CIVIL ENGINEERING CURRICULUM

Dept. of Civil & Environmental Engineering

Degree: *B.S. in Civil Engineering*

Concentration: *General Civil Engineering*

FRESHMAN YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 241	Calculus I & Lab	3	MATH 242	Calculus II & Lab	3
CHEM 141	General Chemistry I	3	PHY 211	General Physics I	4
CHML 141	General Chem I Lab	1	PHYL 211	General Physics I Lab	1
ENG 104	Composition I	3	ENG 105	Composition II	3
HIST 101	History of Civilization	3	HIST 102	History of Civilization	3
UNIV 100	Concepts for Success	2	SPCH____	Speech Option	3
	TOTAL = 15			TOTAL = 17	

SOPHOMORE YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 243	Calculus III & Lab	3	MATH 244	Calculus IV & Lab	3
PHY 212	General Physics II	4	MATH 368	Ord. Diff. Equations	3
PHYL 212	General Physics II Lab	1	CIV 223	Engineering Mech. II	3
ENG ____	English Option	3	CIV 240	Strength of Materials	3
CIV 222	Engineering Mech. I	3	BIO 101 & BIOL 101 or	Intro. Biology & Lab	3
CIV 201	Engineering Graphics	2	SCI 205	Earth & Space Science	
	TOTAL = 16			TOTAL = 15	

JUNIOR YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 307	Probability & Statistics for Eng.	3	CIV 360	Design of Steel Structures	3
CIV 320	Structural Analysis	3	CIV 370	Water Res. Eng.	3
CIV 330	Fluid Mechanics	3	CIV 380	Intro. Geotech. Eng.	3
CIVL 330	Fluid Mech. Lab	1	CIVL 380	Geotechnical Eng. Lab	1
CIV 340S	Intro. Environ. Eng.	3	CIV 390	Intro. Transp. Eng.	3
CIVL 340	Environ. Eng. Lab	1	CIV elective	Civil Eng. Elective	3
CIV 355	Engineering Economy	3	CIV elective	Civil Eng. Elective	3
	TOTAL = 17			TOTAL = 19	

SENIOR YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
CIV 410	Capstone Design I	3	CIV 411W	Capstone Design II	3
CIV 420	Design of Concrete Structures	3	CIV 461	Professional & Ethical Issues in Civil Eng.	1
CIVL 421	Structural Eng. Lab	1	ART_____	Fine Arts Option	3
CIV 430	Foundation Eng.	3	CIV Elective	Civil Eng. Elective	3
CIV elective	Civil Eng. Elective	3	CIV Elective	Civil Eng. Elective	3
PHIL ____	Philosophy Option	3			
	TOTAL = 16			TOTAL = 13	

TOTAL HOURS: 128

CIVIL ENGINEERING TECHNICAL ELECTIVES

CIV 310 & CIVL 310 Eng. Surveying Lec. and Lab.
CIV 431Traffic Engineering
CIV 441 Water & Wastewater Treatment Processes
CIV 451 Computer Methods in Civil Engineering
CIV 460 Design of Environmental Engineering Facilities
CIV 465 Advanced Water Resources Engineering
CIV 466 Advanced Design of Hydraulic Structures
CIV 468 Hazardous Waste Engineering
CIV 470 Urban Transportation Engrg System Design
CIV 471 Principles of Geoenvironmental Engineering
CIV 472 Applied Geotechnical Engineering Design
CIV 475 Pavement Design
CIV 476 Advanced Design of Steel Structures
CIV 477 Advanced Design of Concrete Structures
CIV 478 Design of Wood and Masonry Structures
CIV 479 Evaluation, Maintenance, and Rehabilitation of Public Works Infrastructure
CIV 481 Special Problems in Civil Engineering
CIV 491 Internship in Civil Engineering I
CIV 492 Internship in Civil Engineering II

At least one civil engineering elective must be chosen from CIV 441 or CIV 460 (required environmental engineering elective). At least one civil engineering elective must be chosen from CIV 431, CIV 470, CIV 475 or CIV 479 (required transportation engineering elective). The selection of other courses requires the approval of adviser and Dept. Chair.

The students are required to contact their advisers or Department Chair prior to taking any civil engineering elective.

The students must take the Fundamentals of Engineering (FE) exam during the last semester, prior to graduation.

