Academic Plan for the Degree of "Bachelor of Science in Civil Engineering"

TABLE 1 : PREPARATORY YEAR REQUIREMENTS

Level 1

Course Code	Course Title	Cr. Hr	Pre-requisite
CHS 101	Health and Fitness	2	
PHYS 107	Introduction to physics -1	3	
ENGL 109	English -1	6	
CT 130	Computer Skills	3	
MATH 130	Introduction to Math	3	
Total		**17**	

Level 2

Course Code	Course Title	Cr. Hr	Pre-requisite
RAD 101	Entrepreneurship	2	
ACT 105	Academic and Life Skills	3	
ENGL 110	English -2	4	ENGL 109
ENGL 128	English for Engineering Purposes	2	
MATH 135	Mathematics	4	MATH 130
Total		**15**	

TABLE 2: RECOMMENDED SEMESTER SCHEDULE**

Level 3

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
IC 101	Introduction to Islamic Culture	2 (2,0,0)		
MATH 105	Differential Calculus	3 (3,1,0)		
CHEM 101	General Chemistry(1)	4 (3,1,2)		
PHYS 103	General Physics (1)	4 (3,1,2)		
GE 212	Computer Programming	3 (2,0,2)		
GE 106	Introduction to Engineering	2 (1,0,2)		
Total		**18**		

Level 4

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
ARAB 101	Language Skills	2 (2,0,0)		
MATH 106	Integral Calculus	3 (3,1,0)	MATH 105	
MATH 107	Vectors and Matrices	3 (3,1,0)	MATH 105	
PHYS 104	General Physics (2)	4 (3,1,2)	PHYS 103	
GE 107	Engineering Drawing and Design	3 (1,0,4)		
ENGL 116	English Composition	3 (3,0,0)		
Total		**18**		

Level 5

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
IC 102	Islam and Society Building	2 (2,0,0)		
MATH 203	Differential & Integral Calculus	3 (3,1,0)	MATH 106 MATH 107	
ENGL 107	Technical Writing	3 (3,0,0)	ENGL 106	
CE 201	Statics	3 (3,1,0)	MATH 106 MATH 107	
CE 212	Surveying	3 (2,1,2)	MATH 107	
CE 240	Introduction to Environmental Engineering	3 (2,1,2)	CHEM 101	
Total		**17**		

Level 6

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
ARAB 103	Expository Writing	2 (2,0,0)		
MATH 204	Differential Equations	3 (3,1,0)	MATH 203	
ME 202	Dynamics	3 (3,1,0)	CE 201	
CE 320	Fluid Mechanics	3 (3,1,0)	CE 201 PHYS 103	CE 321
CE 321	Fluid Mechanics Lab	1 (0,0,2)	CE 201 PHYS 103	CE 320
CE 302	Mechanics of Materials	3 (3,1,0)	CE 201	CE 305
CE 305	Mechanics of Materials Lab	1 (0,0,2)	CE 201	CE 302
Total		**16**		

Level 7

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
IC 103	The Islamic Economic System	2 (2,0,0)		
MATH 254	Numerical Methods	3 (3,1,0)	MATH 107	
CE 307	Construction Materials	3 (2,1,2)	CE 302	
CE 323	Water Resources Engineering	3 (3,1,0)	CE 320	
CE 360	Structural Analysis (1)	3 (3,1,0)	CE 302	
CE 381	Geotechnical Engineering (1)	2 (2,1,0)	CE 302	CE 382
CE 382	Geotechnical Engineering Lab.	1 (0,0,2)	CE 302	CE 381
Total		**17**		

Level 8

Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
STAT 324	Engineering Probability and Statistics	3 (3,1,0)		
CE 341	Water Supply and Waste Water Treatment Eng.	3 (2,1,2)	CE 240 CE 323	
CE 330	Traffic Engineering (1)	3 (3,1,0)		
CE 460	Structural Analysis (2)	3 (3,1,0)	CE 360	
CE 370	Reinforced Concrete Design (1)	3 (3,1,0)	CE 307 CE 360	
CE 481	Geotechnical Engineering (2)	2 (2,1,0)	CE 381 CE 382	
Total		**17**		

Level 9				
Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
CE 431	Highway Engineering	3 (3,1,0)	CE 330 CE 481	CE 432
CE 432	Highway Engineering Lab	1 (0,0,2)	CE 330 CE 481	CE 431
CE 482	Foundation Engineering	2 (2,1,0)	CE 370 CE 481	
CE 404	Management of Engineering Projects	2 (2,1,0)		
CE 499	Cooperative Summer Training	0 (0,0,0)	102 hours excluding PYP hours	
CE 496	Senior Design Project (1)	2 (2,0,0)		
CE 4xx	Specialized elective courses (1)	3 (3,1,0)	Refer to Tables A-E	
CE 4xx	Specialized elective courses (2)	3 (3,1,0)	Refer to Tables A-E	
Total		**16**		

Level 10				
Course Code	Course Title	Cr. Hr	Requisites	
			Pre-	Coe-
IC 104	Fundamentals of the Islamic Political System	2 (2,0,0)		
GE 403	Engineering Economy	2 (2,1,0)		
GE 490	Ethics and Professional Practice	2 (2,1,0)		
CE 410	Construction Engineering and Management	3 (3,1,0)		
CE 497	Senior Design Project (2)	2 (2,0,0)	CE 496	
CE 4xx	Specialized elective courses (3)	3 (3,1,0)	Refer to Tables A-E	
CE 4xx	Specialized elective courses (4)	3 (3,1,0)	Refer to Tables A-E	
Total		**17**		

** PROGRAM IS PRECEDED BY A 2-LEVEL PREPARATORY YEAR

TRACKS:

Student must take at least 12 credit hours with adviser's approval

Track Name: CONSTRUCTION ENGINEERING AND MANAGEMENT

Course Code	Course Title	Prerequisites
CE 411	Introduction to Construction Contracts	--
CE 412	Estimating Construction Cost	--
CE 413	Construction Scheduling	--
CE 414	Construction Management	--
CE 417	Construction Equipment and Methods	--
CE 419	Selected Topics in Construction Engineering & Management	--

Track Name: TRANSPORTATION ENGINEERING

Course Code	Course Title	Prerequisites
CE 433	Urban Public Transportation	CE 330
CE 434	Railway Engineering	CE 431
CE 435	Airport Engineering	CE 431
CE 436	Traffic Engineering (2)	CE 330
CE 437	Analysis and Design of Pavement Systems	CE 431
CE 438	Transportation Planning	CE 330
CE 439	Pavement Maintenance	CE 431

