B.S. in Civil Engineering - Summer Training Option

Four-year Academic Plan

Digital/Business Foundation

جامعة الملك فهد للبترول والمعادن
King Fahd University of Petroleum & Minerals

Freshman Year

Course	Type	Title	LT	LB	Cr
CHEM 101	MS	Principles of Chemical Science I	3	3	4
ENGL 101	GS	Intro. to Academic Discourse	3	0	3
IAS 121	GS	Language Foundation	2	0	2
MATH 101	MS	Calculus I	4	0	4
PHYS 101	MS	General Physics I	3	3	4
		Total	15	6	17

Course	Type	Title	LT	LB	Cr
ENGL 102	GS	Intro. to Report Writing	3	0	3
IAS 111	GS	Belief & Its Consequences	2	0	2
ICS 104	DF	Intro. to Programm. in Python & C	2	3	3
MATH 102	MS	Calculus II	4	0	4
PE 101	GS	Health and Physical Education I	0	2	1
PHYS 102	MS	General Physics II	3	3	4
		Total	14	8	17

Sophomore Year

Course	Type	Title	LT	LB	Cr
CE 201	CR	Statics	3	0	3
CE 216	CR	Computer Graphics	1	3	2
CE 261	CR	Surveying I	1	3	2
ENGL 214	GS	Academic & Professional Comm.	3	0	3
ISE 291	DF	Intro. to Data Science	3	0	3
MATH 201	MS	Calculus III	3	0	3
		Total	14	6	16

Course	Type	Title	LT	LB	Cr
CE 203	CR	Structural Mechanics I	3	0	3
CE 204	CR	Civil Engineering Materials	3	0	3
CE 206	CR	Civil Engineering Materials Lab	0	3	1
CE 230	CR	Engineering Fluid Mechanics	3	0	3
COE 292	DF	Intro. to Artificial Intelligence	3	0	3
MATH 208	MS	Diff. Eqs. & Linear Algebra	3	0	3
		Total	15	3	16

Junior Year

Course	Type	Title	LT	LB	Cr
BUS 200	DF	Business & Entrepreneurship	3	0	3
CE 305	CR	Structural Analysis I	3	0	3
CE 318	MS	Numerical & Stat.l Methods in CE	2	3	3
CE 330	CR	Environmental Eng. Principles	3	0	3
CE 375	CR	Environmental Chemistry Lab	0	3	1
IAS 212	GS	Ethics and Governance	2	0	2
		Total	13	6	15

Course	Type	Title	LT	LB	Cr
GEOL/BIOL xxx	MS	Science Elective	2	3	3
CE 315	CR	Reinforced Concrete I	2	3	3
CE 354	CR	Intro. to Geotechnical Engineering	3	0	3
CE 356	CR	Geotechnical Engineering Lab	0	3	1
GS xxx	GS	GS Elective	3	0	3
IAS xxx*	GS	Islamic/Arabic Elective	2	0	2
CGS 392	GS	Career Essentials	0	2	1
		Total	12	11	16

Summer Session

Course	Type	Title	LT	LB	Cr
CE 399	CR	Summer Training	0	0	1

Senior Year

Course	Type	Title	LT	LB	Cr
CE 410	CR	Senior Design Project I	0	1	0
CE 335	CR	Engineering Hydrology	2	3	3
CE 341	CR	Transportation Engineering	3	0	3
CE 343	CR	Transportation Engineering Lab	0	3	1
CE 422	CR	Constuct. Management & Economy	3	0	3
CE xxx	CE	CE Elective I	3	0	3
CE xxx	CE	CE Elective II	3	0	3
		Total	14	7	16

Course	Type	Title	LT	LB	Cr
CE 412	CR	Senior Design Project II	0	6	3
XXX xxx	FE	Free Elective	3	0	3
CE xxx**	CE	CE Design Elective I	3	0	3
CE xxx***	CE	CE Design Elective II	3	0	3
XE xxx	TE	Technical Elective	3	0	3
		Total	12	6	15
		Total Credit Hours			**129**