Engineering classes are generally offered once a year.

No pre-req violations are allowed. If a student has a pre-req violation, he/she may not be able to graduate on time.

DEVELOPMENTAL COURSE REQUIREMENTS

ENG 002	Required for students with an ACT English subtest score of 16 or less. Strongly encouraged for students with English subtest score of 19 or less.
MATH 004	Required for students with an ACT Mathematics subtest score of 16 or less. Strongly encouraged for students with Mathematics subtest score of 19 or less.
RE 002	Required for students with an ACT Reading subtest score of 16 or less. Strongly encouraged for students with Reading subtest score of 19 or less.
GNST 101,102	Required for students taking two or more intermediate courses. Students in the Academic Support Program will not be permitted to take more than 15 semester hours, including intermediate courses and the Academic Support Program.

Note: (a) Students who transfer 12 or more hours of college credit are exempt from GUID 100. (b) Students are required to take the Mathematics Placement Test to determine if they need to take any math courses before taking Math 231- Calculus I; (b) Students who fail the English Proficiency Exam, must register for ENG 399.

SPEECH OPTIONS

SPCH 201	Speech Arts
SPCH 334	Argumentation and Debate
SPCH 355	Persuasion
SPCH 430	Small Group Discussion

PHILOSOPHY OPTIONS

PHIL 301Introduction to Philosophy
PHIL 416Logic
PHIL 208Aesthetics
PHIL 309Ethics

HUMANITIES AND FINE ARTS

ART 206 Art Appreciation
MUS 205 Music Appreciation
DR 201 Introduction to Drama
ENG 201/202 Humanities
ENG 205 World Literature
FR 101/102 Elementary French
FR 201/202 Intermediate French
FR 213 French Phonetic Reading
SP 101/102 Elementary Spanish
SP 201/202 Intermediate Spanish
*Note-students may take the equivalent of any foreign language the University offers.

ENGLISH OPTIONS

ENG 213 Professional Writing
ENG 206 Literature of Science
ENG 205 World Literature

CIVIL ENGINEERING CURRICULUM

Dept. of Civil & Environmental Engineering

Degree: *B.S. in Civil Engineering*

Concentration: *Environmental Engineering Concentration*

FRESHMAN YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 241	Calculus I & Lab	3	MATH 242	Calculus II & Lab	3
CHEM 141	General Chemistry I	3	PHY 211	General Physics I	4
CHML 141	General Chem. I Lab	1	PHYL 211	General Physics I Lab	1
ENG 104	Composition I	3	ENG 105	Composition II	3
HIST 101	History of Civilization	3	HIST 102	History of Civilization	3
UNIV 100	University Success	2	SPCH____	Speech Option	3
	TOTAL = 15			TOTAL = 17	

SOPHOMORE YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 243	Calculus III & Lab	3	MATH 244	Calculus IV & Lab	3
CHEM 142	General Chemistry II	3	MATH 368	Ordinary Differ. Eq.	3
CHML 142	General Chem. II Lab	1	CHEM 241	Organic Chemistry I	3
ENG___	English Option	3	CHML 241	Organic Chem. I Lab	1
CIV 201	Engineering Graphics	2	CIV 223	Engineering Mech. II	3
CIV 222	Engineering Mech. I	3	CIV 240	Strength of Materials	3
BIO 101	Intro. Biology & Lab	3			
BIOL 101 or SCI 205	Earth & Space Science				
	TOTAL = 18			TOTAL = 16	

JUNIOR YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
MATH 307	Probability & Statistics for Eng.	3	CIV 360	Design of Steel Structures	3
CIV 320	Structural Analysis	3	CIV 370	Water Res. Eng.	3
CIV 330	Fluid Mechanics	3	CIV 380	Intro. Geotechnical Eng.	3
CIVL 330	Fluid Mechanics Lab	1	CIVL 380	Geotechnical Eng. Lab	1
CIV 340S	Intro. Environ. Eng	3	CIV 390	Intro. Transp. Eng.	3
CIVL 340	Environ. Eng. Lab	1	CIV elective	Civil Eng. Elective	3
CIV 355	Engineering Economy	3			
	TOTAL = 17			TOTAL = 16	