Track Name: WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

WATER RESOURCES ENGINEERING

Course Code	Course Title	Prerequisites
CE 423	Hydraulics Structures	CE 323
CE 425	Surface and Groundwater Hydrology	CE 323
CE 426	Water Resources Planning	CE 323
CE 427	Hydraulics of Pressurized Flow	CE 323
CE 428	Hydraulics of Open Channel Flow	CE 323
CE 429	Computer Applications in Water Resources	CE 323
CE 430	Coastal Engineering	CE 323

ENVIRONMENTAL ENGINEERING

Track Name: STRUCTURAL ENGINEERING

Course Code	Course Title	Prerequisites
CE 464	Structural Analysis Using Finite Elements	CE 370
CE 466	Bridge Engineering	CE 370
CE 468	Wind and Earthquake Resistant Design	CE 370
CE 470	Reinforced Concrete Design (2)	CE 370
CE 473	Steel Structure	CE 360
CE 475	Pre-stressed Concrete Design	CE 370
CE 476	Advanced Concrete Technology	CE 307
CE 477	Concrete Technology	CE 307

Course Code	Course Title	Prerequisites
CE 445	Waste Water Reclamation and Use	CE 341
CE 446	Environmental Impact Assessment	CE 341
CE 447	Computer Aided Design of Water Distribution System	CE 341
CE 448	Computer Aided Design of Sewerage System	CE 341
CE 449	Sanitary Installations and Specifications.	CE 341
CE 450	Renewable energy	CE 341
CE 451	Solid waste management and treatment	CE 341

Track Name: GEOTECHNICAL ENGINEERING

Course Code	Course Title	Prerequisites
CE 483	Deep Foundations Engineering	CE 481 CE 482
CE 484	Geotechnical Engineering in Arid Regions	CE 481
CE 485	Introduction to Rock Mechanics	CE 481
CE 486	Improvement of Geotechnical Materials	CE 481
CE 487	Selected Topics in Geotechnical Engineering	CE 481

COURSE DESCRIPTION

PREPARATORY YEAR

CHS 101 Health and Fitness **2(2, 0, 0)**

This course is based on a scientific foundation based on the development of critical and creative thinking skills for students and the transition from the method of indoctrination through the three stages (readiness, learning, application, and evaluation) and focus on the various activities individual and collective

PHYS 107 Introduction to physics -1 **3(3, 0, 0)**

This course is intended to provide students with basic topics include history of physics, Invention of the Numbers and Measurements, Atomic structure, Current and Resistances, Electricity, Thermodynamic and heat transfer, Waves and Sound, Nuclear structure, Nuclear binding, stability and radioactivity, alpha and beta decay, gamma ray, biological effect of radiation, fundamental particle, particle accelerator, Quarks and Gluons.

Prerequisite: *None*

ENGL 109 English Language-1 **6(4, 2, 2)**

This initial stage of the course is designed to give the students a strong foundation in the English language, improving their command of English as well as improving their vocabulary, reading, writing and communication skills. In the process of improving these skills, students will also develop their confidence in the language and their presentation skills. These all contribute to life skills of students and help to prepare them for their future studies and careers beyond SU. As the course progresses and students reach a higher level of English, the focus will switch to the academic side of the language. This will involve preparing students for the style of language they will need for their future studies.

Prerequisite: *None*

ENGL 110 English -2 **4(3, 0, 2)**

This initial stage of the course is designed to give the students a strong foundation in the English language, improvement their command of English as well as improving their vocabulary, reading,

writing and communication skills. In the process of improving these skills, students will also develop their confidence in the language and their presentation skills. These all contribute to life skills of students and help to prepare them for their future studies and careers beyond SU. As the course progresses and students reach a higher level of English, the focus will switch to the academic side of the language. This will involve preparing students for the style of language they will need for their future studies.

Prerequisite: *ENGL 109*

ENGL 128 English for Engineering Purposes **2(0, 0, 0)**

The initial stage of the course is designed to provide with a secure foundation in the English language, enhancing their command of English as well as heightening their communicative skills. Each subsequent stage in the course expands upon students' improved skills. This seies of course levels allow students to develop their confidence in the language simultaneously with their presentation skills, in additional, the holistic approach of the course program supplies students with indispensable life-skills and preparation for a future beyond Shaqra University with a profound emphasis of Academic English that will promote the successful interaction and communication of students in their undergraduate and graduate studies. Hence, students will be equipped with the skills for acquiring the academic English language proficiencies required at University. To that end, the vocabulary of the course entails a selection of common-core lexical items that have a high frequency of use in a wide-range if technique and industrial settings.

Computer Skills CT 130 **3(2, 0, 2)**

This course is aiming to study the General Computer Topics, Computer Hardware and Software, Data and instructions, the Computer Processor and Main Memory. Input/Output devices and Storage devices. System Software (Operating System Basic Features, DOS, Windows, Unix, OS/2, and Macintosh), Application Software (Application Software Basic Features, Networks, Security and Privacy, Troubleshooting and Maintenance, Digital Ethics and Awareness, The Internet, Cloud Computing, MS Word, Excel Access and Power Point.
Prerequisite: *None*

MATH 130 Introduction to Mathematics **3(2, 2, 0)**

Course covers the essentials of functions (Linear, Quadratic, Polynomial, Rational polynomial, Logarithmic and Exponential), Numbers, Absolute value, graphing, solving equations and inequalities.
Prerequisite: *None*

MATH 135 - Math (2) **4(4,2,0)**

Define and evaluate the six trigonometric ratios, Solve triangles using trigonometric ratios. Define radian measure and convert angle measures from degrees to radians. Define the trigonometric functions in terms of the unit circle. Find roots of Complex Numbers. Use trigonometric functions to model and solve real-world problems, including right triangle relations, arc length, and speed. Solve trigonometric equations algebraically. Define the domain and range of the inverse trigonometric functions. Write a trigonometric function to model and solve real-world problems. Verifying trigonometric identities on one side and/or both sides. Use the addition and subtraction identities for sine and cosine. Use the double-angle and half-angle identities. Use identities to solve trigonometric

equations. Solve triangles using the Law of Cosines and Law of Sines. Find the exact value of the trigonometric functions. Solving Linear Equation System and application of System application. Solving of Linear Equation System using Inverse of Matrices.

Prerequisite: *MATH 130*

RAD 101 Entrepreneurship **2(2, 0, 0)**

Entrepreneurship course provides information, knowledge and skills to pupils in order to improve their chance of entrepreneurial success in various fields. This course is created in line with the main objective of 2030 vision to incubate of projects.

