

Highlights of the Undergraduate Curriculum

at

Civil and Environmental Engineering Department

King Fahd University of Petroleum & Minerals

Prepared By: CE Undergraduate Committee

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Version: 1.3

Latest Changes to the document:

- Number Change : MATH 260 is assigned a new course number MATH 208
- Replacement : Change the pre-requisite of CE 318, from MATH 260, to MATH 208
- Number Change: MATH 480 is assigned a new course number MATH 474.
- Dropped: In the Technical Elective List: MATH 301 is now cancelled

Note: This document is supposed to be accurate at the time of its preparation. All readers are expected to confirm and check, when necessary, if there have been any recent changes and modifications.

1- Introduction

The Civil & Environmental Engineering Department at KFUPM offers two undergraduate programs/degrees; the ***Civil Engineering Program*** (CE) and the ***Applied Civil Engineering Program*** (ACE). The four-year undergraduate curriculum provides basic knowledge in sciences, mathematics, and engineering in the first two years. After that, students are required to choose one of the three options within the program (e.g. *Structural/Materials*, *Geotechnical/Transportation*, or *Water/Environmental Engineering*). Certain civil engineering core and elective courses are required from students in each of the different options. During the third year, the student is introduced to different fields in civil engineering with the emphasis on applications and design. After the completion of his third year, the student undertakes an 8-week summer training program in industry (in CE Curriculum) or a 28-week COOP training (in ACE Curriculum). Appropriate electives are also offered to further enhance the student's knowledge in one or more of the areas of civil engineering. In addition, courses in humanities, social sciences and economics are integrated into the program to broaden the student's knowledge.

The Civil & Environmental Engineering undergraduate curriculum is accredited by the Accreditation Board of Engineering and Technology (ABET) in the USA. The department undertakes periodic assessments of its program and course learning outcomes for the continuous improvement of teaching and learning, and to ensure that the educational objectives are met.

2- Vision

The vision of the Department of Civil & Environmental Engineering is to establish itself as a leading center of Civil Engineering education by supporting academic distinction and seeking excellence in teaching, learning, research and public services in partnership with the University.

3- Mission

The mission of the Department of Civil & Environmental Engineering is to maintain a preeminent role in teaching and research by pursuing a policy of rapid adaptation to new knowledge, discoveries, technological advances and emerging economics and to serve the public through the dissemination of knowledge and information. The department seeks to provide an environment of learning within which creative thinking, practical skills and self development are cultivated and sustained to produce qualified Civil Engineers who will challenge the present and enrich the future.

4- Strategic Goals

The strategic goals set by the department to achieve the vision and mission are:

- To seek continual improvement of the teaching environment and academic programs through an arduous self-evaluation as well as extramural evaluation by peers to provide an education reflective of the essential knowledge, professional competence and skills required of the graduates for successful careers in the Civil Engineering profession.
- To readily adopt and apply advances in educational technologies to improve teaching and learning environment.
- To make the student community more motivated and responsive to learning and to instill a greater sense of responsibility and accomplishment among the students and to foster personal growth and lifelong learning.

5- Program Educational Objectives

The program aims to prepare graduates who, after few years of their career, will have:

1. Successfully established themselves as practicing civil engineers
2. Demonstrated in their profession the ability to work as responsible members of a professional team and take leadership roles
3. Pursued professional career development activities to acquire new knowledge and skills.

6- Student Outcomes

The eleven student outcomes are:

- (a) Students shall have an ability to apply knowledge of mathematics, science, and engineering to engineering problems.
- (b) Students shall have an ability to design and conduct experiments, as well as analyze and interpret data.
- (c) Students shall have an ability to design a system, component, or process to meet desired needs within constraints.
- (d) Students shall have an ability to function on multi-disciplinary teams.
- (e) Students shall have an ability to identify, formulate, and solve engineering problems.
- (f) Students shall have an understanding of professional and ethical responsibility.
- (g) Students shall have an ability to communicate effectively.

- (h) Students shall have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- (i) Students shall have a recognition of the need for, and an ability to engage in lifelong learning.
- (j) Students shall have a knowledge of contemporary issues.
- (k) Students shall have an ability to use techniques, skills, and modern engineering tools including computational tools necessary for engineering practice.

7- Program Details

Details of the CE & ACE programs are given in the following charts and tables.

Requirements for the B.S. Degree in Civil Engineering (CE)

Every student majoring in Civil Engineering (CE) must complete the following curriculum:

(a) General Education Requirements (69 credit hours)		Credit Hours
English	ENGL 101, 102, 214	9
Computer Skill	ICS 103	3
Interdisciplinary Basic Courses	ME 201, 203, EE 204	9
Mathematics	MATH 101, 102, 201, 208	14
Sciences	PHYS 101, 102, CHEM 101, 111	14
Islamic and Arabic Studies	IAS 101, 111, 201, 212, 301, 322	12
Physical Education	PE 101, 102	2
Others	ISE 307, MGT 301	6
		69

(b) Core Requirements (43 credit hours)		
Computer Graphics	CE 215	3
Surveying	CE 261	2
Mechanics and Structures	CE 201, 203, 305	9
Materials	CE 303	4
Geotechnical	CE 353	4
Transportation	CE 341, 343	4
Fluid Mechanics and Environmental Engineering	CE 230, 330	6
Introduction to CE Design	CE 312	1
Numerical and Statistical Methods in CE	CE 318	3
Construction Methods and Management	CE 421	3
Senior Design Project	CE 410, 412	3
CE Seminar	CE 490	1
		43

(c) Electives (21 credit hours)		
CE Electives	Two CE xxx Courses	6
CE Option Electives (from chosen option)	CE xxx, CE 4xx	6
Additional Science XXX xxx	GEOL 201 or BIOL 233	3
General Studies	GS 3xx	3
Technical Elective (from approved list)	XE xxx	3
		21