SENIOR YEAR

FIRST SEMESTER			SECOND SEMESTER		
Course		**Units**	**Course**		**Units**
CIV 410	Capstone Design I	3	CIV 411W	Capstone Design II	3
CIV 420	Design of Concrete Structures.	3	CIV 461	Professional & Ethical Issues in Civil Eng.	1
CIVL 421	Structural Eng. Lab	1	CIV Elective	Civil Eng. Elective	3
CIV 430	Foundation Eng.	3	PHIL____	Philosophy Option	3
			ART____	Fine Arts Option	3
CIV elective	Civil Eng. Elective	3			
CIV elective	Civil Eng. Elective	3			
	TOTAL = 16			TOTAL = 13	

TOTAL HOURS: 128

CIVIL ENGINEERING TECHNICAL ELECTIVES

CIV 310 & CIVL 310 Eng. Surveying Lec. and Lab.
CIV 431Traffic Engineering
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CIV 460 Design of Environmental Engineering Facilities
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CIV 466 Advanced Design of Hydraulic Structures
CIV 468 Hazardous Waste Engineering
CIV 470 Urban Transportation Engrg System Design
CIV 471 Principles of Geoenvironmental Engineering
CIV 472 Applied Geotechnical Engineering Design
CIV 475 Pavement Design
CIV 476 Advanced Design of Steel Structures
CIV 477 Advanced Design of Concrete Structures
CIV 478 Design of Wood and Masonry Structures
CIV 479 Evaluation, Maintenance, and Rehabilitation of Public Works Infrastructure
CIV 481 Special Problems in Civil Engineering
CIV 491 Internship in Civil Engineering I
CIV 492 Internship in Civil Engineering II

At least two civil engineering electives must be chosen from CIV 441, CIV 460, CIV 468, or CIV 471. The selection of other courses requires the approval of adviser and Dept. Chair.

At least one civil engineering elective must be chosen from CIV 431, CIV 470, CIV 475 or CIV 479. The selection of other courses requires the approval of adviser and Dept. Chair.

The students are required to contact their advisers and department chair prior to taking any civil engineering elective.

The students must take the Fundamentals of Engineering (FE) exam during the last semester, prior to graduation.

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SPCH 355	Persuasion
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HUMANITIES AND FINE ARTS

ART 206	Art Appreciation
MUS 205	Music Appreciation
DR 201	Introduction to Drama
ENG 201/202	Humanities
ENG 205	World Literature
FR 101/102	Elementary French
FR 201/202	Intermediate French
FR 213	French Phonetic Reading
SP 101/102	Elementary Spanish
SP 201/202	Intermediate Spanish

*Note-students may take the equivalent of any foreign language the University offers.

PHILOSOPHY OPTIONS

PHIL 301	Introduction to Philosophy
PHIL 416	Logic
PHIL 208	Aesthetics
PHIL 309	Ethics

ENGLISH OPTIONS

ENG 213	Professional Writing
ENG 206	Literature of Science
ENG 205	World Literature

COURSE DESCRIPTIONS

CIV 201 (2) Engineering Graphics. Prerequisite: MATH 112 or MATH 118 or Equivalent.
Develop skills to visualize and represent three-dimensional objects graphically, orthographic projection, pictorial drawings, graphics and charts, principles of computer-aided drafting and design (CADD) including substantial use of the AutoCAD software or equivalent, two and three-dimensional drafting and pictorial drawings using a CADD system, applications in various engineering disciplines and systems approach.

CIV 220 (3) Circuit Theory. Prerequisite: MATH 242 and PHY 211. This course introduces concepts and basic laws in the analysis of AC and DC linear electric circuits. Topic include mesh and nodal analysis. Thevenin's and Norton's theorems, superposition principle, transients in RLC circuits, phasor notation, and frequency response.

CIV 222 (3) Engineering Mechanics I. Co-requisite: PHY 211. Calculus-based statics of particles and rigid bodies; equilibrium; distributed forces; centroids; structures, trusses, frames, machines; forces in beams and cables; friction; moments of inertia, real life examples for engineering applications and systems approach**.**

CIV 223 (3) Engineering Mechanics II. Prerequisite: CIV 222, MATH 242. Calculus-based kinematics and kinetics of a particle. Planar kinematics of a rigid body: planar kinetics of a rigid body including force and acceleration; work and energy; impulse and momentum; vibrations, real life examples and systems approach.