Prerequisite: *None*

ACT 105 Academic and Life Skills **3(3, 0, 0)**

This course deals with communication skills as a tool for achieving personal psychological and social adaptability. It is one of the key skills in matrix of (self-development skills) this course covers skills related to communication sufficiency comprised of a wide array of major matrix of knowledge, skills and approaches comprised in four main sufficiency: Knowledge sufficiency, Social sufficiency, Comprehension sufficiency, Productive sufficiency.

Prerequisite: *None*

UNIVERSITY REQUIREMENTS

IC 101 - Introduction to Islamic Culture **2 (2, 0, 0)**

This course is designed to establish the correct Islamic faith, and connect the Muslim generations to the main sources of Islam. It aims also to highlight the importance of turning this knowledge into a reality in the Muslim behavior, and finding appropriate Islamic solutions to the problems raised by the theories and positive systems as well as the refutation to its suspicions. The course introduces also the definition of the foundations of Islamic civilization, and the status of the reality of the Islamic nation and the reasons for their backwardness and their advancement.

Pre-requisites: *None*

IC 102 - Islam and Society Building **2 (2, 0, 0)**

This course aims to highlight the characteristics of the Muslim community and its foundations specially in the area of family formation, with emphasis on the role of women in the family and the shaping of society. Then, it shows the teachings and guidance of Islam in the district of marriage, raising children, which helps to preserve the entity and stability of the family, and thus strengthen the cohesiveness of society and, finally, addressing the Islamic solutions for what is happening in the family issues and problems, as well as the most important issues of society.

Pre-requisites: *None*

IC 103 - The Islamic Economic System **2 (2, 0, 0)**

This course aims to introduce the Islamic conception of economic life as well as patterns of behavior of systems and institutions that demonstrate the rules and legal provisions related to economic life and

economic implications with the results of its application in modern life. The course includes also a brief comparison with other economic systems in order to bring out the main advantages of the Islamic system.

Pre-requisites: *None*

IC 104 - Fundamentals of the Islamic Political System **2 (2, 0, 0)**

This course aims to introduce the political system in Islam and the most important foundations on which it is based, then the statement distinguishes the political system of Islam and other political systems as it is a part of the comprehensive system of Islam which is a global and moral one.

Pre-requisites: *None*

ARAB 101 - Language Skills **2 (2, 0, 0)**

The syntax signs, the actual sentence, the nominal sentence, the subject of the nominal sentence, the predicate, " verily (enna), almost (kada), suppose (znna), was (kana)" and similar verbs, links: pronouns, relative pronouns, demonstrative pronouns and others numbers.

Pre-requisites: *None*

ARAB 103 - Expository Writing **2 (2, 0, 0)**

Reading skills, and skill of conversation, writing the paragraph and the article, the development of the paragraph to the article, writing the administrative letters.

Pre-requisites: *None*

COLLEGE REQUIREMENTS

Compulsory Requirements

MATH 105 - Differential Calculus **3 (3, 1, 0)**

Limits and Continuity: The Concept of Limit, Computation of Limits, Continuity and its Consequences, Limits Involving Infinity, Formal Definition of the Limit. Differentiation: The Concept of Derivative, Computation of Derivatives (The Power Rule, Higher Order Derivatives, and Acceleration), the Product and Quotient Rules, The Chain Rule, Derivatives of Exponential and Logarithmic Functions, Implicit Differentiation and Inverse Trigonometric Functions, the Mean Value Theorem. Applications of Differentiation: Indeterminate Forms and L'Hopital's rule, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity and the Second Derivative Test, Optimization, Related Rates.

Pre-requisites: *None*

MATH 106 - Integral Calculus **3 (3, 1, 0)**

The definite integral, fundamental theorem of calculus, the indefinite integral, change of variable, numerical integration. Area, volume of revolution, work, arc length. Differentiation and integration of inverse trigonometric functions. The logarithmic, exponential, hyperbolic and inverse hyperbolic functions. Techniques of integration: substitution, by parts, trigonometric substitutions, partial fractions, miscellaneous substitutions. Indeterminate forms, improper integrals. Polar coordinates.

Pre-requisite: *MATH 105*

MATH 107 – Vectors and Matrices **3 (3, 1, 0)**

Vectors in two and three dimensions, scalar and vector products, equations of lines and planes in space, surfaces, cylindrical and spherical coordinates. Vector valued functions, their limits, continuity, derivatives and integrals. Motion of a particle in space, tangential and normal components of acceleration. Functions in two or three variables, their limits, continuity, partial derivatives, differentials, chain rule, directional derivatives, tangent planes and normal lines to surfaces. Extrema of functions of several variables, Lagrange multipliers. Systems of linear equations, matrices, determinants, inverse of a matrix, Cramer's rule.

Pre-requisite: *MATH 105*

MATH 203 - Differential & Integral Calculus **3 (3, 1, 0)**

Infinite series, convergence and divergence of infinite series, integral test, ratio test, root test and comparison test. Conditional convergence and absolute convergence, alternating series test. Power series, Taylor and Maclaurin series. Double integral and its applications to area, volume, moments and center of mass. Double integrals in polar coordinates. Triple integral in rectangular, cylindrical and spherical coordinates and applications to volume moment and center of mass. Vector fields, line integrals, surface integrals, Green's theorem, the divergence theorem, Stoke' theorem.

Pre-requisite: *MATH 106*, *MATH 107*

MATH 204 - Differential Equations **3 (3, 1, 0)**

Various types of first order equations and their applications. Linear equations of higher order. Systems of linear equations with constant coefficients, reduction of order. Power series methods for solving second order equations with polynomial coefficients. Fourier series, Fourier series for even and odd functions. Complex Fourier series. The Fourier integral.

Pre-requisite: *MATH 203*

MATH 254: Numerical Methods **3 (3, 1, 0)**

Various numerical methods for solving nonlinear equations. Direct and iterative methods for solving systems of linear equations along with error estimate. Polynomial interpolation with error formula. Numerical differentiation and integration with error terms. An introduction to numerical solution of ordinary differential equations.

Pre-requisite: *MATH 107*

STAT 324 - Engineering Probability and Statistics **3 (3, 1, 0)**

Probability and probability distribution - Mathematical expectations of random variables. Discrete and continuous distributions. Sampling distributions - Estimation, testing of hypothesis - Regression and correlation.