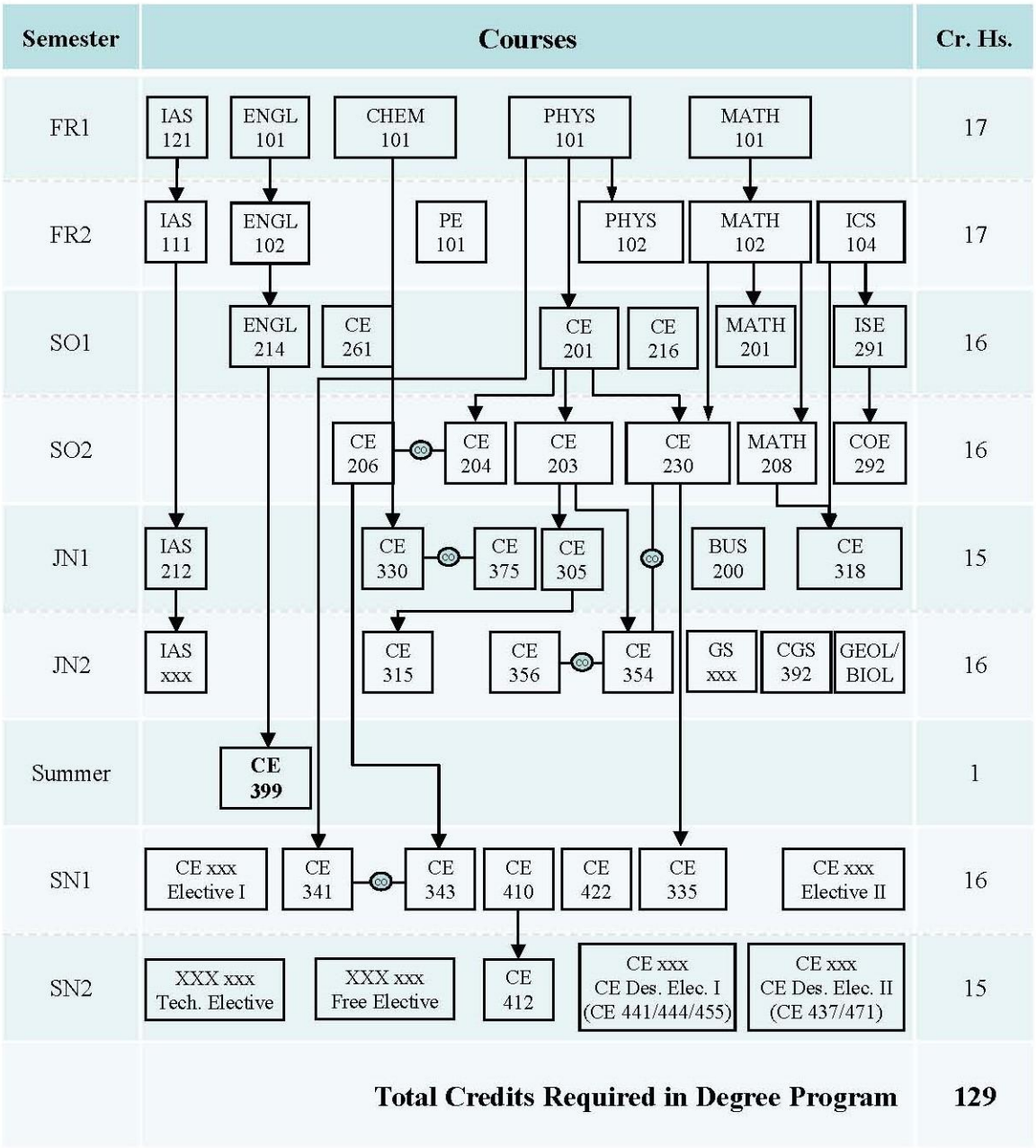
*RES 200 can be used in place of IAS Elective

**CE 441 or CE 444 or CE 455

***CE 437 or CE 471

MS	Math and Science	**32**
GS	General Studies	**22**
CR	Core Subjects	**45**
CE	Core Electives	**12**
EN	Engineering Electives	**0**
TE	Technical Electives	**3**
FE	Free Electives	**3**
DF	Digital/Business Foundation	**12**
	Total	**129**
	Total Core (CR+CE)	**57**
	Total Engineering (Total Core+EN)	**57**

Semester-wise Flow Chart of **Civil Engineering** Courses with Summer Training Option



