. Four credit hours. Three hours of lecture and one three-hour laboratory per week. Prerequisites: INGE 4011 and (INGE 4015 or INQU 4010 or INGE 4010). Corequisite: GEOL 4015.

Sampling, identification and description of soils; index and hydraulic properties; interaction between mineral particles and water; permeability and seepage; stress strain and consolidation characteristics of soils; shear strength determinations. Stress distribution and soil improvement.

INCI 4145. WATERWORKS AND SEWERAGE DESIGN. Three credit hours. Three hours of lecture per week. Prerequisite: INCI 4138.

Design of water transmission, distribution, and collection systems. Analysis of flow in pipe networks, head losses, pressure distribution; system configuration; sewer hydraulics; quantities of water, sewage, and storm flows used in design; design of water supply systems, sanitary and storm sewers, and pumping stations.

INCI 4146. INFORMATION TECHNOLOGY APPLICATIONS IN CONSTRUCTION. One credit hour. Three hours of laboratory per week. Prerequisite: INCI 4055.

Introduction to the main applications of information technology used in construction. Laboratory practice of information technology applications in the construction process. Applications related to project and facilities

management, construction cost estimating, construction planning and scheduling, productivity, information storage and retrieval are presented. In addition, contracts, specifications, visualization and modeling are included.

INCI 4147. FUNDAMENTALS OF INTEGRATED PRACTICE FOR RESILIENT AND SUSTAINABLE INFRASTRUCTURE. Three credit hours. Three hours of lecture per week.

The course focuses on the implications of natural disasters on the design and construction processes, including the human factors, for solving problems of the design team. Study of the relevant dimensions for resilient and sustainable design and construction solutions, from the perspective of integrated practice and the integrated production of projects (Integrated Project Delivery / IPD).

INCI 4950. INTEGRATED CIVIL ENGINEERING PROJECT. Three credit hours. One hour of lecture and four hours of practice per week. Pre-requisite: authorization of the Director of the Department.

Design of a Civil Engineering project, integrating subdisciplines of the profession. Development of a project from its inception, and a conceptual and preliminary design, to its final design. Development of design alternatives, including computational methodology, plans, cost estimates, and specifications.

INCI 4995. ENGINEERING PRACTICE FOR CO-OP STUDENTS. Three to nine credit hours. Prerequisites: authorization of the Director of the Department. Be registered in the Civil Engineering or Surveying program.

Practical experience in Civil Engineering in cooperation with a Company or agency to be jointly supervised by the academic department, the coop program coordinator, and an official from the cooperating organization. A written report will be required upon completion of each period of work and its corresponding final grade will be given at the end of each period.

INCI 4998. UNDERGRADUATE RESEARCH. One to six credit hours. Three to twenty-four hours of laboratory per week. Pre-requisite: fourth- or fifth-year student and authorization of the Director of the Department. Participation, under the supervision of a faculty member acting as an investigator, in a research project. Advanced Undergraduate and Graduate Courses