Pre-requisites: *None*

PHYS 103 - General Physics (1) **4 (3, 1, 2)**

Motion: vectors, gravitational fields and its applications (measurement of the acceleration of the gravity by the simple pendulum and by the compound pendulum experiment) - applications of Newton's laws (one and two dimensions). Fluid Mechanics: fluid static and fluid dynamics (measurement of surface tension by direct method and by capillary tube experiment) – viscosity (measurement of the coefficient of viscosity experiment) - static equilibrium and elasticity. Conservation of Energy: temperature (measurement of specific heat experiment) – (measurement of the thermal conductivity experiment) – first law of thermodynamics heat engines – entropy and second law of thermodynamics – the kinetics theory of gases – waves – sound waves (measurement of sound velocity experiment)

Lab: Simple pendulum- compound pendulum – Hooke's law – measurement of coefficient of viscosity of liquid- surface tension – measurements of thermal conductivity – measurement of the specific heat of solid bodies.

Pre-requisites: *None*

PHYS 104 - General Physics (2) **4 (3, 1, 2)**

Electrostatics: charge and matter- electric field – Gauss's law – electric potential – direct current – electric circuits (Ohm's law experiment) – capacitors (measurement of capacitance of a capacitor). Magnetism: magnetic field (magnetic field experiment) Ampere's law – Biot & Savart law – magnetic materials- Faraday's law of induction. Geometrical optics: reflection and refraction of light (refractive index experiment) - (measurement of magnification factor of the microscope) - fiber optics -

dispersion of light – lenses law (determination of the radius of the curvature of lens experiment), (determination of the focal length of the lens experiment).

Lab: Ohm's law – measurement of capacitance of a capacitor – magnetic field - determination of radius of curvature and focal length of a lens - measurement of refractive index of glass – microscope - measurement of light velocity.

Pre-requisites: *PHYS 103*

CHEM 101 - General Chemistry **4 (3, 1, 2)**

Stoichiometry: SI Units, chemical formulas, the mole, methods of expressing concentration, calculations based on chemical equations. Gases: laws, kinetic theory, deviation and van der Waals equation. Thermochemistry: types of enthalpy changes, Hess Law and its applications, first law of thermodynamics. Solutions: type of solutions and laws related, colligative properties. Chemical kinetics: law of reaction rate, reaction order, factors affecting the rates. Chemical Equilibrium: relation between Kc & Kp, Le Chatelier's principle and factor affecting equilibrium. Ionic equilibrium: acid and base concepts, pH calculations of acid, base and buffer solutions. Atomic Structure: emission spectrum, Bohr's theory de Broglre's hypothesis, quantum numbers, electronic configuration of elements, consequences of the periodic table.

Lab: Discovering salts, detection of acidic radical (anions), checking basic radicals (cations), determining acidic and alkaline parts concentration, heating value (bomb calorimeter)

Pre-requisites: *PHYS 100*

ENGL 107 - Technical Writing **3 (3, 0, 0)**

Types of documents. Principles of organizing, developing and writing technical information. Report structure and components. Report forms and rhetorical patterns common to scientific and technical Disciplines. Technical writing conversions including headings, illustrations, style and tone. Extensive writing assignments for various report and document types.

Pre-requisites: *None*

ENGL 116 - English Composition **3 (3, 0, 0)**

English composition provides students with the theatrical foundations that prepare them for the demands of academic and professional writing. In this course, students will learn and practice the strategies and processes that successful writers employ as they work to accomplish specific purposes**.**

Prerequisite: *None*

Complementary Requirements

GE 106 - Introduction to Engineering Design **2 (1, 0, 2)**

Introduction and practicing the engineering professional culture and ethics. Enhancing on personal skills such as teamwork, leadership, written and oral presentation. Problem solving strategies. Problem definition and techniques for stimulation of ideas. Decision making in design. Mathematical and computer modeling techniques.

prerequisite: *None*

GE 107 - Engineering Drawing and Design **3 (1, 0, 4)**

Constructional geometry and basics of lettering; Sketching; Orthographic projection; Pictorial and auxiliary views; Dimensioning; Introduction to computer graphics; Engineering applications. Computer aided design using Auto CAD.

Pre-requisites: *GE 106*

GE 212: Computer Programming **3 (2, 0, 2)**

Introduction to computers and numbers systems. Concepts of algorithm and program structures, comments, and printing. Formatting output, Escape sequence, and program debugging. Variables, arithmetic operators, and expressions. Access of input/output files. Program control using: if-else statement, switch commands, for loops, and while loops. User-defined functions. One and two-dimensional Arrays. Multidimensional arrays. Strings and Pointers. Engineering Applications.

Prerequisite: *None*

GE 403 - Engineering Economy **2 (2, 1, 0)**

Foundation of engineering economy; cost concepts; Time value of money operations. measuring the worth of investments; comparison of alternatives; depreciation; economic analysis of public projects.

Pre-requisites: *None*.

GE 490 - Ethics and Professional Practice **2 (2, 1, 0)**

Codes of Ethics; Professional Liability; Essentials of plans and specifications; Bidding; Awarding and administration of contracts; Contracts and Contract Law; Strandraization and Standards; Licensure; Bonding claims; Public policy and its impacts; Risks and managing the risks;

Prerequisites*: None.*

DEPARTMENT REQUIREMENTS

CORE COURSES

CE 201 - Statics **3 (3, 1, 0)**

Force systems; vector analysis, moments and couples in 2D and 3D. Equilibrium of force systems. Analysis of structures; plane trusses and frames. Distributed force system; centroids and composite bodies. Area moments of inertia. Analysis of beams. Friction.

Prerequisite: *MATH 106, MATH 107*

CE 212 - Surveying **3 (2, 1, 2)**

Introduction & definitions; surveying types & importance, measurements units; basics of Linear Measurements (tape, optical & electronic); theodolites & angular measurements; levels & leveling operations; applications of leveling (contouring); planimetric (cross-sectional area & volume determination); introduction to total station; setting out; introduction to underground surveying; introduction to photogrammetry & remote sensing.

Prerequisite: *MATH 107*

CE 240 - Introduction to Environmental Engineering **3 (2, 1, 2)**

Introduction to environment and environmental engineering, environmental concerns and polices, natural water systems, self-purification mechanisms, water pollution, air pollution, land pollution, dispersion of pollutants, control technology, solid waste management and treatment, renewable energy, noise, light and thermal pollution, measurements and control of pollution, Environmental Impact Assessment for projects

Lab: Measurements of air pollution (concentration of CO, CO_2, NOx, SO_2) measurements of water pollution (salinity, turbidity, hardness, softness, COD, BOD, suspended and dissolved matter), measurements in land pollution (concentration of organic and inorganic pollutants), biogas production from organic wastes, wind energy, solar energy.