CIV 240 (3) Strength of Materials. Prerequisite: CIV 222. Forces and stresses, axial loading, torsion, pure bending, transverse loading, shear force and bending moment diagrams, transformation of stress and strain, design of beams and shafts, deflection of beams, statically indeterminate problems, energy methods, columns, real life examples and systems approach.

CIV 310 (2) Engineering Surveying. Prerequisite: PHY 211, Co-requisite: CIV 311.
Plane surveying, measurement of distances and angles, differential leveling, traverse adjustment and area computations, topographic surveying and contours, horizontal and vertical curves, surveying computations, elements of site plan, Professional ethics in surveying.

CIVL 310 (1) Engineering Surveying Laboratory. Prerequisite: PHY 211, Co-requisite: CIV 310. Field experience to measure surveying parameters including distances, angles, and elevations. Field notes, surveying equipment; critically analyze and interpret data, report writing.

CIV 320 (3) Structural Analysis. Prerequisite: CIV 240. Analysis of statically determinate and indeterminate structures for fixed and moving loads. Equations of equilibrium and compatibility. Influence lines, and shear and moment envelopes. Analysis of forces and deflections in structures by methods of moment distribution, consistent deformation, and virtual work, computer analysis of structures, real life examples.

CIV 330 (3) Fluid Mechanics. Prerequisites: CIV 223, CIV 240, Co-requisite: MATH 368, CIVL 330. The objective of this course is to provide students with a fundamental knowledge in the dynamics of fluid flows. In this course basic conservation laws of mass, momentum, energy principles, dimensional analyses, boundary layer, fluid drag and lift will be taught with an emphasis in developing problem solving skills for real world engineering applications.

CIVL 330 (1) Fluid Mechanics Laboratory. Co-requisite: CIV 330. Laboratory experience to measure fluid properties and apply principles for application in engineering design. The experiments will include pressure and velocity measurement, application of mass, energy, and momentum principles, energy losses, forces on immersed bodies, and flow measurement devices; critically analyze and interpret data, report writing.

CIV 340S (3) Introduction to Environmental Engineering. Prerequisites: CHEM 141; co-requisites; CIVL 340, CIV 330, and CIVL 330. Basic concepts of environmental engineering, local and global environmental issues, scientific, social, ethical, regulations and public policy on environmental protection; quantitative engineering analysis of sources, transformations, and effects of pollutants in water, air, and soil; introduction to water and wastewater treatment processes, air pollution control technologies, solid waste and hazardous waste management. This course requires the completion of a service learning component in specific areas of environmental engineering.

CIVL 340 (1) Environmental Engineering Laboratory. Prerequisite: CHEM 141 , Co-requisites: CIV 340, CIV 330, CIVL 330. Experiments for the analysis of water, wastewater and certain solid wastes. Selected experiments may include determinations of water's or wastewater's pH, alkalinity, turbidity, hardness, and electric conductivity; solids, nitrogen species, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon, and chlorinated compounds. Also included will be contaminant leaching test of some solid or hazardous wastes and absorption of contaminants by solid media. Critical analysis of experimental and interpretation of data and scientific presentation (reporting) of results are emphasized.

CIV 355 (3) Engineering Economy. Prerequisite: MATH 242 and junior standing. Introduction to economic principles, application of economic principles to multidisciplinary engineering problems; calculation of capitalized costs, present worth, prospective rates of return, and annual costs, economy of equipment replacement, market forces and firm analysis; case studies and group project.

CIV 360 (3) Design of Steel Structures. Prerequisite: CIV 320. The course topics includes engineering properties and behaviors of structural steel subjected to various environmental variations, including fatigue, cold work, and temperature impacts, and dynamic impacts; basic design philosophy of Load and Resistance Factored Design (LRFD) and its theoretical background; design methods and code provisions on steel tension members, connections of bolts and weld, steel compression members, and steel columns in steel frame system; and basic practice of design of various steel structures.

CIV 370 (3) Water Resources Engineering. Prerequisites: CIV 330 and CIVL 330.This course is designed to review the fundamentals and practices of water resources engineering. Students will explore water resources engineering processes in the theoretical and applied realm in the fields of closed conduit (pipe) flow, open channel flow, surface water hydrology, and groundwater flow. Application of probability and statistical concepts along with the legal, economic and environmental considerations to the analysis and design of complex hydraulic and hydrologic systems will prepare interested students for future careers in water supply, wastewater, floodplain, storm water, and groundwater management.