Civil and Environmental Engineering Department

Revised List of Technical Electives

Existing Courses
ARE 420 Solar Energy in Buildings
ARE 457 Intro to Building Maintenance & Management
EE 204 Fundamentals of Electrical Circuits
GEOL 341 Engineering Geology
ISE 307 Engineering Economics Analysis
MATH 302 Engineering Mathematics
ME 201 Dynamics
ME 203 Thermodynamics I
ME 482 Mechanical Vibrations
MATH 333 Methods of Applied Mathematics I
Added Courses
ARE 416 Planning and Design of Structural Systems
ARE 417 Innovative Building Structures
ARE 418 Structural Design of High-Rise Buildings
ARE 423 Building Performance Evaluation
ARE 426 Room Acoustics
ARE 427 Noise Control in Buildings
ARE 430 Contracts and Specifications
ARE 435 Construction Safety
ARE 436 Fire Safety Management
ARE 437 Decisions Analysis and Modeling
ARE 438 Facilities Planning and Management
ARE 461 Appl. Of AI in Smart Buildings
ARE 465 Construction Processes and Methods
ARE 492 Mosque Systems and Operation
CEM 442 Application of Digital Technologies in Construction Management
ME 472 Corrosion Engineering
MATH 333 Methods of Applied Mathematics I
MATH 474 Linear & Nonlinear Programming
STAT 319 Probability and Statistics for Engineers & Scientists

CIVIL ENGINEERING

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.
Note: Not open for CE students

CE 201 Statics (3-0-3)
Basic concepts and principles of mechanics; algebraic vector operations on action and reaction vectors; equilibrium of particles in two and three dimensions; definitions of moment and couple; reduction of system of forces; equilibrium of rigid bodies; statically determinate structures including beams, trusses, frames and machines; analysis of internal forces; shear and bending moment diagram for beams; static friction forces and engineering applications; center of gravity of masses, and centroid of lines, areas, and volumes; area 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; analysis of truss-type structures and internal forces; geometric properties of cross-section area; centroid and moments of inertia; shear and bending moment diagrams in beams; stress, Stress-strain relationships; stress and deformation of axially loaded members; stress-concentration; thermal stresses; pressure-vessels; torsion-stress and deformation; elastic bending and shear stresses in beams; compound stresses; stress transformation.
Note: Not open for CE students, Not to be taken for credits with CE 201 or CE 203
Prerequisite: PHYS 101

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, shear stress in beams, compound stresses, stress transformation, deflection of beams, and introduction to the concept of singularity functions.
Prerequisite: CE 201

CE 204 Civil Engineering Materials (3-0-3)
Introduction; hydraulic cements; water; aggregates for Portland cement and asphalt concrete mixes; admixtures; design of concrete mixtures; production, handling and placement of concrete; properties of fresh concrete; curing of concrete; properties of hardened concrete; asphalt types, physical properties, grading systems and usage of asphalt; asphalt concrete mix design; engineering properties and usage of structural steel. 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 201
Corequisite: CE 206

CE 206 Civil Engineering Materials Laboratory (0-3-1)

Laboratory sessions on tests of concrete constituents using standard procedures generally ASTM standards, 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.

Corequisite: CE 204

CE 216 Computer Graphics (1-3-2)

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, AutoCAD Civil 3d, Contour Map Lines, Cut and Fill, Blue Print Reading, and 3D Drawings.

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

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

Prerequisites: 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 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 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 appropriate computer software in design; completion of a design project; interpretation of blueprints; 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.
Prerequisites: ICS 104, MATH 208

CE 330 Environmental Engineering Principles (3-0-3)
Introduction to water treatment along with physical operations and chemical processes; Introduction to wastewater treatment and reuse along with preliminary, primary, secondary, and tertiary treatment; municipal solid and hazardous waste management and disposal.
Prerequisite: CHEM 101
Corequisite: CE 375

CE 335 Engineering Hydrology (2-3-3)
The hydrologic cycle, precipitation; evaporation and transpiration; infiltration; streamflow; hydrograph analysis including unit hydrograph; hydrologic flood routing; introduction to flood frequency analysis; occurrence of groundwater; fundamentals of groundwater flow including Darcy's law and its applications; steady and unsteady flow to wells.
Prerequisite: CE 230

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
Corequisite: CE 343

CE 343 Transportation Engineering Lab (0-3-1)
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; laboratory sessions on 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 software; application of transportation related software.
Prerequisite: CE 206
Corequisite: CE 341

CE 354 Introduction to Geotechnical Engineering (3-0-3)
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.
Prerequisite: CE 203
Corequisites: CE 230, CE 356

CE 356 Geotechnical Engineering Laboratory (0-3-1)

Conduct and report on experiments in geotechnical engineering, including: specific gravity; moisture content; sieve analysis; hydrometer analysis; Atterberg limits; compaction; field density; permeability; consolidation; direct shear; unconfined compression; California bearing ratio; triaxial shear.