Prerequisites: *CHEM 101*

CE 302 - Mechanics of Materials **3 (3, 1, 0)**

Stresses and Strains - Introduction and fundamentals of mechanics of deformable materials. Concept of stress and strain and Hooke's law. Concept of failure, yield and allowable stresses. Factor of safety and allowable stress design. Transformation of stress and strain and Mohr's circle. Stresses in Beams - Normal stress under axial loading and bending. Shear stress and stress due to torsion. Analysis of Determinate Beams and frames - Shear force and bending moment diagrams. Deflections in Determinate Beams and Cantilevers - Deflection of beams; Load deflection relationship, Deflection calculation by double integration, moment area and conjugate beam methods. Buckling of columns.

Prerequisites*: CE 201; Co-request: CE 305*

CE 305 - Mechanics of Materials Labs **1 (0, 0, 2)**

Concepts and fundamentals of Experimental demonstrations of uniaxial deformations and Poisson's effect, beam deflection, slope and curvature, angle of twist and shearing strain in a twisted circular shaft. Column buckling

Prerequisites*: CE 201; Co-request: CE 302*

CE 307 – Construction materials **3 (2, 0, 2)**

Cement, Aggregate and cement concrete: Methods of manufacturing of cement and its chemistry, Types of cement, Hydration mechanism, Testing of cement and aggregates, Properties of fresh and hardened concrete and their tests, Introduction to mix design. Conventional and Non-conventional construction materials: Bricks & Concrete blocks Classification and tests. Types of masonry bonds. Timber - Structure and characteristics of hard and soft wood, Engineering applications: Defects, Seasoning, Preservation, Fire proofing. Steel: Types and mechanical properties of various structural steel.

Lab: Tests on cement (consistency, setting time, compressive strength), tests on aggregate (fineness modulus of sand & gravel, bulking of sand, silt content), tests on concrete (slump test, compaction factor, compressive strength, flexural strength, non-destructive testing- rebound hammer & PUNDIT)

Prerequisites: *CE 302*

CE 320 - Fluid Mechanics **3 (3,1,0)**

Dimensions and units; fluid properties, pressure at a point, pressure variation with depth, hydrostatic forces on plane surfaces, hydrostatic forces on curves surfaces, buoyant forces, stability of floating bodies, continuity equation, Euler equation, Bernoulli equation, energy equation, momentum equation, velocity and discharge measurements, steady pipe flow, introduction to pumps. Introduction to open channel hydraulics.

Prerequisites*: CE 201; PHYS 103; Co-requisites: CE 321*

CE 321 - Fluid Mechanics Laboratory **1 (0, 0, 2)**

Determination of dynamic viscosity. Flow through small orifices. Verification of Bernoulli's equation. Flow through venture-meters. Impact of water jets on plates (flat & hemispherical). Centre of pressure, Impact of Liquid jet, Head losses through sudden contraction and enlargement, Stability of floating bodies. Losses in pipes and pipe fittings. Performance test on centrifugal pumps. Uniform open channel flow. Velocity measurements in open channels.

Prerequisites*: CE 201; PHYS 103; Co-requisites: CE 320*

CE 323 - Water Resources Engineering **3 (3, 1, 0)**

Hydrologic cycle and budget, meteorological data, hydrologic processes: precipitation; evaporation; transpiration Infiltration, rainfall, runoff, detention, flood flows, watersheds, hydrograph of basin outflow, storage routing for natural channels and aquifers, groundwater movement, aquifer characteristics, probability concepts in design recurrence intervals, flood frequency analysis and flow direction curves, hydraulics of wells, boundary effects, wells construction and maintenance.

Prerequisites*: CE 320*

CE 330 - Traffic Engineering (1) **3 (3, 1, 0)**

Introduction to Transportation Engineering, Concepts and definitions, Principles of Transportation Planning, Prediction of Demand, Transportation Supply, Introduction to Traffic Engineering, Characteristics of Driver, Vehicles and Pedestrian, Studies of Main Traffic Elements (Speed Studies – Traffic volume Studies – Trip Duration Studies), Relations between Speed, Volume and Density, Highway Capacity and Level of Service, Parking Characteristics, Traffic Control System, Traffic Signals, Traffic Signs.

Prerequisites: *None*

CE 341 - Water Supply and Waste Water Treatment Engineering **3 (2, 1, 2)**

An introduction about treatment and water supply works and its importance for urban communities, population studies and consumption rates, water sources, water treatment for different water types (Sedimentation, filtration, disinfection), water quality, distribution and storage works (elevated and ground tanks and water distribution networks). Moreover, an introduction about wastewater works and wastewater characteristics, estimation of wastewater quantities and sources, design of wastewater networks and pump stations, treatment processes (preliminary, primary, biological and tertiary treatment). Furthermore, the treatment and disposal of sludge.

Lab: Measurements of water and wastewater characteristics (suspended, dissolved, volatile, and fixed solids concentrations, determination of turbidity, alkalinity, hardness, conductivity, pH of solutions, and heavy metals, Jar test, disinfectant residual, COD, BOD, TOC, TOX, DO, NO_2, NO_3, NH_4, P, SVI, MLSS, MLVSS, and microbiological examinations)

Prerequisites*: CE 240, CHEM 10.*

CE 360 - Structural Analysis (1) **3 (3, 1, 0)**

General - Classification of structures; loads and structural design. Concept of static and kinematic indeterminacies. Analysis of determinate truss and arches. Analysis of statically indeterminate beams and frames – Application of force and displacement methods – Use of theorem of three moment equations, slope deflection and moment distribution methods for the analysis of various types of indeterminate beams, non-sway and sway frames. Deformation of beams, frames and trusses using virtual work method

Prerequisites*: CE 302*

CE 370 - Reinforced Concrete Design (1) **3 (3, 1, 0)**

Introduction to reinforced concrete and building codes. Limit states and working stress design philosophy. Flexural behavior of reinforced concrete simple and continuous beams: Design of beams for flexure and shear in accordance with strength design method of SBC-304. Development and splice length of reinforcement. Design of one-way and two way floor systems. Design of compression members: Short column, Columns with uni-axial and bi-axial bending; Long columns, use of design charts. Design of stair case.

Prerequisites*: CE 307; CE 360*

CE 381 - Geotechnical Engineering (1) **2 (2, 1, 0)**

Types and classification of rocks. Formation of soils. Weight-volume relationships. Consistency limits. Classification of soils. Soil compaction. Permeability and seepage. Total and effective stress principle. Soil stresses using elastic theory.