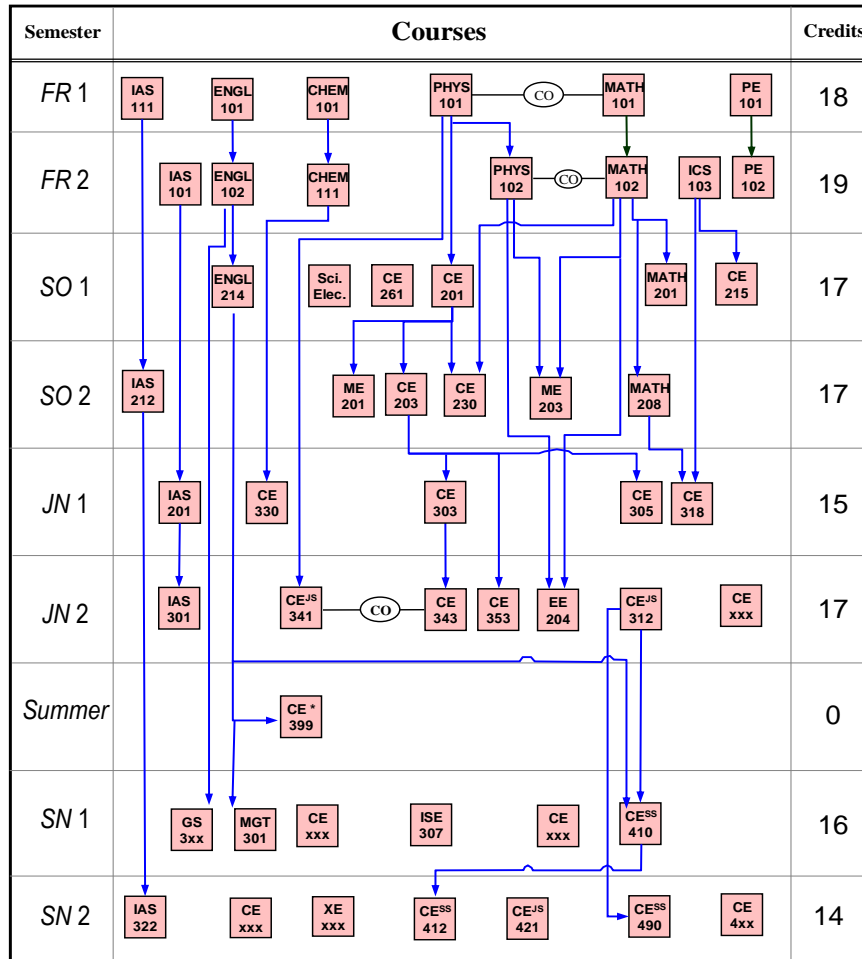
(d) Summer Training (0 credit hours)		
A minimum of 8-week program to gain experience; submit and present a report.		
Summer Training	CE 399	0
		0

The total number of credit hours required is **133**

COURSE	TITLE	LT	LB	CR	COURSE	TITLE	LT	LB	CR	
Preparatory Year										
ENGL 01-xx	Prep. English I (First Quarter)	15	5	4	ENGL 03-xx	Prep. English III (Third Quarter)	15	5	4	
ENGL 02-xx	Prep. English II (Second Quarter)			4	ENGL 04-xx	Prep. English IV (Fourth Quarter)			4	
MATH 001	Prep. Math I	3	1	4	MATH 002	Prep. Math II	3	1	4	
PYP 001	Prep. Physical Science	2	0	2	PYP 002	Prep. Computer Science	0	2	1	
PYP 003	Life Skills	0	2	1	PYP 004	Prep. Eng. Technology	0	2	1	
PE 001	Prep. Health and Physical Educ. I	0	2	1	PE 002	Prep. Health and Physical Educ. II	0	2	1	
		20	10	16				18	12	15
Total credit hours required in Preparatory Program: 31										
First Year (Freshman)										
CHEM 101	General Chemistry I	3	4	4	CHEM 111	Basics of Environmental Chemistry	2	0	2	
ENGL 101	Intro. to Academic Discourse	3	0	3	PHYS 102	General Physics II	3	3	4	
IAS 111	Belief and its Effects	2	0	2	MATH 102	Calculus II	4	0	4	
MATH 101	Calculus I	4	0	4	ENGL 102	Intro. to Report Writing	3	0	3	
PE 101	Health and Physical Educ. I	0	2	1	IAS 101	Practical Grammar	2	0	2	
PHYS 101	General Physics I	3	3	4	PE 102	Health and Physical Educ. II	0	2	1	
					ICS 103	Computer Programming in C	2	3	3	
		15	9	18				16	8	19
Second Year (Sophomore)										
CE 201	Statics	3	0	3	CE 203	Structural Mechanics I	3	0	3	
CE 215	Computer Graphics	2	3	3	CE 230	Eng. Fluid Mechanics	3	0	3	
CE 261	Surveying I	1	3	2	MATH 208	Intro. to Differential Eq. & Linear Algebra	3	0	3	
ENGL 214	Academic & Professional Comm.	3	0	3	ME 201	Dynamics	3	0	3	
MATH 201	Calculus III	3	0	3	IAS 212	Professional Ethics	2	0	2	
XXX xxx	Science Elective	3	0	3	ME 203	Thermodynamics I	3	0	3	
		15	6	17				17	0	17
Third Year (Junior)										
CE 303	Structural Materials	3	3	4	CE 312	Intro. to CE Design	1	0	1	
CE 305	Structural Analysis I	3	0	3	CE 341	Transportation Eng.	3	0	3	
CE 318	Numerical & Statistical Methods in CE	2	3	3	CE 343	Transportation Eng. Laboratory	0	3	1	
IAS 201	Objective Writing	2	0	2	CE 353	Geotechnical Eng. I	3	3	4	
CE 330	Environmental Eng. Principles	3	0	3	IAS 301	Language Comm. Skills	2	0	2	
					CE xxx	CE Elective I	3	0	3	
					EE 204	Fundamentals of Electrical Circuits	2	3	3	
		13	6	15				14	9	17
Summer Session					CE 399	Summer Training	0	0	0	
Fourth Year (Senior)										
CE xxx	CE Elective II	3	0	3	CE 412	Senior Design Project	0	6	2	
CE xxx	Option Elective I	3	0	3	CE 421	Construction Methods and Management	3	0	3	
ISE 307	Eng. Economics Analysis	3	0	3	CE 4xx	Option Elective II	3	0	3	
GS 3XX	GS Elective	3	0	3	XE xxx	Technical Elective	3	0	3	
MGT 301	Principles of Management	3	0	3	IAS 322	Human Rights in Islam	2	0	2	
CE 410	Senior Design Project Preparation	0	3	1	CE 490	Civil Eng. Seminar	1	0	1	
		15	3	16				12	6	14
Total credit hours required in Degree Program : 133										

