

# B.S. CIVIL ENGINEERING

## Plan of Study

Year 1	<b>Fall</b>		<b>Spring</b>
	FYEX Foundation for College Success		
	ENGR 100 Introduction to Engineering Design + ENGR 162 Intro to Eng. Graphics (3 Cr.)		DASC 120 Statistics I (Lab)
	MATH 113 Calculus I		MATH 114 Calculus II
	GEOL 163 Applied Geology (Lab)		PHYS 211 Classical Physics I
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>
CORE requirement			
Year 2	<b>Fall</b>		<b>Spring</b>
	ENGR 160 Surveying (2 Cr.)		
	ENGR 220 Statics		ENGR 221 Mechanics of Materials (Lab)
	MATH 210 Introduction to Differential Equations & Systems		SCI/MATH Elective (4 Cr.)
	CHEM 109 General Chemistry for Engineers (Lab) –OR– CHEM 111 General Chemistry I (Lab)		ENGR 368 Fluids Mechanics for Civil Engineering (Lab)
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>
CORE requirement			
Year 3	<b>Fall</b>		<b>Spring</b>
	ENGR 362 Construction & Engineering Economic Analysis (Lab)		CIVIL Major Course
	CIVIL Major Course		CIVIL Major Course
	CIVIL Major Course		CIVIL Major Course
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>
	CORE requirement		
Year 4	<b>Fall</b>		<b>Spring</b>
	CIVIL Major Course		CIVIL Major Course
	CIVIL Elective Course		CIVIL Elective Course (Optional)
	ENGR 480 Design Clinic I		ENGR 481 Design Clinic II
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>


**Note 1:** See Complete Course Listing for list of CIVIL Major and Elective classes, and Science/Math Electives

**Note 2:** Some CIVIL Major Courses are only offered once per year – see below for details and suggested Year 3 and Year 4 course sequences

**Note 3:** CIVIL Elective courses are announced during the Spring semester (prior to Registration) for the following year

### Complete Curriculum (138 credits)

<p><b>Engineering Major Requirements (61 credits):</b>  <u>Core Engineering Courses (29 credits):</u>                      ENGR 100 Introduction to Engineering Design (2 credits)                      ENGR 160 Surveying (2 credit) [FALL ONLY]                      ENGR 162 Introduction to Engineering Graphics (1 credit) [FALL ONLY]                      ENGR 220 Statics (4 credits)                      ENGR 221 Mechanics of Materials (4 credits)                      ENGR 362 Constr. and Engin. Econ Analysis (4 credits) [FALL ONLY]                      ENGR 368 Fluid Mechanics for Civil Engineering (4 credits)                      ENGR 480 Engineering Design Clinic 1 (4 credits)                      ENGR 481 Engineering Design Clinic II (4 credits) [WID]  <u>Civil Major Courses (28 Credits):</u>                      ENGR 363 Construction Materials (4 credits)                      ENGR 364 Structural Analysis (4 credits)                      ENGR 366 Soil Mechanics (4 credits)                      ENGR 464 Design of Steel and Concrete Structures (4 credits)                      ENGR 466 Transportation Engineering (4 credits) [SPRING ONLY]                      ENGR 467 Water Resources (4 credits) [SPRING ONLY]                      ENGR 468 Env. Engineering (4 credits) [SUST, WTL] [FALL ONLY]  <u>Civil Elective Courses (4 Credits):</u>                      ENGR 381 Thermodynamics                      ENGR 457 Applied Soil Mechanics                      ENGR 458 Transportation Facilities                      ENGR 461 Timber Design                      ENGR 462 Prestressed Concrete Design                      ENGR 471 Design of Steel Structures II                      ENGR 472 Design of RC Structures II                      ENGR 473 Water Treatment (2 credits)                      ENGR 479 Wastewater Treatment (2 credits)</p>	<p><b>Allied Requirements (32 credits):</b>  <u>Core Allied Courses (28 credits):</u>                      MATH 113 Calculus I (4 credits)                      MATH 114 Calculus II (4 credits)                      MATH 210 Introduction to Differential Eqns. and Systems (4 credits)                      PHYS 211 Classical Physics I (4 credits)                      GEOL 163 Applied Geology (4 credits)                      DASC 120 Statistics I (4 credits)                      One of:                          CHEM 109 General Chemistry for Engineers (4 credits)                          CHEM 111 General Chemistry I (4 credits)  <u>Science/Math Elective Courses (4 credits):</u>                      MATH 200 Multi-Variable Calculus                      MATH 230 Intro to Applied Math                      DASC 240 Applied Regression Analysis                      CHEM 112 General Chemistry II                      GEOL 210 Soils, Science, and Society (2 Cr.)                      GEOL 211 Environmental Earth Materials (2 cr.)                      GEOL 296 Soils, Science, and Society (2 cr.)                      BIOL 209 Biology of Sustainability                      PHYS 212 Classical Physics II                      GEOL 410 Hydrogeology</p> <p><b>University of St. Thomas Core Curriculum (45 credits):</b>                      FYEX Foundation for College Success (1 credit)                      Language and Culture (0-8 credits)                      Literature and Writing (4 credits)                      Philosophy and Theology (12 credits)                      Social Analysis (4 credits)                      Fine Arts (4 credits)                      Historical Studies (4 credits)                      Integrations in the Humanities (8 credits)  <i>Some of these courses must satisfy the flagged requirements; check your degree evaluation</i></p>
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<b>EMPHASIS IN STRUCTURAL ENGINEERING</b>			
<b>Year 3</b>	<b>Fall</b>		<b>Spring</b>
	ENGR 362 Construction & Engineering Economic Analysis (Lab)*		ENGR 366 Soil Mechanics (Lab)
	ENGR 363 Construction Materials (Lab)		ENGR 464 Design of Steel and Concrete Structures (Lab)
	ENGR 364 Structural Analysis		ENGR 466 Transportation Engineering*
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>
CORE requirement			
<b>Year 4</b>	<b>Fall</b>		<b>Spring</b>
	ENGR 468 Environmental Engineering (Lab)*		ENGR 467 Water Resources*
	CIVIL Elective Course		CIVIL Elective Course
	ENGR 480 Design Clinic I		ENGR 481 Design Clinic II
	CORE requirement		CORE requirement
	<b>January-term</b>		<b>Summer</b>

