Iligan Institute of Technology
of the Mindanao State University
Quality Education for a better Mindanao

MASTER OF SCIENCE IN CIVIL ENGINEERING

Introduction

Civil engineering covers such diverse areas of concern as design of structural systems, water resource planning, treatment and ultimate disposal of noxious solid and liquid wastes, design of building systems for rural and urban dwellers in the commercial and industrial sectors, development of transportation systems, construction methods and management, and implementation and management of public work projects designed to improve the environment without due prejudice to the health, safety and welfare of the public. The formation of new communities, cities and industries especially in Mindanao, the recent demands of the population for higher level of safety of the built environment calls for civil engineers with higher level of scientific and technical know-how.

Undergraduate programs in civil engineering alone are not sufficient to meet the requirements necessary to produce high-level manpower resources for scientific and technological advancement and to satisfy the research and development demands of an industrialized country.

Objectives

The MSCE program is offered with the following objectives:

1. to provide high-level manpower resources in the field of civil engineering needed by industries and agencies in both the private and public sectors; and

2. to develop the competence of Filipino scientists and engineers in the field of civil engineering through promotion and support of technical researches and related scientific activities.

Admission Requirements

Admission to the program is contingent upon the policies and guidelines of the Graduate School. In addition, all applicants must meet the following requirements:

1. The student must have an undergraduate engineering degree from a recognized institution. In the event that the degree is in a field other than civil engineering, the student may be required to complete a set of prerequisite undergraduate courses before graduate degree credits may be accrued.

2. The student must have an undergraduate weighted average grade of at least 2.0 or equivalent, or must be able to show some evidence of potential ability to pursue a graduate degree, e.g., excellent performance in teaching or research, or experience in the industry or private sector as evidenced by a strong recommendation from his immediate superior or former mentors.

Degree Requirements

The degree may be earned through a thesis or coursework option. The minimum course requirements for each option are as follows:

Thesis Option		Coursework Option	
Core Courses	15 units	Core Courses	24 units
Foundation Courses	6	Foundation Courses	9
Electives	3	Electives	9
Thesis	6	Special Project	3
	---	Comprehensive Exam	-

Total	30 units	Total	45 units

Core courses are identified by CE prefixes. They may be taken from any of the five areas of discipline, namely, Engineering Construction and Management, Structural Engineering, Geotechnical Engineering, Transportation Engineering and Water Resources Engineering. The offering of such courses is based on the availability of faculty members vis-à-vis the number of students meeting the five-enrollee-per-class requirement. Core courses taken beyond the minimum requirement may be credited as electives.

Foundation courses are identified by ES prefixes. These courses provide the students necessary background to tackle the core courses. ES 201 is a required foundation course and must be passed within the first year.

Electives are courses that may be taken, in consultation with the adviser, from any of the foundation courses of the MOE or MSCE program, or from any discipline-related courses of the MOE program. Likewise, core courses of MSCE program beyond the 15-unit or 24-unit minimum requirement for the thesis or coursework option, respectively, may also be credited as electives.

Special Project is a course in which the student conducts a practice-oriented study culminating to the presentation of a project report.

Comprehensive exam is a written exam given to students undergoing the coursework option. This is aimed at determining the students' ability to integrate and apply knowledge that they have acquired in their program of study.

MASTER OF SCIENCE IN CIVIL ENGINEERING (MSCE)

(LIST OF COURSES BY SEMESTER, THESIS OPTION)

First Year, First Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
ES 201	Advanced Engineering Mathematics I	3	3	0	3	
	Foundation Course	3	3	0	3	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Total	12	12	0	12	

First Year, Second Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Elective	3	3	0	3	
	Total	12	12	0	12	

Second Year, First Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
CE 299	Thesis	6				
	Total	6				

Second Year, Second Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
CE 299	(Thesis Continuation)	-				
	Total	-				

MASTER OF SCIENCE IN CIVIL ENGINEERING (MSCE)

(LIST OF COURSES BY SEMESTER, COURSEWORK OPTION)

First Year, First Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
ES 201	Advanced Engineering Mathematics I	3	3	0	3	
	Foundation Course	3	3	0	3	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Total	12	12	0	12	

First Year, Second Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
	Foundation Course	3	3	0	3	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Elective	3	3	0	3	
	Total	12	12	0	12	