Prerequisites*: CE 302;* Co-requisite: *CE 382*

CE 382 - Geotechnical Engineering Laboratory **1 (0, 0, 2)**

Moisture content. Liquid, plastic and shrinkage limits. Specific gravity. Sieve analysis. Hydrometer test. Compaction test. Field Density. Permeability test. Direct shear test. Unconfined compression test. Consolidation test. Conventional triaxial test.

Prerequisites*: CE 302;* Co-requisite: *CE 381*

CE 404 – Management of Engineering Projects **2 (2, 1, 0)**

This course is in an introductory course on project management. The course covers the project management process from the beginning to the end, focusing on practical skills that make students able to immediately complete projects on time and on budget, while achieving their targets.

Pre-requisites: *None*

CE 410 - Construction Engineering and Management **3 (3, 1, 0)**

Construction documents; Construction project procurement & delivery method; Construction operations and methods; Construction estimating process (Earthwork /Concrete /Masonry /Carpentry /Steel/ Mechanical and Electrical estimating); Contemporary issues in construction management

Prerequisites*: None.*

CE 431 - Highway Engineering **3 (3, 1, 0)**

Introduction, Highway Travel Characteristics; Highway Surveys and Plans; Geometric Design of Highway – Horizontal and Vertical Curves; Highway Classification as per AASHT0- Carriage Way – Shoulders- Medians-Right of way-Foot paths- Cycle Tracks- Service roads- branch Roads- Sight Distances- camber; Intersections and Interchanges; Pavement Structural Design.

Prerequisites*: CE 330; CE 481;* Co-requisite: *CE 432*

CE 432 - Highway Engineering Lab **1 (0, 0, 2)**

Aggregate Testes (sieve analysis, water absorption, aggregate impact value, aggregate abrasion value, aggregate crushing value), Asphalt Tests (Bitumen content, ductility of bitumen, penetration of bitumen, specific gravity of bitumen, softening point of bitumen), CBR Test, Marshall Mix design.

Prerequisites*: CE 330; CE 481;* Co-requisite: *CE 431*

CE 460 - Structural Analysis (2) **3 (3, 1, 0)**

Analysis of Building frames: Approximate methods, Matrix method of Analysis: Stiffness and Flexibility methods, application to the beams and frames. Moving Loads on Structures: Use of Influence line diagram for determinate and indeterminate beams and frames, Introduction to structural dynamics, Computer applications

Prerequisites*: CE 360*

CE 481 - Geotechnical Engineering (2) **2 (2, 1, 0)**

Compressibility of soils; consolidation of soils, Shear strength of soils; Slopes Stability; Lateral earth pressures; Retaining walls; Soil improvement: compaction - concepts, measurement and field techniques, overview of other soil improvement techniques.

Prerequisites: *CE 381; CE 382*

CE 482 - Foundation Engineering **2 (2, 1, 0)**

Site investigations, types of foundation, bearing capacity of foundations. Settlement of foundations. Spread footings. Combined footings. Mat foundations, pile foundation, basic design of foundation, and general overview of Saudi Building Code for soils and foundations.

Prerequisites*: CE 481, CE 370*

CE 499 - Cooperative Summer Training **0 (0, 0, 0)**

Students could go for practical training of 10 weeks at one of the Civil construction companies. Students could acquire new skills, get used to creative thinking, team work, writing professional reports practice problem solving and decision-making. The training provides students with an opportunity to enrich their university experience by relating the academic studies to practice.

Engineering Courses from Other Departments

ME 202 – Dynamics **3 (3, 1, 0)**

Kinematics of a particle: curvilinear motion and relative motion; Kinematics of a rigid body in plane motion: relative velocity relative acceleration, and rotating axes; Kinetics of particles: Newton's 2nd law, work and energy, impulse and momentum, and impact; Kinetics of a rigid body in plane motion: translation, fixed axis rotation, general motion, work and energy, and impulse and momentum.

Pre-requisites*: CE 201*

Senior Design Projects

CE 496 – Senior Design Project (1) **2 (2,0,0)**

This is the first phase of the capstone design project that is a continual project over two semesters, and involves number of students working as one team tackling different aspects of the civil engineering works. This phase introduces knowledge of ethical responsibilities, public policies, administration, leadership, and contemporary issues related to Civil Engineering practice. It also includes project selection, data collection, identification of real-life constraints (e.g. economy, environmental, global, and contemporary issues), generation of possible design alternatives considering client needs, and preparation of a work plan for implementing and completing the project. All work conducted during the semester must be complied in a final report.

Pre-requisite*: 1. Subjected to regulations established by the College Council.*
2. Successful completion of 100 credit hours (Excluding the Preparatory Year)

CE 497 - Senior Design Project (2) **2 (2, 0, 0)**

This is the implementation phase of the capstone design project. It includes analysis of design criteria, parameters and constraints for the design alternatives to select the preferred option, and design calculation and/or use of experimental tools (if required) to refine design. The final report to be submitted by the team includes project title, description, objectives and constraints; data and assumption; design alternatives and analysis; details of preferred design analysis and calculations along with pertinent drawings; and summary and conclusions.

Prerequisite*: CE 496*

LECTIVE COURSES

Construction Engineering and Management Track

CE 411- Introduction to Construction Contracts **3 (3, 1, 0)**

Basics of construction law. Types and selection of construction contracts. Essentials of plans and specifications. Bidding. Awarding and administration of contracts. Liability. Bonding claims. Construction contracts in Saudi Arabia. Introduction to computer applications. Group project.

Co-requisite*: CE 404*

CE 412 - Estimating Construction Cost **3 (3, 1, 0)**

The estimating process. Conceptual estimation. Range estimation. Detailed estimate. Earthwork. Concrete. Masonry. Carpentry and steel. Mechanical and Electrical estimating. Heavy construction. Profit and bonds. Labor productivity. Computers in estimating. Bidding strategy, Group Project.

Co-requisite*: CE 404*

CE 413 - Construction Scheduling **3 (3, 1, 0)**

Construction Planning. Construction Scheduling using different CPM techniques
Probabilistic scheduling. Constrained and unconstrained resource allocation. Network compression. Techniques for scheduling repetitive works. Updating construction schedules.

Co-requisite*: CE 404*

CE 414 - Construction Management **3 (3, 1, 0)**

Construction site organization. Analysis of contract cash flow. Construction economics. Design of a project control system. Site cost control. Role of BOQ in contract valuation.