The chart below is intended only to give an overview of course flow in the program. It is NOT an official reference for pre-requisites to courses. Official pre-requisites to any CE or non-CE course should be obtained from the official course description of each course.

Flow Chart for the Civil Engineering (CE) program



Total Credits Required in Degree Program

LEGEND:

GS 3xx General Studies Elective
 CE xxx Civil Engineering Elective
 XE xxx Technical Elective
 Sci. Elec. Geol 201 or Biol 233

(CO)

Co-requisite
 JS Junior standing
 SS Senior standing
 * Summer Training Program

Requirements for the B.S. Degree in Applied Civil Engineering (ACE)

Every student majoring in Applied Civil Engineering (ACE) must complete the following curriculum:

(a) General Education Requirements (66 credit hours)		Credit Hours
English	ENGL 101, 102, 214	9
Computer Skill	ICS 103	3
Interdisciplinary Basic Courses	ME 201, EE 204	6
Mathematics	MATH 101, 102, 201, 208	14
Sciences	PHYS 101, 102, CHEM 101, 111	14
Islamic and Arabic Studies	IAS 101, 111, 201, 212, 301, 322	12
Physical Education	PE 101, 102	2
Others	ISE 307, MGT 301	6
		66

(b) Core Requirements (43 credit hours)		
Computer Graphics	CE 215	3
Surveying	CE 261	2
Mechanics and Structures	CE 201, 203, 305	9
Materials	CE 303	4
Geotechnical	CE 353	4
Transportation	CE 341, 343	4
Fluid Mechanics and Environmental Engineering	CE 230, 330	6
Introduction to CE Design	CE 312	1
Numerical and Statistical Methods in CE	CE 318	3
Construction Methods and Management	CE 421	3
Applied Design Project	CE 413	3
CE Seminar	CE 490	1
		43

(c) Electives (15 credit hours)		
CE Electives	Two CE xxx Courses	6
CE Option Electives (from chosen option)	CE xxx	3
Additional Science XXX xxx	GEOL 201 or BIOL 233	3
General Studies	GS 3xx	3
		15

(d) Cooperative Work (9 credit hours)		
A minimum of 28-week program to gain experience; submit and present a report.		
Cooperative Work	CE 351	9
		9