CIV 380 (3) Introduction to Geotechnical Enineering. Prerequisites: EN 240, and CIV 330. Co-requisite: CIVL 380. Engineering soil classification, flow of water in soils, soil permeability and seepage, concepts of effective stress, stress and compressibility of soils, primary and secondary consolidation settlement, time rate of settlement, soil compaction, soil shear strength, introduction to slope stability, critical thinking and engineering judgment.

CIVL 380 (1) Geotech. Engrg. Laboratory. Co-requisite: CIV 380. Laboratory experiments to be performed by students to obtain soil parameters required for designed problems. Engineering classification of soils, grain size distribution, Atterberg limits, specific gravity, unconfined compression, compaction, in-situ field tests, consolidation, and shear strength determination, applications to design problems, critically analyze and interpret data, report writing.

CIV 390 (3) Introduction to Transportation Engineering. Co-requisite: CIV 380. Introduction to planning practice and procedure, design, operation, management, and maintenance of transportation systems, with emphasis on urban issues. General characteristics of transportation engineering systems including streets, highways, transit, airways. Capacity considerations including time-space diagrams. Elementary dynamics of traffic and functional consideration of routes and terminals. Components of transportation engineering facility design including geometric design, earthwork, and pavements.

CIV 410 (3) Capstone Design I. Prerequisite: CIV 340, CIV 360, CIV 390 and senior Standing in Civil Engineering. Group projects for senior students to work in teams to analyze and design civil engineering systems, and to consider various factors for design. Understanding of multi-disciplinary systems, interaction between design and construction professionals, realistic design constraints, economical issues, professional practice issues including importance of professional licensure and continuing education, contemporary issues, procurement of work, bidding vs. quality based selection processes, engineering professionalism and ethics. Developing teamwork and leadership skills. Oral presentation and written report is required.

CIV 411W (3) Capstone Design II. Prerequisite: CIV 411. Continuation of Capstone Design I. Group projects for senior students to work in teams to analyze and design civil engineering systems, and to consider various factors for design. Understanding of multi-disciplinary systems, interaction between design and construction professionals, realistic design constraints, economical issues, professional practice issues including importance of professional licensure and continuing education, contemporary issues, procurement of work, bidding vs. quality based selection processes, engineering professionalism and ethics. Developing teamwork and leadership skills. Oral presentation and written report is required.

CIV 420 (3) Design of Concrete Structures. Prerequisites: CIV 320. The course topics include behaviors of reinforced concrete structural elements under different conditions; design criterions of Load and Resistance Factored Design (LRFD) for strength and serviceability of concrete structures; design method and code provisions on reinforced concrete members subjected to bending, shear, combination of shear and torsion, and combination of axial compression and bending moment; development length of reinforcement in concrete, design method and code provisions on columns in concrete frame systems; basic practice of design and construction of various concrete structures; and introduction to project management.

CIVL 421 (1) Structural Engineering and Materials Testing Lab. Prerequisite EN 240. Engineering properties and behavior of concrete and other structural members. Test of a small-scale model structures. Use of computer-based data acquisition and interpretation systems for comparison of experimental and theoretically predicted behavior; nondestructive testing, critically analyze and interpret data, report writing.

CIV 430 (3) Foundation Engineerin. Prerequisite: CIV 380. Shallow foundation analysis and factors to consider for design, subsurface investigations for design, bearing capacity and settlement, mat foundations, piles, caissons, lateral earth pressures and retaining walls, site improvement techniques, design of sheet pile walls and support systems, critical thinking and engineering judgment, ethical considerations.

CIV 431 (3) Traffic Engineering. Prerequisite: CIV 390. Study of fundamentals of traffic engineering; analysis of traffic stream characteristics, capacity of urban and rural highways; design and analysis of traffic signals and intersection; traffic control; traffic impact studies; and traffic accidents.

CIV 441 (3) Water and Wastewater Treatment Processes. Prerequisites: CHEM 141, CHML 141, CIV 340, CIVL 340. Theories, engineering principles, and design of modern water supply and wastewater treatment processes. Physical-chemical processes including screening, sedimentation, aeration, coagulation, flocculation, filtration, absorption, softening, and disinfection. Biological processes including activated sludge process and anaerobic processes for wastewater and sludge digestion, with emphasis on urban issues. Completion of a design project.