Co-requisite*: CE 404*

CE 417 - Construction Equipment and Methods **3 (3, 1, 0)**

Overview of the construction industry; Earthmoving materials and operations; Excavation and lifting; Loading & hauling; Compacting & finishing; Concrete construction; Concrete form design; Construction economics; Contract construction.

Co-requisite*: CE 404*

CE 419 – Selected Topics in Construction Engineering and Management 3 (3, 1, 0)
Selected topics related to constrcution engineering and management will be covered in this course.

Co-requisite*: CE 404*

WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

CE 423 - Hydraulic Structures 3 (3, 1, 0)
Design of inlet structures of irrigation canals, cross structures, culverts, siphons and aqueducts, energy dissipation below hydraulic structures, spillways, and design of dams.

Prerequisite*: CE 323*

CE 425 - Surface and Groundwater Hydrology 3 (3, 1, 0)
Review of hydrologic cycle elements, computation of average precipitation, stream flow and stage relationship, hydrograph analysis, infiltration indices, hydrograph of basin outflow, storage routing for natural channels and reservoirs, probability concepts in design recurrence intervals, flood frequency analysis and flow direction curves, hydraulics of wells, boundary effects, wells construction and maintenance.

Prerequisite*: CE 323*

CE 426 - Water Resources Planning 3 (3, 1, 0)
Water supply, water demand, planning process, considerations in planning: economic, social, environmental, and legislative, case study of Saudi Arabia.

Prerequisite*: CE 323*

CE 427 - Hydraulics of Pressurized Flow 3 (3, 1, 0)
Conservation of mass, conservation of energy and applications of the energy equation, pumps and turbines, pump selection, pumps in series, pumps in parallel, unsteady flow, dimensional analysis and dynamic similitude.

Prerequisite*: CE 323*

CE 428 - Hydraulics of Open Channel Flow 3 (3, 1, 0)
Concepts of fluid flow, elements of channel section, type of flow, state of flow, conservation laws, critical flow, uniform flow, design of channel sections, gradually varied flow, rapidly varied flow.
Prerequisite*: CE 323*

CE 429 - Computer Applications in Water Engineering 3 (3, 1, 0)
Studying and applying computer programs in the field of open channel flow, closed conduit systems, surface and groundwater hydrology.

Prerequisite*: CE 323*

CE 430 - Coastal Engineering **3 (3, 1, 0)**

Coastal Zone Planning, ocean waves along the coast, wave statistics, wave refraction, wave diffraction, wave shoaling, wind and wave generation, tides and tidal currents, sand migration, coastal erosion and erosion control, erosion around structures due to waves and currents and propeller erosion.
Prerequisites: *CE 323*

CE 445 - Wastewater Reclamation and Reuse **3 (3, 1, 0)**

Potential reuse applications. Sources of water for reuse. Treatment technologies suitable for water reuse applications. Criteria for each application. Feasibility and planning of water reuse systems. Management of biosolids resulting from wastewater treatment.

Prerequisite*: CE 341*

CE 446 - Environmental Impact Assessment **3 (3, 1, 0)**

Definition. Importance. Objectives. Principles & Main Features. Components, Stages and Activities of an EIA process: Public Involvement, Screening, Scoping, Impact Analysis, Mitigation and Impact Management, Reporting, Review of EIA Quality, Decision-making, Implementation and Follow Up.

Prerequisite*: CE 341*

CE 447 - Computer Aided Design of Water Distribution System **3 (3, 1, 0)**

Introduction for water supply networks, Planning of water, firefighting and irrigation networks, Water networks, Data Entry, Integration with Cad programs, Water networks Hydraulic design, Design limitations and diameters of pipes and the network balanced Alternatives scenarios pumps and valves, Flex tables, Elevated and ground tanks, Water network design practice project
Pre-requisites: CE 341

CE 448 - Computer Aided Design of Sewerage System **3 (3, 1, 0)**

Introduction for sewage networks, Planning of water, firefighting and irrigation networks, Distribution of loads on the network and enter data on computer programs such as levels, water consumption rates, Patterns ….etc, Sewerage and storm systems planning, Corresponding loads from buildings and rainwater with data entry of the levels of the ground and the rates of water consumption and rates of rainfall, Design of pipes diameters with the determination of levels and slopes of pipes and locate of lifting stations. Profile draw
Pre-requisites: *CE 341*

CE 449 - Sanitary Installations and Specifications **3 (3, 1, 0)**

Plumbing inside buildings, Sanitary tools and its installation, Hot and cold water supply, Sanitary works and wastewater disposal, Firefighting systems inside buildings, Hydrostatic testing of pipes, and Sanitary installation tests

Pre-requisites: *CE 341*

CE 450 - Renewable energy **3 (2, 1, 2)**

The concept of renewable energy, benefits of renewable energy, different types and sources of renewable energies (solar, wind, biomass, hydro power, and geothermal power), renewable energy in the new energy framework and case study for renewable energies.
Lab: Measurements of biomass characteristics (HHV, LHV, COD, TN, TC, TVS, TFS, VFA, and TS), moreover, measuring the biomass, solar and wind power by using bench scale.

Pre-requisites: *CE 341*

CE 451 - Solid waste management and treatment **3 (2, 1, 2)**
The concept and meaning of solid waste, types, sources, characteristics, quantities, solid waste management, treatment and energy recovery via different technologies.
Lab: Measurements of solid waste characteristics (HHV, LHV, COD, TN, TC, TVS, TFS, VFA, and TS), determine the contaminants in landfill leachate (concentration of organic and inorganic pollutants), biogas production from organic wastes, biogas composition, and biogas analysis.

Pre-requisites: *CE 341*

TRANSPORTATION ENGINEERING

CE 433 - Urban Public Transportation **3 (3, 1, 0)**
Conceptual Framework for Estimating Transit Demand, Technological Characteristics and Their Impacts on Capacity, Service Quality, and Cost. Data Collection and Analysis, Performance Monitoring, Route Design, Frequency Determination, and Vehicle and Crew Scheduling.

Prerequisites*: CE 330*
CE 434 - Railway Engineering **3 (3, 1, 0)**
Dynamic of Motion, Geometric Design of Railways, Track, Turnouts and Crossings, Railway Stations, Railways Signaling.

Prerequisites*: CE 431*
CE 435 - Airport Engineering **3 (3, 1, 0)**
Aviation System, Master Plan, Air Travel Demand, Aircraft Characteristics, Capacity and Configuration, Design System Elements, Terminal Area, Geometric Design, Pavement Design, Drainage, Marking, Signing and Lighting.