Second Year, First Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Elective	3	3	0	3	
CE 298	Special Project	3	3	0	3	
	Total	12	12	0	12	

Second Year, Second Semester

Course No.	Course Title	Units	Hrs/Wk			Prerequisite(s)
			Lec	Lab	Total	
	Core Course	3	3	0	3	
	Core Course	3	3	0	3	
	Elective	3	3	0	3	
	Comprehensive Exam	-				
	Total	9	9	0	9	

CATALOGUE OF COURSES

FOUNDATION COURSES

ES 201 Advanced ENGINEERING Mathematics I

Vector spaces; linear independence; matrices; rank and inverse of a matrix; decomposition theorems; eigenvalues and eigenvectors; unitary and similarity transformations of matrices; initial and boundary value problems; power series solutions; applications to engineering problems.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 81 (Math Methods of Engineering I) or equivalent

ES 202 Advanced ENGINEERING Mathematics II

Boundary value problems of differential equations; Sturm-Liouville theory; singular boundary conditions, orthogonal expansions, separation of variables in partial differential equations, spherical harmonics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 81 (Math Methods of Engineering I) or equivalent

ES 205 NUMERICAL METHODS FOR ENGINEERS

Error analysis; solution of non-linear equations; direct and iterative methods of solving linear systems; approximations of functions; numerical differentiation and integration; numerical solution of ordinary differential equations; computer machine problems.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 81 (Math Methods of Engineering I) or equivalent

ES 210 PROBABILITY AND STATISTICAL CONCEPTS IN ENGINEERING PLANNING AND DESIGN

Basic probability and statistics with application and examples in engineering systems; elementary probability theory; random variables and their distribution; random processes; statistical inference; curve fitting and prediction; correlation and application to quality assurance reliability life testing.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 85 (Probability and Statistics in Engineering) or equivalent

ES 211 REGRESSION ANALYSIS AND EXPERIMENTAL DESIGN

Review of the fundamentals of statistics and probability; review of regression analysis: linear and multiple regression analysis of variance; design of experiments; completely randomized design; randomized complete blocks; Latin square multiclassification; factorial, incomplete blocks and fractional replications; confounding, general mixed factorials; optimum design.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 210 (Probability and Statistical Concepts in Engineering Planning and Design) or equivalent

ES 215 COMPUTER PROGRAMMING

Elements of Computer Programming; Structured Computer Programming in FORTRAN or C, or any structured programming language.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CSc11 (Computer Programming) or Consent of Instructor

ES 216 OPERATIONS RESEARCH

Operations research methods; linear programming, transportation problem; assignment problem; integer programming; review of probabilities; network analysis, PERT-CPM, dynamic programming; game theory, Markov chains; non-linear programming.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

ES 218 ENERGY MANAGEMENT

Energy resources, conversions, uses; energy conservation methods in the home, in transportation, in industrial and commercial sectors; fuel substitution; factors in the design of low-energy consumption buildings; economics of energy; technological, economic, societal and environmental factors.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

ES 219 ENVIRONMENTAL ENGINEERING AND MANAGEMENT

Pollution control laws; regulations and standards; types, sources and harmful effects of pollution, solid and liquid waste disposal and management; air pollution control.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CORE COURSES

CONSTRUCTION MANAGEMENT COURSES

CE 200 PRINCIPLES OF CONSTRUCTION MANAGEMENT

History of construction management; nature of the construction industry; planning theory; organization theory; staffing, leading and communication theory; control theory; organization structure and communication in construction; planning, estimating, monitoring, evaluation and control in construction; constructibility improvement; quality management in construction; selection of consultants; contractors, vendors, etc.; contemporary construction management perspective; emerging issues in construction project management.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 201 FINANCIAL MANAGEMENT AND ECONOMIC DECISION ANALYSIS IN CONSTRUCTION

Basic economic concepts; types and organization of cost estimates; comparison of alternatives; replacement; depreciation and depletion; tax considerations; quantity take-offs; manual and computer methods; contract cost estimates based on CSI subdivisions; cost adjustments with or without indices; interest calculations; effect of inflation; cash flow forecasting and budgetary control; project cost control; construction cost accounting; financing business units and projects; decision making under risk and uncertainty; economic decision models.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 202 CIVIL ENGINEERING SYSTEMS PLANNING, DESIGN AND DEVELOPMENT METHODOLOGY

Principles of organization; scheduling, planning, design and development methodologies applied to Civil Engineering systems and projects; planning strategies and application of detailed analysis and procedure of project planning and design from needs analysis; problem definition; generation of alternatives; evaluation and selection of alternatives; detailed design, construction and operational considerations; project evaluation considering technical, economic, financial, community and environmental impact; students generally work on a single project for the entire term in consultation with their instructor.