CIV 451 (3) Computer Methods in Civil Engineering. Prerequisites: EN 105, MATH 368, and departmental approval. Fundamentals of analog and digital computers. Organization of problems for computational solution, flow charts, programming, simulation of nonlinear physical systems for application in engineering design, numerical methods in civil engineering. Case studies in civil engineering.

CIV 460 (3) Design of Environmental Engineering Facilities. Prerequisites: CIV 330, CIV 340 and CIVL 340. Analysis and design considerations for environmental engineering facilities such as water and wastewater treatment plants; physical engineering management of solid and hazardous waste, design constraints, resources recovery; biological processes; economical, ethical, societal and other professional considerations, urban issues, completion of a major design project.

CIV 461 (1) Professional & Ethical Issues in Civil Engineering. Prerequisites: senior standing in civil engineering. The task of this course is to reflect on the professional and ethical responsibilities of engineers, which can sometimes conflict with technical responsibilities. This course will articulate an ethical framework for engineers by critically reflecting on engineering practice and examining the ethical challenges that confront engineers working within teams and organizations. The course covers issues such as the social responsibility of engineers, attitudes, truth-telling and disclosure, whistle-blowing, contemporary issues, risk-assessment, and the importance of professional licensure.

CIV 465 (3) Advanced Water Resources Engineering. Prerequisite: CIV 370. Advanced engineering hydrology, advanced hydraulic structures, hydraulic similitude and modeling, wave action, flow over spillways, optimization of water resources systems, design constraints, introduction to GIS applications to water resources engineering, completion of a major design project.

CIV 466 (3) Advanced Design of Hydraulic Structures. Prerequisite: CIV 370. Analysis and characteristics of flow in open channels (natural and artificial); channel design considerations including uniform flow (rivers, sewers), flow measuring devices (weirs, flumes), gradually varied flow (backwater and other flow profiles, flood routing), rapidly varied flow (hydraulic jump, spillways), and channel design problems (geometric considerations, scour, channel stabilization, sediment transport); analysis and design of hydraulic structures such as dams, spillways etc. based on economic, environmental, ethical, political, societal, health, urban issues, and safety considerations.

CIV 468 (3) Hazardous Waste Engineering. Prerequisite: CHEM 241, CHML 241, CIV 340, CIVL 340. Comprehensive study of the complex, interdisciplinary engineering principles involved in hazardous waste handling, collection, transportation, treatment, and disposal. Also covered are waste minimization, site remediation, and regulations important for engineering

applications. Design constraints, engineering judgment, and ethical responsibility are covered. Contemporary hazardous waste issues and urban issues are also addressed.

CIV 470 (3) Urban Transportation Engrg System Design. Prerequisite: CIV 310, CIVL 311, CIV 390. Advanced design of highway systems, vehicle and driver characteristics, highway capacity, design of urban streets and expressways. Design constraints. Individual and team design projects oriented toward the solution of local urban transportation problems, societal and economical considerations.

CIV 471 (3) Principles of Geoenvironmental Engineering. Prerequisite: CIV 380.
Topics in geoenvironmental engineering in an urban environment. landfill design and incineration options. Stability of landfills, geotechnical characteristics of landfills, liner systems. Waste characterization, minimization, collection, treatment, transport and disposal. Leachate characteristics and potential groundwater contamination, design constraints. Legal and ethical considerations.

CIV 472 (3) Applied Geotechnical Engineering Design. Pre or co-requisite: CIV 430. Practical real life urban projects and advanced laboratory experience in geotechnical engineering, construction dewatering, construction issues, safety and economy, urban geotechnical engineering issues, preparation of subsurface investigation and geotechnical engineering reports, ethical considerations, oral presentation.

CIV 475 (3) Pavement Design. Prerequisite: CIV 380 and CIV 390. Aggregate, binder systems. Theory and design of pavement structures, rigid and flexible pavement design, subgrade materials, pavement management, nondestructive testing, pavement maintenance, design constraints, infrastructure maintenance, major design project.