The total number of credit hours required is

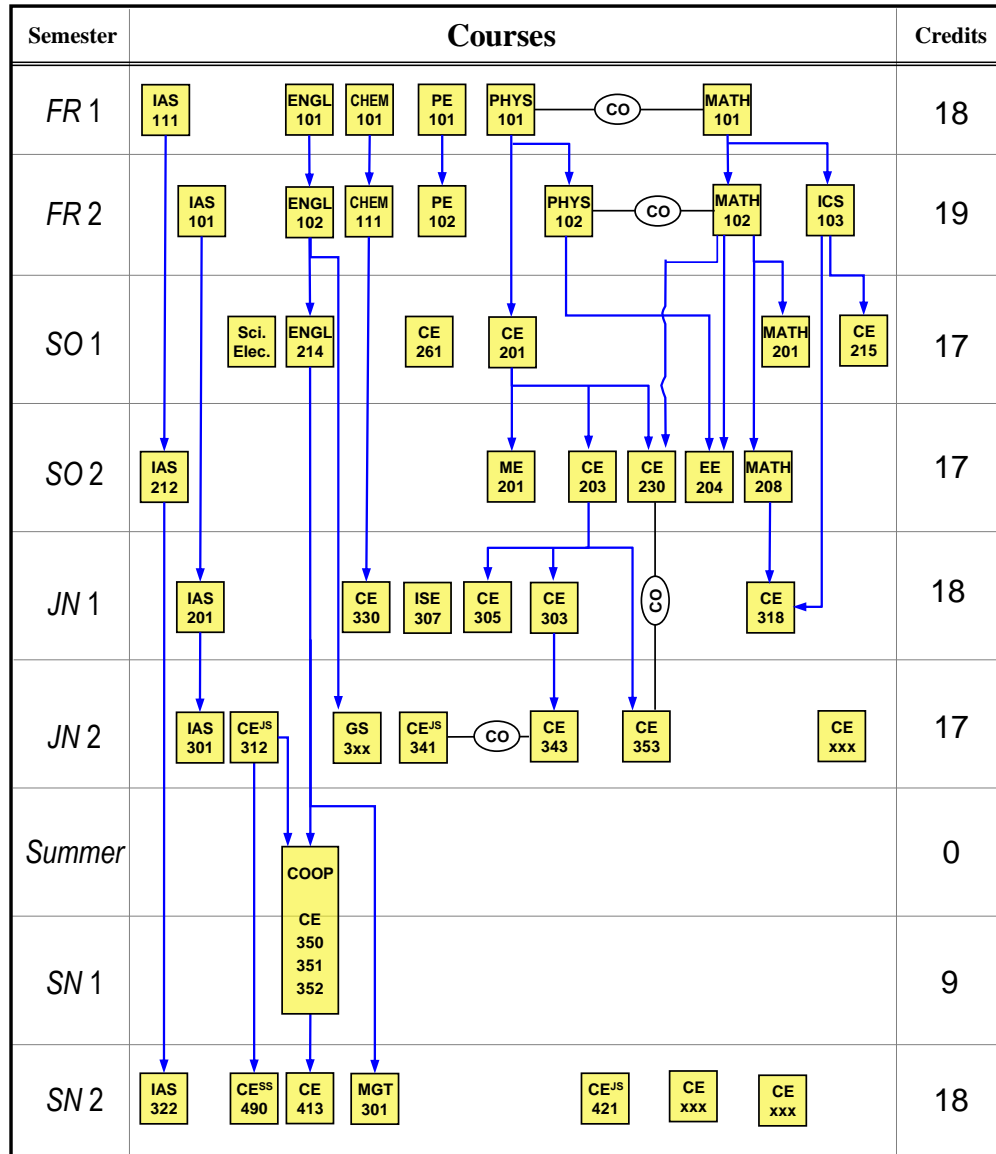
133

Curriculum for Applied Civil Engineering (ACE)

COURSE	TITLE	LT	LB	CR	COURSE	TITLE	LT	LB	CR	
Preparatory Year										
ENGL 01-xx	Prep. English I (First Quarter)	15	5	4	ENGL 03-xx	Prep. English III (Third Quarter)	15	5	4	
ENGL 02-xx	Prep. English II (Second Quarter)			4	ENGL 04-xx	Prep. English IV (Fourth Quarter)			4	
MATH 001	Prep. Math I	3	1	4	MATH 002	Prep. Math II	3	1	4	
PYP 001	Prep. Physical Science	2	0	2	PYP 002	Prep. Computer Science	0	2	1	
PYP 003	Life Skills	0	2	1	PYP 004	Prep. Eng. Technology	0	2	1	
PE 001	Prep. Health and Physical Educ. I	0	2	1	PE 002	Prep. Health and Physical Educ. II	0	2	1	
		20	10	16				18	12	15
Total credit hours required in Preparatory Program: 31										
First Year (Freshman)										
CHEM 101	General Chemistry I	3	4	4	CHEM 111	Basics of Environmental Chemistry	2	0	2	
ENGL 101	Intro. to Academic Discourse	3	0	3	PHYS 102	General Physics II	3	3	4	
IAS 111	Belief and its Effects	2	0	2	MATH 102	Calculus II	4	0	4	
MATH 101	Calculus I	4	0	4	ENGL 102	Intro. to Report Writing	3	0	3	
PE 101	Health and Physical Educ. I	0	2	1	IAS 101	Practical Grammar	2	0	2	
PHYS 101	General Physics I	3	3	4	PE 102	Health and Physical Educ. II	0	2	1	
					ICS 103	Computer Programming in C	2	3	3	
		15	9	18				16	8	19
Second Year (Sophomore)										
CE 201	Statics	3	0	3	CE 203	Structural Mechanics I	3	0	3	
CE 215	Computer Graphics	2	3	3	CE 230	Eng. Fluid Mechanics	3	0	3	
CE 261	Surveying I	1	3	2	MATH 208	Intro. to Differential Eq. & Linear Algebra	3	0	3	
ENGL 214	Academic & Professional Comm.	3	0	3	ME 201	Dynamics	3	0	3	
MATH 201	Calculus III	3	0	3	IAS 212	Professional Ethics	2	0	2	
XXX xxx	Science Elective	3	0	3	EE 204	Fundamentals of Electrical Circuits	2	3	3	
		15	6	17				16	3	17
Third Year (Junior)										
CE 303	Structural Materials	3	3	4	CE 312	Intro. to CE Design	1	0	1	
CE 305	Structural Analysis I	3	0	3	CE 341	Transportation Eng.	3	0	3	
CE 318	Numerical & Statistical Methods in CE	2	3	3	CE 343	Transportation Eng. Laboratory	0	3	1	
IAS 201	Objective Writing	2	0	2	CE 353	Geotechnical Eng. I	3	3	4	
CE 330	Environmental Eng. Principles	3	0	3	IAS 301	Language Comm. Skills	2	0	2	
ISE 307	Eng. Economics Analysis	3	0	3	CE xxx	CE Elective I	3	0	3	
					GS 3xx	GS Elective	3	0	3	
		16	6	18				15	6	17
Summer Session					CE 350	Cooperative Work	0	0	0	
Fourth Year (Senior)										
CE 351	Cooperative Work	0	0	9	CE 413	Applied Design Project	0	9	3	
					CE 421	Construction Methods and Management	3	0	3	
					CE xxx	CE Elective II	3	0	3	
					CE xxx	Option Elective	3	0	3	
					IAS 322	Human Rights in Islam	2	0	2	
					CE 490	Civil Eng. Seminar	1	0	1	
					MGT 301	Principles of Management	3	0	3	
		0	0	9				15	9	18
Total credit hours required in Degree Program : 133										

The chart below is intended only to give an overview of course flow in the program. It is NOT an official reference for pre-requisites to courses. Official pre-requisites to any CE or non-CE course should be obtained from the official course description of each course.

Flow Chart for the Applied Civil Engineering (ACE) Program



Total Credits Required in Degree Program

LEGEND:

GS 3xx General Studies Elective
 CE xxx Civil Engineering Elective
 Sci. Elec. Geol 201 or Biol 233



Co-requisite
 JS Junior standing
 SS Senior standing

8- Program Electives

8.1 CE Electives :

All students are required to take 2 CE elective courses. The first, **CE Elective I** must be either CE 315 or CE 408. The second, **CE Elective II** must be either CE 438 or CE 473. These courses were selected to ensure that all students have broad exposure to different disciplines within the CE major and to emphasize design applications.