Credit : 3 units (1 hr lec)
Prerequisite(s) : Consent of Instructor

CE 203 CIVIL ENGINEERING FEASIBILITY ANALYSIS

Theory and practice of feasibility studies for proposed Civil Engineering projects and other related areas of interest.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : Consent of Instructor

CE 204 CONSTRUCTION PRODUCTIVITY ANALYSIS

Productivity in construction; factors affecting construction productivity; productivity measurement; productivity improvement during design and construction.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 205 CIVIL ENGINEERING LAWS, CONTRACTS AND ETHICS

General principles of law; overview of the preparation and presentation of construction project bids and proposals; project award process, bid packages, quantity take-offs, estimating, scheduling, and project presentation; students' participation in a realistic bidding exercise; ethical, social, political, legal and ecological issues of the engineering profession; construction statutes; engineer's view of contracts for design and construction; construction contracts and their procurement; elements and importance of contracts, obligations, frauds, proposals, bonds, specifications, performance and termination; construction claims prevention and management; disputes and their resolution; construction insurance; preparation and administration of complete specifications and contract documents for an engineering project; Civil Engineering code of ethics; legislation and policy affecting labor-management relationships in construction; invention and patents.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 206 INTERNATIONAL ISSUES IN CONSTRUCTION

History of world construction; the future of world construction; cultural influences in construction management; cross-cultural management in construction; international joint ventures; international contracting; global human resources management; privately financed public infrastructure projects and technology transfer; hybrid management in construction; the construction industries in the Asia-Pacific region

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 207 MATERIALS AND PRODUCTS FOR CONSTRUCTION

Theories of composites; law of mixtures; properties of composites; ferrocement technology; applications of ferrocement; fiber-reinforced c oncrete; cement
replacement materials; high-strength concrete; bamboo; paving blocks; prefabricated elements.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 208 PROCUREMENT MANAGEMENT FOR CONSTRUCTION

History of construction procurement; importance and nature of procurement; procurement procedure; value engineering application; equipment procurement; materials procurement; procurement of labor; procurement of outlet works.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : none

CE 209 OPERATIONS RESEARCH IN CIVIL ENGINEERING

Applications to Civil Engineering systems planning, design and operation of operations research methods such as linear programming, integer programming, network analysis, dynamic programming, game theory and non-linear programming; Civil Engineering applications of decision theory, stochastic techniques, and operations research; probabilistic decision theory; queueing theory; inventory theory; reliability theory; scheduling theory; heuristics and systems simulation.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 210 ADVANCED CONSTRUCTION ENGINEERING

Problems of the construction industry; contract administration, men, machines and methods in Civil Engineering construction; applications of mathematical methods and management tools to project and construction management.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 211 ADVANCED CONSTRUCTION FIELD TECHNIQUES

Advanced techniques for construction of bridges, high-rise office buildings, and structures in adverse environments; production and handling of high-strength concrete; erection of complex structural steel structures; placement of high-performance concrete under water and slurries; field repair of damaged structures; introduction of alternative techniques and their limitations; students' performance using selected techniques and evaluation of their performance.

Credit : 3 units (3 hrs lec)

Prerequisite(s) : Consent of Instructor

CE 212 INFORMATION TECHNOLOGY FOR CONSTRUCTION

Introduction to information technology for construction; analysis and design of information systems; implementation, development and selection of systems; application packages for construction operations; artificial intelligence and expert systems; automation in construction and robotics.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : none

CE 213 CONSTRUCTION OF HARBOR, COASTAL AND OCEAN STRUCTURES

Construction methods and equipment for construction of cofferdams, caissons, wharves, marine terminal, outfall sewers, power plant intakes and discharges, submarine oil and gas pipelines, dredging, offshore platforms, sub sea and deep ocean facilities.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