CIV 476 (3) Advanced Design of Steel Structures. Prerequisite: CIV 360. Behavior and design of members subjected to fatigue, dynamic, combined loading. Methods of allowable design stress, and load resistance factor design. Design of continues beams, plate girders, composite beams, open-web joists, connections, torsion and plastic analysis and design. Framing systems and loads for industrial buildings and bridges, design constraints and a major design project.

CIV 477 (3) Advanced Design of Concrete Structures. Prerequisite: CIV 420. Theory and design of reinforced concrete continuous beams, slender columns, two-way-slabs, footings, retaining walls, shear walls and multi-story buildings. Design for torsion and design constraints. Framing systems and loads for buildings and bridges, design constraints and a major design project.

CIV 478 (3) Design of Wood and Masonry Structures. Prerequisite: CIV 420. Engineering Properties and behavior of wood for analysis and design of wood beams, walls and diaphragms. Engineering properties and behavior of masonry for analysis and design of masonry walls, columns and shear walls. Framing systems and loads for multi-story buildings, design constraints and a major design project.

CIV 479 (3) Evaluation, Maintenance, and Rehabilitation of Public Works Infrastructure. Prerequisites: CIV 390, CIV 475. Evaluation, maintenance, and rehabilitation of deteriorated infrastructure systems by considering life cycle costs and long-term performance. Understanding rehabilitation alternatives in the practical field and designing rehabilitation schemes based on the non-destructive testing methods and economical considerations.

CIV 481 (3) Special Problems in Civil Engineering. Prerequisite: Departmental Approval. Individual investigation in a recognized major area of civil engineering of particular interest to the students that is not normally covered in regular courses. May include a co-op project.

CIV 491 (1-3) Internships in Civil Engineering I. Prerequisites: Junior or senior standing. Students work as interns with engineering firms or research laboratories to receive career-related training under the supervision of qualified engineers. The projects and tasks for the internship must be approved by both the work supervisor and the departmental instructor. Progress reports and final report in both writing and oral presentation are required. A minimum of 50 hours per credit is required.

CIV 492 (1-3) Internships in Civil Engineering II. Prerequisite: CIV 491. Continuation of the internship projects or tasks that the students conducted in the previous CIV 481 course and need more time to finish, or start of the second internship with engineering firms or research laboratories. The projects and tasks for the internship must be approved by both the work supervisor and the departmental instructor. Progress reports and final report in both writing and oral presentation are required. A minimum of 50 hours per credit is required.

Difference between General Civil Engineering and Environmental Engineering Concentrations

The curricula for the two concentrations are very similar to each other. For the Environmental concentration, two additional chemistry courses (CHEM 142 CHML 142 and CHEM 241, CHML 241) are required, and General Physics II (PHY 212 and PHYL 212) is not a required course. The environmental concentration requires two civil engineering electives be chosen from CIV 441, CIV 460, CIV 468, or CIV 471. These are summarized below.

Course No.	**Course Name**	**No. of Credits Include in General Civil Eng. Concentration**	**No. of Credits Included in Environ. Eng. Concentration**
PHY 212 & PHYL 212	General Physics II & Lab (5 Credits)	5	
CHEM 142 & CHML 142	General Chemistry II & Lab (4 Credits)		4
CHEM 241 & CHML 241	Organic Chemistry I & Lab (4 Credits)		4
CIV Electives	Civil Engineering Electives (9 or 12 Credits)[a], See below.	12	9
Total No. of Credits		17	17

[a]See the technical electives requirements for each concentration.

GENERAL CIVIL ENGINEERING CONCENTRATION TECHNICAL ELECTIVES REQUIREMENTS

At least one civil engineering elective must be chosen from CIV 441 or CIV 460. At least one civil engineering elective must be chosen from CIV 431, CIV 470, CIV 475 or CIV 479. The selection of other courses requires the approval of the adviser and Dept. Chair.

ENVIRONMENTAL ENGINEERING CONCENTRATION TECHNICAL ELECTIVES REQUIREMENTS

At least two civil engineering electives must be chosen from CIV 441, CIV 460, CIV 468, or CIV 471. At least one civil engineering elective must be chosen from CIV 431, CIV 470, CIV 475 or CIV 479. The selection of other courses requires the approval of the adviser and Dept. Chair.
The students are required to contact their advisers or Department Chair prior to taking any civil engineering elective.