Prerequisites*: CE 431*
CE 436 - Traffic Engineering (2) **3 (3, 1, 0)**
Traffic Stream Characteristics, Parking Studies, Accident Studies, Intersection Signalization, Statistical analysis of traffic data, Traffic lanes capacity, Traffic management & demand management, Intelligent transport systems.

Prerequisites*: CE 330*
CE 437 - Analysis and Design of Pavement Systems **3 (3, 1, 0)**

Introduction, Types of Pavement, Stresses in Flexible Pavement, Vehicle and Traffic Consideration, Materials Characterization, Soil and Base Stabilization, Sub-grades, Bases and Sub-bases, Material Variability, Flexible Pavement Design Methods.

Prerequisites*: CE 431*

CE 438 - Transportation Planning **3 (3, 1, 0)**

Introduction to Transportation Planning and Forecasting Models, The Transportation Systems and Its Characteristics, Urban Transportation Planning Process, Travel Demand Forecasting Models: Trip Generation, Trip Distribution, Mode Choice, and Network Traffic. Case Studies.

Prerequisites*: CE 330*

CE 439 - Pavement Maintenance **3 (3, 1, 0)**

Concept of Pavement Serviceability and Maintenance, Pavement Evaluation, Types of Pavement Maintenance and Rehabilitations, Identification of Flexible Pavement Distresses, Treatment of Pavement Distresses, Maintenance Activities, Maintenance Decisions, Structural and Functional Overlay, Economic Evaluation of Pavement Maintenance Alternatives.

Prerequisites*: CE 431*

STRUCTURAL ENGINEERING

CE 464 - Structural Analysis Using Finite Element **3 (3, 1, 0)**

Introduction to finite element method: element types, meshing, and modeling concepts. Application of finite element computer programs to frames, slabs, walls and footings. Graphical presentation and interpretation of results. Validation and verification of computer solutions by comparison to known solutions and code methods.

Prerequisites*: CE 370*

CE 466 - Bridge Engineering **3 (3, 1, 0)**

Types of Bridges. Design codes and bridge loadings. Analysis of bridge superstructures. Design of slab-on-girder decks: R.C. girders, pre-stressed girders, steel girders and composite girders. Analysis and design of bridge substructures.

Prerequisites*: CE 370*

CE 468 - Wind and Earthquake Resistant Design **3 (3, 1, 0)**

Concepts, basic requirements and criteria of wind design. Analysis and design procedures. Basic requirements and criteria of seismic design. Design ground motion. Seismic design categories, building configuration and structural systems. Analysis procedures. Design and detailing requirements of RC frames. Requirements for non-structural components. Computer applications for RC frames.

Prerequisites*: CE 370*

CE 470 - Reinforced Concrete Design-2 **3 (3, 1, 0)**

Design of foundation: Isolated and combined footing. Water tank and staging: Introduction, Design criteria, Design of rectangular and circular water tank. Design of retaining walls, Serviceability of RC structures

Prerequisites*: CE 370*

CE 473 - Steel Structures **3 (3, 1, 0)**

Introduction to types of structural steel and steel structures. Concept of LRFD method. Strength and design of tension members with bolted and welded connections. Strength and design of columns, beams and beam-columns. Design of bolted and welded connections, splices, and column base plates. Analysis and design of roof trusses and frame structures.

Prerequisites*: CE 360*

CE 475 - Pre-Stressed Concrete Design **3 (3, 1, 0)**

Fundamentals of pre-stressing, pre-stressing materials and pre-stress losses. Allowable stress and ultimate strength design methods. Analysis and design of beams for flexure, shear and deflection. Slab system.

Prerequisites*: CE 370*

CE 476 - Advance Concrete Technology **3 (3, 1, 0)**

Hydration and pore structure development; lightweight concrete and heavyweight concrete, Hot and cold weather concreting, Durability of concrete. Quality of concrete and compliance with specifications, Concrete sustainability.

Prerequisites*: CE 307*

CE 477 - Concrete Technology **3 (3, 1, 0)**

Constituent materials of Concrete; Types, Properties and Tests as per Code, Concrete; Production, Properties, tests and Quality Control, Introduction to Non-destructive Tests.

Concrete Mix Design; Concepts, Methods, Sample problems using IS code method Characteristic and Target strengths, Sampling and acceptance criteria Equipments and methods for mixing, compaction, curing, Admixtures and construction chemicals; Types, method of mixing, Effect on different properties of concrete, Behavior of Concrete in Extreme Climate: Permeability & Durability, Effect of Temperature, Saline Environment, Sulphate & Acid Attack, Corrosion and Fire Resistance. Special forms of Concrete: Ferro cement, Fiber Reinforced Concrete, Polymer Concrete, Light Weight Concrete, High Density Concrete etc., Gunite and shortcreting

Prerequisites*: CE 307*

GEOTECHNICAL ENGINEERING

CE 483 - Deep Foundations **3 (3, 1, 0)**

General concepts. Types of deep foundation. Bearing capacity of single piles. Bearing capacity of group piles. Settlement of piles. Laterally loaded piles. Excavation and bracing. Sheet piling. Drilled piers. Caisson foundations.

Pre-requisites: *CE 481; CE 482.*

CE 484 - Geotechnical Engineering in Arid Regions **3 (3, 1, 0)**

Geology of arid regions. Introduction to unsaturated soil mechanics. Construction and design of foundations on: expansive soils, collapsing soils, shrinking soils, loessial soils, salt bearing soils, highly weathered limestone, large cavities in rock, coralline limestone, and sand dunes.

Pre-requisites: *CE 481.*

CE 485 - Introduction to Rock Mechanics **3 (3, 1, 0)**

Rock and rock mass classifications for engineering purposes. Index properties and their measurements in field and laboratory. Stresses and their measurements. Deformability. Strength and failure criteria. Stability of rock masses.

Pre-requisites: *CE 481.*

CE 486 - Improvement of Geotechnical Materials **3 (3, 1, 0)**

Improving performance of soils for engineering applications. Analysis of methods of stabilizing soils and rocks including topics on: Mechanical and chemical stabilization and earth reinforcement.

Pre-requisites: *CE 481.*

CE 487 - Selected Topics in Geotechnical Engineering **3 (3, 1, 0)**

Soil behavior. Computer applications in geotechnical engineering. Seepage and consolidation. Soil dynamics. Principles of unsaturated soil mechanics. Geo-environmental engineering.

Pre-requisites: *CE 481.*