STRUCTURAL ENGINEERING COURSES

CE 220 ADVANCED STRUCTURAL ANALYSIS

Theory and applications of modern structural analysis; structural modeling concepts; static and kinematic requirements; matrix formulations; vector transformations; stiffness and flexibility methods of matrix analysis; direct stiffness method; virtual work energy theorems; numerical solution methods; practical analysis of large frame structures using commercial software; plastic analysis of frames; P-delta effects.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 152 (Structural Theory II) or equivalent

CE 221 COMPUTER METHODS OF STRUCTURAL ANALYSIS AND DESIGN

Review of numerical methods and solution techniques appropriate to complex structural problems; condensation and substructure techniques; comprehensive presentation of structural analysis in matrix language using force, displacement and direct stiffness methods, considering effects of applied forces, support settlement, and temperature changes; application of matrix methods to complex structures such as trusses, frames, multistory buildings with emphasis on numerical solutions by efficient computer implementations; database abstraction
methods for engineering systems; database models and systems; computer graphics; engineer-computer interfaces; introduction to finite element method.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 220(Advanced Structural Analysis), or
ES 205 (Numerical Methods for Engineers) or consent of Instructor

CE 222 NON-LINEAR STRUCTURAL ANALYSIS

Theory, modeling and computations for analysis of structures with material and geometric non-linearities; sources of non-linearity; modeling of inelastic materials and members; P-delta and large deformation theory; analysis of stability; practical applications.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 220 (Advanced Structural Analysis) or consent of Instructor

CE 223 FINITE ELEMENT METHODS IN ENGINEERING

Theory for approximate analysis of deformation and stress in solids; finite element formulation for frame, plane stress and plane strain, axisymmetric, torsion and three-dimensional elastic problems; the isoparametric formulation and implementation; finite element modeling of structural systems; plate and shell elements; problems other than structural mechanics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 220 (Advanced Structural Analysis), or CE 221 (Computer Methods of Structural Analysis and Design), or CE 228 (Introduction to Solid Mechanics) or consent of Instructor

CE 224 BOUNDARY ELEMENT METHOD

Introduction to boundary element method; mathematical background, theories and numerical methods; two-dimensional, three-dimensional and axisymmetric potential and elastostatic problems; use of a BEM computer program in structural analysis. thermoelasticity, multi-domain and fracture mechanics problems; BE formulation in non-linear problems with emphasis on elastoplasticity; coupling BE and FE, centrifugal loading, infinite elements and time-dependent problems; use of a BEM computer program in structural analysis.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 225 STRUCTURAL DYNAMICS

General theory of free, forced, and transient vibrations; foundation excitation; vibration transmission, isolation, and measurement; systems with single and multiple degrees of freedom; eigenvalue problems; mode superposition technique; vibration of continuous systems; generalized coordinates and Lagrange's equations; method of influence coefficients; matrix formulation and solution; estimation of maximum response by response spectrum analysis; evaluation of earthquake induced deformations and forces in structures by linear response history analysis; effects of inelastic behavior.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 220 (Advanced Structural Analysis), or ES 205 (Numerical Methods for Engineers) or consent of Instructor

CE 226 PLATE AND SHELL STRUCTURES

Theory and design of plates and shells; bending and stretching of plates; circular plates; rectangular plates; plates on elastic foundation; large deflections; stability; anisotropy; numerical and classical methods. General properties of stress systems in shells; surface theory; deformation; shells of revolution; cylindrical shells; hyperbolic and elliptic paraboloids; displacements; boundary conditions; stability.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 205 (Numerical Methods for Engineers) or consent of Instructor

CE 227 STRUCTURAL STABILITY

Simple column buckling for various conditions; basic considerations for elastic and inelastic equilibrium; determination of buckling strength of columns with variable cross-section; elastic stability of framed structures.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 228 INTRODUCTION TO SOLID MECHANICS

Cartesian tensors; stress and strain tensors; equilibrium; rigid body displacements; constitutive laws; anisotropic, orthotropic, and isotropic elastic solids; natural boundary conditions; compatibility conditions; Maxwell-Betti structural theorem; governing equations in cylindrical coordinates; two main approaches to boundary valued problems; isotropic elastic planes; isotropic elastic half-spaces; bending of thin plates; brief introduction to nonlinear mechanics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 229 THEORY OF ELASTICITY AND PLASTICITY