\* Course offered only in the term shown


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Suggested **Civil** Elective Courses:

- ENGR 461** Timber Design
- ENGR 462** Prestressed Concrete Design
- ENGR 471** Design of Steel Structures II
- ENGR 472** Design of Reinforced Concrete Structures II
- ENGR 457** Applied Soil Mechanics

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EMPHASIS IN WATER RESOURCES OR ENVIRONMENTAL ENGINEERING			
Year 3	Fall		Spring
	ENGR 362 Construction & Engineering Economic Analysis (Lab)*		ENGR 467 Water Resources*
	ENGR 468 Environmental Engineering (Lab)*		ENGR 363 Construction Materials (Lab)
	ENGR 366 Soil Mechanical (Lab)		ENGR 466 Transportation Engineering*
	CORE requirement		CORE requirement
	January-term		Summer
	CORE requirement		
Year 4	Fall		Spring
	ENGR 364 Structural Analysis		ENGR 464 Design of Steel and Concrete Structures (Lab)
	CIVIL Elective Course		CIVIL Elective Course
	ENGR 480 Design Clinic I		ENGR 481 Design Clinic II
	CORE requirement		CORE requirement
	January-term		Summer

\* Course offered only in the term shown

Suggested **Civil** Elective Courses:

**ENGR 381** Thermodynamics


**ENGR 473** Design of Water Treatment Facilities (2 credits)

**ENGR 479** Design of Wastewater Treatment Facilities (2 credits)

**ESCI 310** Environmental Problem Solving → Recommended for students interested in Environmental Engineering but does not satisfy **Civil** Elective Course requirements (4 credits). See also minor in Environmental Engineering.

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EMPHASIS IN TRANSPORTATION, MUNICIPAL, OR GEOTECHNICAL ENGINEERING			
Year 3	Fall		Spring
	ENGR 362 Construction & Engineering Economic Analysis (Lab)*		ENGR 466 Transportation Engineering*
	ENGR 468 Environmental Engineering (Lab)*		ENGR 364 Structural Analysis
	ENGR 363 Construction Materials (Lab)		ENGR 366 Soil Mechanics (Lab)
	CORE requirement		CORE requirement
	January-term		Summer
	CORE requirement		
Year 4	Fall		Spring
	ENGR 464 Design of Steel and Concrete Structures (Lab)		ENGR 467 Water Resources*
	CIVIL Elective Course		CIVIL Elective Course
	ENGR 480 Design Clinic I		ENGR 481 Design Clinic II
	CORE requirement		CORE requirement
	January-term		Summer

\* Course offered only in the term shown

Suggested **Civil** Elective Courses:

**ENGR 457** Applied Soil Mechanics

**ENGR 458** Transportation Facilities

**ENGR 473** Design of Water Treatment Facilities (2 credits)

**ENGR 479** Design of Wastewater Treatment Facilities (2 credits)

### Engineering Course Descriptions

#### **ENGR 100** Introduction to Engineering Design (2 credits)

This course introduces students to the engineering disciplines and the design process through a semester-long design challenge. Students will gain improved self-awareness, empathy, and critical thinking skills; this will help them work as a team in a collaborative and inclusive environment to identify a need, interview clients, plan tasks and propose engineering solutions with consideration for the common good.