8.2 CE Option Electives :

Students in the Civil Engineering Program (CE) are required to take 2 Option Elective courses, while students in the Applied Civil Engineering Program (ACE) need to take only one Option Elective. Depending on the chosen option, every student need to choose his own Option Elective courses from the specific courses listed under his option category, as listed in Table (A).

8.3 Science Elective :

All students are required to take one science elective course (3-credits). The course must be one of the following courses : GEOL 201 or BIOL 233

8.4 General Studies Elective :

All students are required to take one General Studies elective course (3-credits). The course can be any 3-credits GS course 300-level or above.

8.5 Technical Elective :

Students in the CE program are required to take one technical elective course (3-credits). The course can be any of the courses listed in Table B. Students in the ACE program are not required to take a technical elective.

9- Undergraduate Courses

A list of all undergraduate courses offered by the department is given in the Appendix.

Table A: list of Possible Courses for Each Option (to choose the option electives, as per section 8.2 of this document)

Options	Courses
Option 1: Structures, Materials and Construction	CE 315**: Reinforced Concrete I (2-3-3)
	CE 401: Concrete technology (2-3-3)
	CE 402: Durability, evaluation and Repair of Concrete Structures (3-0-3)
	CE 405: Structural Analysis II (3-0-3)
	CE 406: Structural Mechanics II (3-0-3)
	CE 408**: Steel Design I (2-3-3)
	CE 415: Reinforced Concrete II (2-3-3)
	CE 418: Steel Design II (3-0-3)
	ARE 459: Contracts and Specification (3-0-3)
	CE 439: Civil Eng. Systems Analysis (3-0-3)
Option 2: Transportation and Geotechnical Engineering	CE 440: Highway and Airport Materials (3-0-3)
	CE 441: Pavement Design (3-0-3)
	CE 442: Construction and Maintenance of Highways & Airports (3-0-3)
	CE 444: Traffic Engineering. & Roadway Safety (3-0-3)
	CE 453: Geotechnical Engineering II (3-0-3)
	CE 454: Soil Stabilization and Site Improvement (3-0-3)
	CE 455: Foundation and Earth Structures Design (3-0-3)
	CE 456: Seepage Analysis & Its Control (3-0-3)
	CE 464: Project Surveying (3-0-3)
	CE 439: Civil Eng. Systems Analysis (3-0-3)
Option 3: Water Resources & Environmental Engineering	CE 332: Engineering Hydrology and Hydraulics (2-3-3)
	CE 431: Hydrologic Engineering (3-0-3)
	CE 433: Groundwater Engineering (3-0-3)
	CE 436: Open Channel Hydraulics (3-0-3)
	CE 438**: Hydraulic Systems Design (2-3-3)
	CE 473**: Design and Operation of Water and Wastewater Treatment Plants (3-0-3)
	CE 439: Civil Eng. Systems Analysis (3-0-3)
	CE 471: Water and Wastewater: Treatment and Reuse (2-3-3)
	CE 474: Municipal Solid Waste Management (3-0-3)
	CE 476: Industrial Hazardous Waste Management and Treatment (3-0-3)

** See Section 8.1 for the important program requirements related to these courses

Table B : List of Courses Accepted as Technical Elective for CE Program Only
(Not Required for ACE Program)

Effective Term 151

Course	Title
AE 328* (3-0-3)	Flight Structures
ARE 431 (3-0-3)	Building Economy
ARE 440 (3-0-3)	Solar Energy in Buildings
ARE 457 (3-0-3)	Introduction to Building Maintenance & Management
ARE 459 (3-0-3)	Contracts and Specifications
EE 306* (2-3-3)	Electromechanical Devices
GEOL 341 (3-0-3)	Engineering Geology
GEOP 202 (3-0-3)	Introduction to Geophysics
MATH 302 (3-0-3)	Engineering Mathematics
MATH 474 (3-0-3)	Linear & Nonlinear Programming
ME 204 (3-0-3)	Thermodynamics II
ME 428* (3-0-3)	Structure of Flight Vehicles
ME 482* (3-0-3)	Mechanical Vibrations
STAT 319 (2-3-3)	Probability and Statistics for Engineers & Scientists

APPENDIX

List of All Civil Engineering Undergraduate Courses

CE 101 Engineering Graphics (1-3-2)

An introductory course on the “language of engineering” and the use of drafting instruments and machines. Topics include freehand sketching, graphic geometry, orthographic projection, sectional and auxiliary views, dimensioning, intersections, developments, and introduction to working drawings and an overview of computer graphics.

- This course is for non-CE students only

CE 201 Statics (3-0-3)

Basic concepts and principles of mechanics; vector algebra; equilibrium of particles in two and three dimensions; definition of moment and couple; reduction of systems forces; equilibrium of rigid bodies; statically determinate structures including beams, trusses, frames, and machines; internal forces; shear force and bending moment diagrams in beams; friction and its applications, centroid and center of gravity of lines, areas, and volumes; moment of inertia and radius of gyration.

Prerequisite: PHYS 101

CE 202 Statics & Strength of Materials (3-0-3)

Basic concepts and principles of mechanics; equilibrium of particles in two dimensions; definition of moment and couple; reduction of systems forces; equilibrium of rigid bodies in two dimensions; internal forces; shear and bending moment diagrams in beams; centroid and moment of inertia; concepts of stress, strain, and constitutive relations; stress and deformation of axially loaded members; thermal stresses; torsional stress and deformation; elastic bending and shear stresses in beams; compound stresses; stress transformation.

Note: Not to be taken for credit with CE 201 or CE 203

Prerequisite: PHYS 101

- This course is for non-CE students only

CE 203 Structural Mechanics I (3-0-3)

Concepts of stress, strain, and constitutive relations; stress and deformation of axially loaded members; thermal stresses; pressure vessels; energy concepts; torsion of circular and thin-walled sections; shear and bending moment diagrams in beams; elastic bending and shear stresses in beams; compound stresses; stress transformation; bending moment-curvature equation; deflection of beams; singularity functions methods, analysis and design applications.