Analysis of stress; stress boundary conditions; rigid body displacements; isotropic materials; anisotropic materials; torsion; membrane analogy for torsion problem; Airy's stress function; special problems. Mathematical theory of plasticity; plastic stress-strain laws; yield functions and associated flow rules; applications to problems in flexure and torsion; plane plastic flow.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 201 (Advanced Engineering Mathematics I) or
consent of instructor

CE 230 MATERIAL PROPERTIES FOR DESIGN

Series of current readings on the properties of engineering materials, e.g., steel, high-strength lightweight alloys, plastics, composites and ceramics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 231 EXPERIMENTAL METHODS IN STRUCTURAL ENGINEERING

Uses and application of models; laws of similitude, dimensional analysis; scale factors; parametric studies; error and uncertainty in experiment; measurement of strains; electrical resistance strain gauges; rosette analysis; photoelasticity; acoustic emission method; instrumentation for load tests and measurement of settlement in buildings.

Credit : 3 units (2 hrs lec; 3 hrs lab)
Prerequisite(s) : none

CE 232 EARTHQUAKE ENGINEERING

Characteristics of strong earthquakes; determination of location and size of earthquake; earthquake magnitude and intensity; frequency of occurrence of earthquakes; engineering implications of geological phenomena (e.g., earthquake mechanisms, faulting and fault slippage); effects of local geology on earthquake ground motion; response spectra; seismic risk; soil liquefaction. Design of structures to resist earthquakes; ductility; base isolation; development of design criteria for elastic and inelastic structural response; seismic performance of various structural systems; prediction for nonlinear seismic behavior; basis for code design procedures; structural design and detailing for earthquake resistance. Evaluation of seismic vulnerability of existing structures and rehabilitation of seismic deficiencies.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 220 (Advanced Structural Analysis), or
CE 225 (Structural Dynamics) or consent of instructor

CE 233 PLANNING AND OPTIMIZATION OF STRUCTURES

Structural design processes; analyses leading to the choice of load-resisting systems; geometric patterns and selection of materials for optimum design of
structural elements; mathematical programming in optimization of structural systems.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 234 ADVANCED REINFORCED CONCRETE DESIGN

Advanced topics in reinforced concrete construction, including inelastic flexural behavior; limit state design method; application of plastic analysis to reinforced concrete frames; behavior in shear and torsion; yield-line analysis of slabs; behavior under cyclic and reversed loading.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 162 (Design of Concrete Structures II) or equivalent

CE 235 PRESTRESSED CONCRETE STRUCTURES

Behavior and design of prestressed concrete structures under bending moment, shear , torsion and axial load effects ; materials; simple and composite sections; continuous members; slabs; columns; frames; arches; tanks; column buckling; two- and three-way prestressing and balanced-load techniques; time-dependent effects and deflections; allowable stress and ultimate strength methods of analysis and design. Applications to design and construction of bridges and buildings.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 162 (Design of Concrete Structures II) or equivalent

CE 236 PLASTIC DESIGN OF STEEL STRUCTURES

Basic concepts of limit analysis; plastic hinge formation; development and analysis of collapse mechanisms; inelastic behavior of metal structural frameworks; strength and stability under combined loadings; deflections; incremental collapse and shakedown under repeated loading; application of plastic design to high-rise braced and unbraced steel frames; introduction to optimum design. Load and Resistance Factor Design (LRFD).

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 163 (Design of Steel Structures) or equivalent

GEOTECHNICAL ENGINEERING COURSES

CE 240 MECHANICS OF SOILS

Stress and strain concepts and stress distribution in soil; theories of strength, permeability, consolidation, seepage, lateral earth pressures and bearing capacity; settlement and stability analyses of soil foundation; slope stability; subsoil exploration and soil sampling.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 112 (Soil Mechanics) or equivalent

CE 241 TESTING AND INSTRUMENTATION IN SOIL ENGINEERING

Laboratory and field measurements of soil properties; measurements of in-situ soil characteristics; introduction to geotechnical field instrumentations; results evaluations and applications to geotechnical engineering analysis; development in testing and instrumentation methods and equipment.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : CE 112 (Soil Mechanics) or equivalent

CE 242 FUNDAMENTALS OF GEOLOGICAL ENGINEERING

Description and evaluation of rocks; causes and criteria for recognition of geologic structures ; physical and mechanical properties of rock masses; rock slope stability; geological and geophysical exploration for structures in rocks.