#### **ENGR 160** Surveying (2 credits)

Introduction to differential leveling, coordinates systems, horizontal and vertical control networks, closure adjustments, area computations and earthwork volume computations. Concurrent registration with ENGR 162 required, except as approved by Department Chair.

#### **ENGR 162** Introduction to Engineering Graphics (1 credit)

This course covers graphical communication, computer-aided design for civil engineering applications, principles of projection and project design process for civil engineering applications. Concurrent registration with ENGR 160 required, except as approved by Department Chair.

#### **ENGR 220** Statics (4 credits)

Principles of statics including such topics as rigid bodies, equilibrium, equivalent systems of forces, 2D structures, distributed forces, centroids and centers of gravity, moments of inertia, friction, forces in beams & cables, and the principle of virtual work. Emphasis on applications with integrated labs/hands-on projects. Prerequisites: A minimum grade of C- in PHYS 211 and a processed Engineering (Electrical, Computer, Civil, Mechanical) or Physics major or minor declaration.

#### **ENGR 221** Mechanics of Materials (4 credits)

Principles of deformable body mechanics including stress, strain, basic loading situations, transformations of stress and strain, beam theory, and energy methods. Emphasis on applications with integrated labs/hands-on projects. Prerequisite: A minimum grade of C- in ENGR 220

#### **ENGR 362** Construction and Engineering Economic Analysis (4 credits)

Introduction to construction processes including construction planning, equipment, delivery methods, contract documents, procurement, construction methods, scheduling, critical path method, project management, estimating and safety. Construction of buildings, and transportation infrastructure including bridges, roads, rail and highways. Principles of engineering economy including cash flow analysis, cost, analysis and uncertainty. Prerequisites: A minimum grade of C- in MATH 113. ECON 251 recommended.

#### **ENGR 363** Construction Materials (4 credits)

Introduction to construction materials commonly used in civil engineering projects, including aggregates, asphalt, concrete, fiber reinforced polymers, masonry, metals, and wood. For each material, topics will include material properties, specifications, laboratory procedures, and test equipment, with an emphasis on ASTM standards. Introduction to asphalt and concrete mix design. Prerequisites: A minimum grade of C- in ENGR 221, DASC 120, and CHEM 109 or CHEM 111.

#### **ENGR 364** Structural Analysis (4 credits)

Identification of loads and load paths through a structure. Analysis of internal loading, stress and deflection in trusses, beams and frames. Topics include shear and moment diagrams, influence lines, and determination of deflection through energy methods. Prerequisite: A minimum grade of C- in ENGR 221 and MATH 210.

#### **ENGR 366** Soil Mechanics (Lab) (4 credits)

Principles of soil mechanics and geotechnical engineering. Physical and mechanical properties of soils including, shear strength of soil, slope stability, soil stabilization, compaction, consolidation and stress analysis. Role of water in soils including permeability, drainage, and Atterberg limits. Theories related to and design of retaining structures. Design of retaining walls, footings, mat

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foundations and pile foundations. Engineering design will adhere to professional practice, current codes/standards, considerations for economics and safety. Prerequisites: A minimum grade of C- in ENGR 221.

### **ENGR 368** Fluid Mechanics for Civil Engineering (4 credits)

Introduction to the fundamentals of fluid mechanics in the context of civil engineering applications. Topics covered include hydrostatics and pressure variations in non-moving fluids, forces on submerged surfaces, conservation laws of flowing fluids (mass, momentum, and energy), potential flow and viscous flow, boundary layer theory, internal flow, external flow, open channel flow, drag and experimental uncertainty analysis. Hands-on engagement of lecture topics, practical hands-on skills, experimental design and measurement uncertainty analysis is integrated into course laboratory. Prerequisite: A minimum grade of C- in MATH 210 and CHEM 109 or CHEM 111.

### **ENGR 464** Design of Steel and Concrete Structures (4 credits)

Introduction to the design of steel structures; behavior of tension, compression, bending and combined force members and their connections; theoretical, experimental, and practical bases for proportioning members and their connections. Study of the strength, behavior, and design of reinforced concrete members subjected to axial forces, shear forces and moment forces. Prerequisite: A minimum grade of C- in ENGR 363 and ENGR 364.

### **ENGR 466** Transportation Engineering (4 credits)

Introduction to design of transportation systems. Principles of geometric roadway design, traffic modeling and forecasting, traffic signal operation and timing. Land use, social issues, and planning for multi-modal transportation systems. Alternative transportation modes including bike, pedestrian, and mass transit. Basics of pavement design. Prerequisite: A minimum grade of C- in ENGR 160, ENGR 221, and DASC 120.