Corequisite: CE 354

CE 375 Environmental Chemistry Laboratory (0-3-1)

Introductory environmental chemistry laboratory sessions for water & wastewater treatment; Standard solutions; Elementary concepts in solution & colloidal chemistry including chemical equilibrium, kinetics, precipitation; pH measurement; Dissolved-oxygen analysis; Alkalinity analysis; Water-hardness analysis; Turbidity and solids characterization; Total organic carbon (TOC) & Chemical oxygen demand (COD) analysis; Biochemical oxygen demand (BOD) analysis; Total coliforms analysis; Residual chlorine analysis; Jar Test; Adsorption.

Corequisite: CE 330

CE 399 Summer Training (0-0-1)

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.

Prerequisites: 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 204

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 204

CE 403 Characterization of Marine Environment (3-0-3)

Foundations in marine sciences; understanding the physical, chemical, geological and biological characteristics of marine environment; impacts on offshore structures, physical forces affecting marine facilities, marine corrosion and mitigation measures, biofouling and marine pests; effects of offshore structures on the marine environment; environmental impact assessment, impact mitigation, environmental monitoring; marine policy, marine protected areas, national and international regulations.

Prerequisite: Senior Standing

CE 404 Climate Engineering (3-0-3)
Introduction to geoengineering; the economics of climate change; response to climate change: mitigation and adaptation techniques; impacts, adaptation, and vulnerability; plan to keep carbon in check; carbon capture, utilization and storage; climate intervention strategies and technologies; solar radiation management; carbon dioxide removal; weather modification; using the oceans to engineer the climate.
Prerequisite: Senior Standing

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 FEM software; column buckling and introduction to beam-columns; failure theories and fracture mechanics.
Prerequisite: CE 203

CE 407 Introduction to Marine Structures and Materials (3-0-3)
Marine structures and environmental loadings; Offshore structure (fixed; floating; mooring dolphins; jack-ups), costal marine structures (harbor; dry dock); Concrete for marine structures: concrete, concrete mix design and preparation; fresh concrete properties, mechanical properties of hardened concrete, shrinkage and creep, durability; Steel for marine structures: mechanical properties, failure mechanisms; Nonmetals; Miscellaneous materials for marine structures.
Prerequisite: Senior Standing

CE 408 Steel Design I (2-3-3)
Properties of structural steel; steel sections and introduction to Load Resistance Factor Design (LRFD), design of tension members, compression members and capacity calculations; laced columns 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 software for design of elements and overall design of frames.
Prerequisite: CE 305

CE 409 Assessment and Maintenance of Marine Structures (3-0-3)
Environmental factors causing severe deterioration problems in marine structures; deterioration of marine structures such as corrosion, sulfate attack, salt weathering and crystallization, efflorescence, acid attack, abrasion, erosion, cavitation, and cracking; condition surveys, assessment and evaluation of deterioration damage in marine structures;

preventive measures such as coatings, overlays, and cathodic protection; repair methods and materials.
Prerequisite: Senior Standing

CE 410 Senior Design Project I (0-1-0)
This is the first of two courses for the multidisciplinary, capstone project. Multidisciplinary teams will be formed, projects will be defined, and project management will be discussed.

CE 412 Senior Design Project II (0-6-3)
Students undertake a civil engineering design project under the supervision of faculty member with the aim of achieving a comprehensive design experience through a coherent study of all applicable principles, strategies and methodology of design, including construction operation, and maintenance as and when applicable. The project should also take into consideration other appropriate factors such as alternative design, 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 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; design of beam column joints; design of shear wall and load bearing wall system; simple design of stairs; 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; appropriate computer software in design; completion of a multistory design project.
Prerequisite: CE 315

CE 418 Steel Design II (3-0-3)
Introduction to elastic-plastic material behavior, plastic analysis and design of 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 girders, design of rigid connections, design for torsion, computer applications to design rigid frames and steel buildings.
Prerequisite: CE 408

CE 422 Construction Management and Economy (3-0-3)
An overview of construction industry; professional responsibilities, ethics, liabilities and licensing; contracts and project delivery systems; business ownership; project planning and scheduling; cost estimation, cost control, resource leveling, introduction to construction economics, equipment productivity and selection; construction productivity and safety; construction types, equipment, materials, and foundation; concrete form design; contemporary issues in Construction Engineering; field projects and life-long learning.
Prerequisite: Junior Standing