Prerequisite: CE 201

CE 215 Computer Graphics (2-3-3)

The course focus on the following topics: Introduction to Computer Aided Design and Drafting, (CADD), 2D Drawings with AutoCAD includes Multiview Projection, Dimensions, Sections, Auxiliary Views, Free Hand Sketching, Mining and Civil Engineering Problems, Metallic Members and their Connections, Bearing and Slope of Lines and Planes, Contour Map Lines, Cut and Fill, Blue Print Reading, and 3D Drawings.

Prerequisite: ICS 103 or ICS 102 or ICS 101

CE 230 Engineering Fluid Mechanics (3-0-3)

Properties of fluids, hydrostatics with applications to manometers, forces on plane and curved surfaces, buoyancy, equations of continuity, energy and linear momentum with applications, dimensional analysis, dynamic similarity, open channel flow, conduit flow.

Prerequisite: CE 201, MATH 102

CE 261 Surveying I (1-3-2)

Introduction to measuring units; direct distance measurement with tapes; tape corrections; electronic distance measurement; levels and leveling; longitudinal profiles and cross sections; contouring; area and volume computations; the theodolite and angular measurements; optical distance measurements; rectangular coordinates; traverse surveys and computations; mapping; introduction to GPS and GIS.

CE 303 Structural Materials (3-3-4)

Composition and properties of hydraulic cements; characteristics of local aggregates and water; properties of fresh concrete; production, handling and placement of cement and fresh concrete in the local environment; properties of hardened concrete; mix design; special concretes; introduction to pavement types; asphalt cement types, properties and usage; properties of aggregate for asphalt concrete mixes; asphalt concrete mix design concept; types, engineering properties, and usage of structural steel; introduction to aluminum, timber, glass, plastics and other structural materials. Laboratory sessions on tests of concrete constituents, fresh and hardened concrete, aggregate gradation and mix design, flexure behavior of reinforced concrete beams, physical properties and testing of asphalt binders, asphalt concrete mix design; hardness test, tensile and torsion tests on metals, measurement of Poisson's ratio and stress concentration, and bending tests on steel beams.

Prerequisite: CE 203

CE 305 Structural Analysis I (3-0-3)

Shear force and bending moment diagrams for frames; influence lines for beams and trusses; displacement analysis for beams; Virtual Work Method for beams, frames and trusses; Castigliano's Theorem; analysis of statically indeterminate structures; the Force Method; the Slope-Deflection Method, the Moment Distribution Method; introduction to the Stiffness Method for beams and frames, the use of structural analysis software.

Prerequisite: CE 203

CE 312 Introduction to CE Design (1-0-1)

A broad introduction to design in all four disciplines; design landscape and requirements related to data, information, specification and codes, methods and tools, design considerations and constraints; issues related to safety, economy and impact; professional ethics and responsibility; design drawings; a small-scale project work to complement student's understanding.

Prerequisite: Junior Standing

CE 315 Reinforced Concrete I (2-3-3)

Behavior and design of reinforced rectangular and T-sections in flexure; doubly reinforced sections; behavior and design of beams for shear; bond and development length including splices and cut-off points; design of one-way solid and joist floor slabs; design of short columns; design of isolated footings; introduction to prestressing and precast construction; use of STAAD.Pro and other computer softwares in design; completion of a design project; site visits.

Prerequisite: CE 305

CE 318 Numerical & Statistical Methods in Civil Engineering (2-3-3)

Introduction to numerical methods; error analysis; solution of system of linear and nonlinear equations; numerical integration; numerical solutions of ordinary differential equations; curve fitting and interpolation; statistical methods, descriptive statistics, probability distributions, analysis of variance and regression; introduction to linear programming and optimization problems; development and application of computer programs to case studies derived from civil engineering practices.

Prerequisite: ICS 103 (or equivalent), MATH 208

CE 330 Environmental Engineering Principles (3-0-3)

Introduction to major environmental pollution issues; Analyses of water quality; Municipal solid waste management and disposal; Hazardous waste testing, management, and treatment; Air pollution characteristics, effects, measurements, control, meteorology, and dispersion; Noise pollution control; Introduction to wastewater testing, treatment and reuse; Environment Impact Assessment.

Prerequisite: CHEM 111 or CHEM 102

CE 332 Engineering Hydrology and Hydraulics (2-3-3)

The hydrologic cycle, precipitation, evapotranspiration, infiltration, hydrograph analysis, fundamentals of groundwater flow, basic concepts of open channel flow and flow in pipes.

Prerequisite: CE 201, MATH 102

CE 341 Transportation Engineering (3-0-3)

Transportation system in Saudi Arabia; transportation planning and evaluation; vehicle characteristics; human factors; geometric design of highways and intersections; basis of pavement design; introduction to capacity analysis of highways and intersections; introduction to airport planning and design; application of transportation related softwares.

Prerequisite: PHYS 101, Junior Standing

CE 343 Transportation Engineering Laboratory (0-3-1)

Field studies of speed; traffic volume, and delay; capacity analysis; geometric design of highways, intersections, and parking facilities; traffic signal design; pavement material testing and design; flexible pavement design; application of transportation related softwares.

Corequisite: CE 341

Prerequisite: CE 303

CE 350 Begin Cooperative Work (0-0-0)

See contents in CE 351.

Prerequisite: Same as in CE 351

CE 351 Cooperative Work (0-0-9)

A continuous period of 28 weeks is spent in the industry to acquire practical experience in Civil Engineering under the supervision and guidance of the employer and the academic advisor. During this period the student gains an in-depth exposure and appreciation of the Civil Engineering profession. The student is required to write a detailed report about his training period under the regulation of the CE department.

Prerequisite: ENGL 214, CE 312, Junior Standing, Approval of the Department

CE 352 End Cooperative Work (0-0-0)

See contents in CE 351.