### **ENGR 467** Water Resources (4 credits)

Introduction to water resources engineering including analysis and design of hydraulic systems and hydrological assessment. Hydrological cycle, analysis and urban hydrology. Design elements of pipe and channel flow including groundwater flow, distribution systems, pumping systems, reservoirs and storm sewer collection systems. Prerequisites: A minimum grade of C- in ENGR 368.

### **ENGR 468** Environmental Engineering (4 credits)

Introduction to environmental engineering including assessment of the sources, measuring techniques, and treatment methods for pollution caused by human influence. Topics include introduction to environmental chemistry and mass balances, design of water and wastewater systems, air pollution, and solid waste management. Prerequisite: A minimum grade of C- in CHEM 109 or Chem 111.

### **ENGR 480** Engineering Design Clinic 1 (4 credits)

Serves as the first capstone course. Student design teams, under the direction of a faculty coordinator, will develop engineering solutions to practical, open-ended design projects conceived to demonstrate the value of prior basic science and engineering courses. Ethical, social, economic and safety issues in engineering practice will be considered as well. Prerequisites: Either (ENGR 362 and (2) of: ENGR 464, ENGR 466, ENGR 467, or ENGR 468) or (ENGR 320, 350, 371, and 381) or (ENGR 331, 346, and 410) or (CISC 231, ENGR 345, and concurrent registration in or prior completion of ENGR 431)

### **ENGR 481** Engineering Design Clinic II (4 credits)

A continuation of ENGR 480 involving the application of engineering principles to the solution of real problems in an actual industrial setting. Student design teams will work under the direction of faculty advisers and industry liaisons. Opportunity will be provided for objective formulation, analysis, synthesis and evaluation of alternative solutions. Prerequisite: ENGR 480

## **Approved Civil Engineering Electives**

### **ENGR 381** Thermodynamics (4 credits)

A study of thermal and mechanical energy and their applications to technology. First law of thermodynamics (energy conservation); second law of thermodynamics (restrictions on energy transformations). Major topics include the analysis of closed and open (steady state and transient) systems, power cycles, thermophysical properties of substances humidity, dew point and other characteristics of non-reacting mixtures. Prerequisites: A minimum grade of C- in CHEM 115 or 109

### **ENGR 457** Applied Soil Mechanics

This course covers the practical aspects of geotechnical engineering. Students apply concepts learned in ENGR 365 to analyze retaining walls, slopes, and excavations while considering the construction process. This course goes into detail on earth fills, excavations, soil compaction and ground improvement, stability of natural slopes and embankments; earth-pressure theories; design of earth retaining structures. Prerequisite: C- or better in ENGR 366.

### **ENGR 458** Transportation Facilities

This course covers analysis, behavior, performance, and structural design of pavements for highways, airfields, and railroads; pavement construction, maintenance, and rehabilitation. Prerequisite: C- or better in ENGR 221.

### **ENGR 461** Timber Design (4 credits)

Analysis and design of timber structures; behavior of tension, compression, bending and combined force members and their connections. Theoretical, experimental, and practical bases for proportioning members and their connections. Design for lateral forces including diaphragm and braced wall construction. cursory discussion of special topics including braced wall design and mass timber construction. Prerequisite: A minimum grade of C- in ENGR 221.

### **ENGR 462** Prestressed Concrete Design (4 credits)

Introduction to design of prestressed and post-tensioned concrete structures, including prestressing theory, materials, design for flexure and shear, prestress losses, and composite action. Prerequisite: A minimum grade of C- in ENGR 464.

### **ENGR 471** Design of Steel Structures II

Advanced topics in the design of steel structures; behavior of members subject to combined forces, composite members, built up members, advanced connection design, and stability. Theoretical, experimental, and practical bases for proportioning members and their connections. Prerequisite: A minimum grade of C- in ENGR 464.

### **ENGR 472** Design of RC Structures II

Advanced topics in reinforced concrete design, including torsion, biaxial bending in columns, slender columns, two-way floor systems, strut and tie. Prerequisite: A minimum grade of C- in ENGR 464.

### **ENGR 473** Water Treatment (2 credits)

This course is designed to introduce students to process design and water treatment, including concepts, simple models, and sizing/design. Topics will also include sustainable water sourcing and design of pumps and pipes. The course will be split between learning about water treatment processes and working on case studies relevant to local treatment plants. Prerequisite: A minimum grade of C- in ENGR 468.

### **ENGR 479** Wastewater Treatment (2 credits)

This course is designed to introduce students to wastewater treatment, including biological (secondary) wastewater treatment and industrial wastewater treatment topics. The course will be about split between learning about wastewater treatment processes and working on case studies relevant to local facilities. A course project will involve building a process model of a wastewater treatment plant and using it to design and troubleshoot the system. Prerequisite: A minimum grade of C- in ENGR 468.