CE 433 Groundwater Engineering (3-0-3)
Introduction and definitions; Groundwater Aquifers of Saudi Arabia; groundwater storage and supply; Darcy's law and its applications; 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; methods of drilling and construction; development of maintenance of wells.
Prerequisite: CE 335

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 335

CE 437 Applied Hydraulic Engineering (3-0-3)
Application of the basic laws of fluid mechanics to hydraulic problems. Analysis and design of water supply, sanitary and storm sewer systems and their components; open channel flow hydraulics; hydraulic structures; computer applications in the design and analysis of hydraulic systems.
Prerequisite: CE 335

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 204

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 systems; computer applications.
Prerequisite: CE 341

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 354

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 354

CE 457 Advanced Geotechnical Engineering (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 354

CE 462 Advanced Building Materials and Systems (3-0-3)
Introduction to advanced and sustainable materials, definition of interactive and smart materials and systems, properties, types and classifications, their applications, merits and demerits. Examples of current and emerging smart building materials and systems. Biomimetric Materials. Phase-Change Materials. Nano technology applications in the building envelope. Assessment of the suitability and sustainability of smart materials and systems for building and construction projects. Selection criteria based on performance, international-standard practices and certification. Integration strategies of advanced materials and future trends. Site visits to relevant laboratories and materials-manufacturing facilities.
Prerequisite: Senior Standing

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 (GPS) and Geographic Information Systems.
Prerequisite: CE 261

CE 471 Water and Wastewater: Treatment and Reuse (3-0-3)
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: Senior Standing

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: Senior Standing

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: Senior Standing

CE 478 Climate Resilient Infrastructure and Adaptation (3-0-3)
Vulnerability, adaptation, and adaptive capacity; adaptation and equitable development; climate impacts on urban vulnerability; risk and vulnerability assessments; climate adaptation planning and options; participation and community-based adaptation; role of engineering infrastructure on climate adaptation; multi-disciplinary infrastructure for sustainable development; effects of climate change on the multi-disciplinary infrastructure; issues for climate adaptation and climate resilient infrastructure; case studies on selected multi-disciplinary infrastructure.
Prerequisite: Senior Standing

CE 479 Air Quality in Building and Construction Sites (3-0-3)
Introduction to air quality, its determinants; construction site layout planning, pollutants types and sources; problem indicators and factors affecting air quality in buildings and construction sites; particulate matters, dusts, gasses, hazardous processes and exposures in construction sites; air quality audit, measurements and testing technique; airflow and contaminant transport in buildings; construction site contaminants, workers and air safety, health and productivity; organization and management in construction, renovation and project neighbourhoods; legislations, standards and legal issues; modelling and simulation tools; smart monitoring sensors and control instruments; IT applications, data acquisition and transmission; case studies.

Prerequisite: Senior Standing

CE 491 Special Topics in Civil Engineering (3-0-3)

The course covers a special topic with emphasis on recent developments or to explore much deeper into one of the following civil & environmental engineering areas: structural, water resources, transportation, geotechnical and environmental engineering. A detailed syllabus of the course is announced one semester in advance.

Prerequisite: Senior Standing, Approval of the Department

CE 497 Undergraduate Research (1-6-3)

Selection of a research topic, development of research topic, writing a successful proposal, manage and carrying out research tasks, setting up bench scale setup or prototype for lab work or software for modeling based research, communicating the research findings, writing effective reports.

Prerequisite: Approval of the Department

RES-200 Independent Research: An undergraduate independent research course is an academic opportunity for students to delve into a specific research topic of their choice under the guidance of faculty members, researcher, or industrial professionals upon approval. the course provides an end-to-end research experience starting from the selected research theme to delivering the research outcomes in the form of a well-written article that qualifies for publication.

Key Requirements for RES200 Course:

- **Duration:** RES200 is a two-semester course. In the first semester, a student will receive an IC grade, and the letter grade must be assigned by the end of the next term. A student can also complete the course at any point within this academic year.
- **Research Topic:** Student must identify a research topic by himself and obtain advisor's approval. If you do not have one yet, discuss it with your advisor during your first meeting. They will assist you in setting the research goals and writing a one-page summary to initiate your work.
- **Research Proposal:** You must submit your research proposal to your advisor after your first meeting with the advisor.
- **Course Outcome:** The mandatory outcome for this course is a published paper in an **ISI-indexed journal** or the **Journal of Undergraduate Research** (Journal of Undergraduate Research International).

Course Policy: https://ri.kfupm.edu.sa/dr/opportunities/students/undergraduate-students/independent-research