Prerequisite: Same as in CE 351

CE 353 Geotechnical Engineering I (3-3-4)

Soil formation and identification; index and classification properties of soils; clay minerals; soil compaction; capillarity, swelling, shrinkage and effective stresses; flow of water in soils; compressibility and consolidation; stress in soils; shear strength of cohesive and cohesionless soils; introduction to lateral earth pressure and shallow foundation.

Corequisite: CE 230

Prerequisite: CE 203

CE 399 Summer Training (0-0-0)

A continuous period of eight weeks of summer working in the industry to gain exposure and appreciation of the civil engineering profession. On-the-job training can be acquired in one of the four specialties of civil engineering. The student is required to write a brief report about his industrial experience. The report should emphasize duties assigned and completed by the student.

Prerequisite: ENGL 214, Junior Standing, Approval of the Department

CE 401 Concrete Technology (2-3-3)

In-depth study of cement composition, hydration of cement; structure and properties of hardened cement paste; volumetric changes in concrete; properties of concrete related to durability such as water absorption, water permeability, chloride permeability, and chloride diffusion; use of mineral admixtures; advanced concretes and reinforcing bars; requirements and specifications for producing durable concretes suiting the local conditions.

Prerequisite: CE 303

CE 402 Durability, Evaluation and Repair of Concrete Structures (3-0-3)

Durability problems of concrete structures such as reinforcement corrosion, sulfate attack, cement-aggregate reactions, salt weathering, efflorescence, acid attack, and environmental cracking; factors causing severe deterioration problems in the Arabian Gulf; condition survey, diagnosis and evaluation of deterioration damage in concrete structures; repair materials and methods; preventive measures such as protective coatings, cathodic protection, de-chlorination, and re-alkalinization.

Prerequisite: CE 303

CE 405 Structural Analysis II (3-0-3)

Review of matrix algebra and solution of simultaneous equations; flexibility (force) method analysis; stiffness (displacement) method of analysis; 2-D trusses, beams and frames; development of computer programs using the stiffness method; use of available computer packages for applications in structural analysis; introduction to the Finite Element Method; introduction to Structural Stability.

Prerequisite: CE 305

CE 406 Structural Mechanics II (3-0-3)

Bending of beams of non-symmetrical sections; shear center; energy concepts including Rayleigh-Ritz method; use of classical and energy methods in the analysis of curved beams; torsion of prismatic members; beams on elastic foundations; use of finite element methods in solid mechanics, including introduction to use of ANSYS software; stability of beam-columns; failure theories and fracture mechanics.

Prerequisite: CE 203

CE 408 Steel Design I (2-3-3)

Properties of structural steel; steel sections, introduction to load resistance factor design (LFRD), design of tension members, compression members and capacity calculations; width-

thickness ratios; design of beams with and without lateral supports; design of members under combined axial and bending loads; design and details of simple bolted and welded connections, and an introduction to common building connections; use of STAAD.Pro software for design of elements and overall design of frames; completion of a design project; site visit.

Prerequisite: CE 305

CE 410 Senior Design Project Preparation (0-3-1)

Each student starts the planning and undertaking of a suitable senior design project in consultation with the course coordinator. The student makes a presentation of his proposal for senior project work before a committee. The proposal outlines the objectives, scope and details of the work.

Prerequisite: ENGL 214, CE 312

CE 412 Senior Design Project (0-6-2)

Students undertake a civil engineering design project under the supervision of a faculty member with the aim of achieving a comprehensive design experience through a coherent study of all applicable principles, strategies and methodologies of design, including construction operation, and maintenance as and when applicable. The project should also take into consideration other appropriate factors such as alternative designs, economic feasibility and social and environmental impacts. The student is required to make an oral and written presentation of the design project to an examining committee.

Prerequisite: CE 410

CE 413 Applied Design Project (0-9-3)

ACE students undertake a civil engineering design project under the supervision of a faculty member with the aim of achieving a comprehensive design experience through a coherent study of engineering and design principles. The student chooses the project in the field in which he is most familiar through his co-op work experience. The student is required to make an oral and written presentation of the design project to an examining committee.

Corequisite: CE 351

CE 415 Reinforced Concrete II (2-3-3)

Design of two-way slabs using ACI 'direct design method'; design of continuous beams; behavior and design of columns under axial load and bending moment including slenderness effect; introduction to various types of foundations; lateral resistivity, design of wall footings and combined footings; design of retaining walls; simple design of prestressed, precast elements; STAAD.Pro software application in design; completion of a multistory design project.

Prerequisite: CE 315

CE 418 Steel Design II (3-0-3)

Introduction to elasto-plastic material behavior, plastic analysis and design of continuous beams and simple frames using load resistance factor design (LRFD); design of built-up beams and plate girders, optimum proportioning of I-beam, design of composite section analysis and design for torsion, design of semi-rigid and rigid connections, use of STAAD.Pro software in design of rigid frames and steel buildings.

Prerequisite: CE 408

CE 421 Construction Methods and Management (3-0-3)

An overview of construction industry, contracts, contract documents and professional liabilities, issues during construction phase, business ownership, cost estimation, equipment productivity; concrete form design; planning and scheduling, resource leveling, cost control; introduction to PERT, construction management aspects; materials management, construction productivity and safety.

Prerequisite: Junior Standing

CE 431 Hydrologic Engineering (3-0-3)

Review of fundamentals of hydrology and advanced treatment for estimation of elements of the hydrologic cycle; hydrologic flood routing; probability concepts in hydrology, flood frequency analysis; hydrologic principles in engineering design; computer applications in hydrology and introduction to minor structure design.

Prerequisite: CE 332

CE 433 Groundwater Engineering (3-0-3)

Introduction and definitions, groundwater storage and supply, Darcy's Law and its limitation, Dupuit approximation, steady and unsteady flows in confined and unconfined aquifers, radial flow towards wells, storage coefficient and safe yield in a water-table aquifer, design of wells, flow nets, introduction to sources of groundwater contamination.