Credit : 4 units (3 hrs lec, 3 hrs lab)
Prerequisite(s) : Geol 40 (Engineering Geology) or equivalent

CE 243 ROCK MECHANICS

Engineering properties of rocks and their measurements; stresses and strain and its application to fracture and deformation in rocks; analysis of rock mass deformation; seepage; stability of rock slopes, tunnels, underground openings, and foundations on weak and fractured rocks; applications of mechanics and geology to the planning, design and construction of engineering structures.

Credit : 4 units (3 hrs lec, 3 hrs lab)
Prerequisite(s) : Geol 40 (Engineering Geology) or equivalent

CE 244 EARTH STRUCTURES

Soil stabilization by compaction and using admixtures for use in embankment, dams, highway and airfields, and lined waste repositories; in-situ ground improvement; analysis, design and construction of earth and rock fill dams, levees, embankments and other earth structures.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 112 (Soil Mechanics) or equivalent

CE 245 FOUNDATION ENGINEERING

Subsoil investigation; soil/rock-structure interactions; sheeting and bracing for groundwater control; analysis, design and construction aspects of structural foundation systems for shallow and deep foundations and earth retaining structures; case studies.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 112 (Soil Mechanics) or equivalent

CE 246 SOIL STABILIZATION

Methods and techniques in ground improvement; materials for ground improvement and their behaviors; ground improvement for foundation and earth structure stability;

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of instructor

CE 247 SOIL ENGINEERING DESIGN

Application of soil mechanics principles and theories to the analysis and design for settlement, bearing capacity, slope stability, seepage and earth pressures problems; natural soil deposits properties; subsoil exploration.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils) or consent of instructor

CE 248 GROUNDWATER IN GEOTECHNICAL ENGINEERING

Principles of groundwater flow, including steady and transient flow through porous media, analysis of seepage; saturated and partially saturated flow; free surface analysis; numerical method of analysis; permeability in-situ earth materials.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils) or
ES 205 (Numerical Methods for Engineers) or consent of instructor

CE 249 FOUNDATION ANALYSIS AND DESIGN

Foundation engineering fundamentals and theories related to analysis and design of shallow and deep foundations, retaining structures; embankment, excavation and slope stability; subsoil exploration and in-situ shear strength evaluation of soil for stability analysis and design. Integrated design project on major topics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils) or consent of instructor

CE 250 SOIL DYNAMICS

Principles of dynamics; lumped system; elastic half-space theory; dynamic characteristics soil; wave phenomena in soil materials; analysis and design of foundation and earth structures for dynamic loads; foundation design problems.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soil) or consent of instructor

CE 251 COMPUTER APPLICATIONS IN GEOTECHNICAL ENGINEERING

Application of computer solutions to the analysis and design problems in geotechnical engineering.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : CE 240 (Mechanics of Soils) or
ES 71 (Computer Programming) or consent of instructor

CE 252 STATISTICAL METHODS IN GEOTECHNICAL ENGINEERING

Examination of the nature of particular media and their description and characterization; comparison of the deterministic and probabilistic approaches to the action and reaction of structures off, on, or in soil when subjected to loadings; uncertainty considerations in material parameters and their effects on designs; stability assessment in terms of reliability as well as customary factors of safety.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils), or
CE 241 (Testing and Instrumentation in Soil Engineering), or
ES 85 (Probability & Statistics in Engineering) or consent of instructor

CE 253 CRITICAL STATE SOIL MECHANICS

Introduction to critical state approach in soil mechanics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils) or consent of instructor

CE 254 SOIL AND ROCK ENGINEERING PROBLEMS

Application of boundary value solutions to problems in soil and rock mechanics; numerical methods of solutions.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 205 (Numerical Methods for Engineers), or
CE 229 (Theory of Elasticity and Plasticity) or consent of instructor

CE 255 GEOTECHNICAL ASPECTS OF EARTHQUAKE ENGINEERING

Overview of earthquake engineering; role of civil engineer in planning and design for earthquakes; influence of soil conditions on site response; seismic site response analysis; seismic hazard analysis; methods of analysis for seismic loads; dynamic soil property evaluation and modeling; liquefaction and its consequences; seismic analysis for earth pressure, slope stability and deformation; seismic code provision and practices; seismic soil-structure interaction; seismic
analysis of earth dams, embankments and waste containment facilities; seismic performance of pile foundations.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 250 (Soil Dynamics) or consent of instructor