Prerequisite: CE 230

CE 436 Open Channel Hydraulics (3-0-3)

Analysis and characteristics of flow in open channels; channel design considerations including uniform flow, flow measuring devices, gradually varied flow, flood routing, rapidly varied flow; hydraulic factors for the design of reservoirs, dams, spillways and stilling basins.

Prerequisite: CE 230

CE 438 Hydraulic Systems Design (2-3-3)

Fundamental principles and design of water supply, sanitary and storm sewer systems and their components, including pipes, pumps, storage facilities, open-channels, culverts; computer applications in the design and analysis of hydraulic systems.

Prerequisite: CE 230

CE 439 Civil Engineering Systems Analysis (3-0-3)

Techniques commonly associated with systems engineering; new techniques applicable to design and operations of civil engineering systems; linear optimization, linear programming, transportation and assignment problems, network analysis; simulation techniques; decision analysis; nonlinear optimization; critical path method.

Prerequisite: CE 318

CE 440 Highway and Airport Materials (3-0-3)

Construction materials; asphalt cement; emulsified asphalt; foamed asphalt; Portland cement asphalts; cement; aggregates and asphalt additives; specifications; material selection and evaluation; tests of asphalts and aggregates, mix design procedures for hot and cold asphalt mixes, including Marshall and SuperPave; mix design for Portland cement concrete mixes for rigid pavements; characterization techniques; modulus of resilience; fatigue and rutting performance prediction; field quality control procedures; Computer applications in materials evaluation and design.

Prerequisite: CE 303

CE 441 Design of Pavement (3-0-3)

Pavement types and design factors; stresses and strains in flexible and rigid pavements; traffic analysis and design considerations; material characterization; performance evaluation; reliability aspects in design and construction; structural thickness design of highway and airport pavements using different methodologies; pavement evaluation; Computer application in pavement design.

Corequisite: CE 341

CE 442 Construction and Maintenance of Highways and Airports (3-0-3)

Selection and processing of construction materials; asphalt concrete mix design; asphalt plants operation; material placement and compaction methods; quality control; earthwork, highway drainage and roadside requirements; construction standards; pavement performance and evaluation; pavement distress identification; surface treatments; techniques; application and design; overlay design; pavement recycling techniques; computer applications.

Prerequisite: Junior Standing

CE 444 Traffic Engineering and Roadway Safety (3-0-3)

Vehicle, roadway and driver characteristics; traffic engineering and safety studies; highway capacity analysis; traffic control methods and devices; intersection signalization and signal timing; fundamentals of intersection design; parking facilities; introduction to attenuation devices; Intelligent transportation system; computer applications.

Prerequisite: CE 341

CE 453 Geotechnical Engineering II (3-0-3)

Fundamental relations of elasticity and plasticity in soil masses; unsaturated soils behavior; deformation properties of cohesionless and cohesive soils; advanced strength concepts in soils and stress path; slope stability analysis; introduction to soil dynamics.

Prerequisite: CE 353

CE 454 Soil Stabilization and Site Improvement (3-0-3)

General survey of soil types and their behavior and the available techniques for improvement; shallow and deep mechanical modifications; modifications by admixtures and grouting; modifications by inclusions; the use of geosynthetic material in filtration, seepage control, separation, reinforcement and water retention; hydraulic modifications; and treatment of marginal soils.

Prerequisite: CE 353

CE 455 Foundation and Earth Structure Design (3-0-3)

Site investigation, including determination of soil properties for design; bearing capacity theory of shallow foundation; settlement of building foundations; design and analysis of retaining walls, sheet piles and braced excavations; design of pile and pier foundations.

Prerequisite: CE 353

CE 464 Project Surveying (3-0-3)

Route survey; horizontal curves; vertical curves; spirals; construction surveys; applications of Total Stations; topographic surveying and mapping; introduction to Global Positioning System.

Prerequisite: CE 261

CE 471 Water and Wastewater: Treatment and Reuse (2-3-3)

Water treatment including pre-design issues, desalination, lime softening, sedimentation, filtration, membrane systems, ion exchange, adsorption, and disinfection technologies; Wastewater treatment including fundamentals of reactor design, activated sludge system, membrane bioreactor, trickling filter, and secondary clarifier; Natural wastewater treatment technologies for smaller and remote communities; Wastewater reuse including water scarcity issues, legal issues, health issues, technical issues & methodologies, areas of application, and case studies.

Prerequisite: CE 330

CE 473 Design and Operation of Water and Wastewater Treatment Plants (3-0-3)

Theory and practice in sanitary engineering including the concepts of processing, design, economic evaluation and computer analysis; class projects incorporating practical considerations in the design and operation of treatment units and the combining of unit processing in water and wastewater treatment plants; field trips will be organized to visit various types of treatment plants in operation.

Prerequisite: CE 330

CE 474 Municipal Solid Waste Management (3-0-3)

Problems, regulations, collection, handling, recycling and disposal issues related to municipal solid wastes; Characterization of municipal solid wastes including physical, chemical, and biological characteristics; Integrated municipal solid waste management practices including resource recovery, composting, incineration, and landfill design.

Prerequisite: CE 330

CE 476 Industrial Hazardous Waste Management & Treatment (3-0-3)

Theory and design of several industrial hazardous waste management and treatment aspects including regulations, environmental audits, pollution prevention, risk assessment, chemical & biological process fundamentals, and industrial hazardous waste separation, handling, treatment, & disposal techniques.

Prerequisite: CE 330

CE 490 Civil Engineering Seminar (1-0-1)

Weekly presentation of lectures by the instructor and the invited speakers on topical issues in civil engineering, including contemporary issues, professional responsibilities, ethical issues and advances and challenges in civil engineering profession; each student will be required to make a presentation on a selected topic and participate in classroom discussion.

Prerequisite: CE 312, Senior Standing