CE 256 EARTH AND ROCKFILL DAM

Design requirements of earth and rockfill dam; analysis and design for stability and seepage; construction methods and techniques; compaction control; soil
sampling and testing; foundation preparation; and field instrumentation.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 240 (Mechanics of Soils) or consent of instructor

CE 257 RETAINING STRUCTURES

Analysis and design of retaining structures; sheet pile structures, single wall cofferdams, and cellular cofferdams; recent innovations of fluid trench walls and reinforced soil.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 247 (Soil Engineering Design) or consent of instructor

CE 258 SELECTED TOPICS IN GEOTECHNICAL ENGINEERING

A critical and in-depth examination of topics selected mutually by students and instructor from among the topics not covered in other geotechnical courses.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 259 APPLIED SOIL MECHANICS

Soil and foundation engineering case histories, including analysis of failures and recommendations for their correction; engineering report.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 245 (Foundation Engineering), or
CE 248 (Groundwater in Geotechnical Engineering) or consent of instructor

TRANSPORTATION ENGINEERING COURSES

CE 260 TRANSPORTATION ECONOMICS AND POLICY

Engineering economics; cost-benefit; public economics and the role of the public sector; spectrum of transportation policies; economic impact of transportation improvement; evaluation of transport project; environmental policies, impact
statements and assessment.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 261 GEOMETRIC DESIGN OF HIGHWAYS AND STREETS

Location and design of major features and various classes of highways with emphasis on advanced theories and latest practices related to highway alignment, cross-sections, intersections, interchanges, and arterial routes in urban areas.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 122 (Transportation Engineering) or equivalent

CE 262 TRAFFIC ENGINEERING I

Human, vehicular, and traffic characteristics and their use in the planning and functional design of highway and terminal facilities; traffic studies, methods of analysis and evaluation; highway capacity, traffic control measures and devices; functions of the traffic engineer.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : CE 122 (Transportation Engineering) or equivalent &
ES 210 (Probability and Statistical Concepts in Engineering Planning and Design)

CE 263 TRAFFIC ENGINEERING II

Traffic flow variables and their relationships; deterministic flow models; stochastic modeling of traffic processes; traffic simulation models.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 262 (Traffic Engineering I)

CE 264 THEORY OF TRAFFIC FLOW

Study and evaluation of various qualitative and quantitative descriptions of the complex phenomenon of traffic flow. The conceptual and mathematical models considered are statistical relationships, car following analogy, queueing theory, traffic network analyses, computing machine simulation studies, mathematical experiments, and distribution-function theories.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 263 (Traffic Engineering II) or consent of instructor

CE 265 TRANSPORTATION PLANNING I

Elements and features of transportation systems; technology and operating characteristics of existing transportation systems; transportation planning process; survey methods in transportation; transportation demand modeling; transportation
network analysis; GIS in transport planning

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 122(Transportation Engineering) or equivalent, or

ES 210 (Probability and Statistical Concepts in Engineering Planning and Design) or Consent of Instructor

CE 266 TRANSPORTATION PLANNING II

Public transportation planning, surveys and operations; transportation system management; transportation and environmental planning; traffic safety management.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 265 (Transportation Planning I)

CE 267 PAVEMENT DESIGN AND CONSTRUCTION MATERIALS

Properties of paving components; testing of paving materials; design of flexible and rigid pavements; pavement evaluation; maintenance and rehabilitation.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : CE 112 (Soil Mechanics) or equivalent, or
CE 262 (Traffic Engineering I) or consent of instructor

CE 268 AIRPORT DESIGN AND PLANNING

Airport requirements, design and planning, site selection, air traffic controls and geometric design of runways, taxi ways, terminal facilities, etc.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 261 (Geometric Design of Highways and Streets) or
consent of instructor

CE 269 AIR PHOTO INTERPRETATION

Air photo interpretation and application to engineering surveys for city planning, highways, airports, and transportation in general, with emphasis on interpretation of landforms and their influence on location studies.

Credit : 3 units (2 hrs lec, 3 hrs lab)
Prerequisite(s) : Consent of Instructor

CE 270 FREIGHT DISTRIBUTION SYSTEMS

Design, development, management, and control systems and subsystems to effectively distribute goods from producer to user. Deals with logistic models,
characteristics of freight transportation modes, freight handling techniques,
transport service quality and economics.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 271 PUBLIC MASS TRANSPORTATION

Public mass transportation system technology, design, operation, and planning
including vehicle characteristics, bus transit, light rail and rail rapid transit, schedules and networks, capacity, paratransit.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 262 (Traffic Engineering I) or consent of instructor

CE 272 SOIL ENGINEERING FOR TRANSPORTATION FACILITIES

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

WATER RESOURCES COURSES

CE 280 HYDRAULIC DESIGN

Hydraulic structures; gravity structures; reinforced-concrete structures; earth structures; forces acting on hydraulic structures; economic considerations; open channel.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 101 (Hydrology) or equivalent

CE 281 HYDRAULIC MEASUREMENTS

Principles of design and operation of instruments for the measurement of pressure, velocity, discharge and related fluid flow characteristics.

Credit : 2 units (1 hr lec, 3 hrs lab)
Prerequisite(s) : ES 65 (Mechanics of Fluids) or equivalent

CE 282 SOIL EROSION AND SEDIMENTATION

Erosion control structures; sediment transport; stable channel design; desilting and diversion structures.

Credit : 2 units (2 hrs lec)
Prerequisite(s) : ES 65 (Mechanics of Fluids) or equivalent

CE 283 WATER DISTRIBUTION AND WATER TREATMENT PLANT DESIGN

Design of the components of different types of water treatment plants; preparation of a plan of a treatment and distribution system using previously designed components.

Credit : 3 units (1 hr lec, 6 hrs lab)
Prerequisite(s) : CE 101 (Hydrology) or equivalent

CE 284 ANALYSIS AND DESIGN OF HYDRAULIC PROJECTS

Detailed analysis or design of a complex hydraulic structure or a water resources' project emphasizing interrelationships of various components with applications of fluid mechanics and/or hydrology. Students generally work on a single project for the entire term, on frequent consultations with their instructor.

Credit : 3 units (1 hr lec, 6 hrs lab)
Prerequisite(s) : CE 101 (Hydrology) or equivalent

CE 285 FREE-SURFACE FLOW

Open-channel flow; the hydraulic jump; backwater curves and surges in canals and docks; river control; flood routing; reservoir operation.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 65 (Mechanics of Fluids) or equivalent

CE 286 COASTAL ENGINEERING

Engineering applications of the theory of small and finite amplitude water waves; diffraction, reflection, refraction; wind-generated waves and wave prediction procedure; tides and their interaction with the coast line; effect of waves on coastal structures such as breakwaters and pile-supported structures; coastal processes.

Credit : 3 units
Prerequisite(s) : Consent of Instructor

CE 287 APPLIED HYDROLOGY

Basic hydrologic principles; hydrograph analysis; hydrologic techniques applicable to problems in water power, water supply, irrigation and flood control.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : ES 65 (Mechanics of Fluids) or equivalent

CE 288 GROUND WATER DEVELOPMENT

Groundwater movement, storage and exploration; basic principles of ground water flow and aquifer testing; well design, construction, production tests and maintenance; ground water recharge and run off; development and management of aquifers.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : Consent of Instructor

CE 289 WATER RESOURCES PLANNING

Concepts in water resources planning; water inventories, use and control; water conservation measures and legislation; single-purpose and multipurpose project planning; economic and financial analysis.

Credit : 3 units (3 hrs lec)
Prerequisite(s) : CE 101 (Hydrology) or equivalent

OTHER COURSES

CE 295 SPECIAL TOPICS I

This is a specialized course not found in any of the above core courses. Topics vary depending on the availability of a Professor.

Credit : 3 units
Prerequisite(s) : Consent of Instructor

CE 296 SPECIAL TOPICS II

This is a specialized course not found in any of the above core courses. Topics vary depending on the availability of a Professor.

Credit : 3 units
Prerequisite(s) : Consent of Instructor

CE 295 SPECIAL TOPICS III

This is a specialized course not found in any of the above core courses. Topics vary depending on the availability of a Professor.

Credit : 3 units
Prerequisite(s) : Consent of Instructor

CE 298 SPECIAL PROJECT

The student will complete a typical Civil Engineering project design culminating in a professional practice-oriented project. Suitable projects may be undertaken in
response to the needs of the community.

Credit : 3 units
Prerequisite(s) : Consent of Instructor

CE 299 MASTERAL THESIS

Credit : 6 units