Bachelor of Science (B.Sc.) Course Description

Babol Noshirvani University of Technology

Department: *Civil and Environmental Engineering*

Major: *Civil Engineering*

- **Course Title:** Calculus 1 **Number of Credits:** 3

  Descriptions: Cartesian and polar coordinate; complex numbers and manipulations; geometric representation of complex number; polar representation of complex numbers; single variable calculus; basic concepts of single variable function, continuous, discontinuous and piecewise continuous functions; periodic, odd and even functions, algebraic functions; transcendental functions and its graphical representations; trigonometric functions and their inverse; differential calculus, differential calculus, limits and continuity, interpretation of a derivative, geometric interpretation, the use of a table of different type derivatives, higher order derivatives, tangents and normals, approximation of a function at a particular point by Taylor's and Maclaurin's series, maximum and minimum values of a function, the first derivative test, the second derivative test, point of inflexion and its applications in engineering.

- **Course Title:** Physics 1 **Number of Credits:** 3

  Descriptions: Equilibrium, conditions of equilibrium under forces and moments, corresponding principles; Motion in 1D and 2D, speed and acceleration, types of motion, earth motion and gravity; work and energy: intro., work, energy, kinetic energy, potential elastic energy, dissipated energy, internal work, internal potential energy, power and speed; impact, the law of preservation of momentum; temperature; heat, first law of thermodynamics, zeroth law of thermodynamics, temperature measurement; gases kinetic theory, complete gasses, transferable kinetic energy, mean free path, degree of freedom, molar specific heat; entropy and the second law of thermodynamics, one-way reactions, change in entropy.

- **Course Title:** Persian Language **Number of Credits:** 3

  Descriptions: On authorship and its value; properties of a good text; dictation in Persian; punctuations; taking note in reading; report writing; summary writing; research methods; writing articles; story writing; translation techniques; foreign writers.

- **Course Title:** Rules of life **Number of Credits:** 2

  Descriptions: Professional ethics; accepting critics, teamwork spirit, responsibilities to maintain safety, responsibility in workplace and honesty, environmental ethics; global issues.

- **Course Title:** Technical English **Number of Credits:** 3

  Descriptions: The course objective is to reading and understanding of English texts to prepare students to understand technical articles: use of dictionaries and encyclopedias; building vocabulary; topic writing; writing abstract; skimming various texts; introduction and practice of complicated patterns in partially technical texts; understanding and use of academic vocabulary in test up to 3000 vocabulary; simple exercises of equivalent vocabulary and sentence translation to Persian language.

- **Course Title:** Technical and Structural Drawing **Number of Credits:** 2

  Descriptions: Introduction to principles of technical drawings and visualize part views; unknown section views with and without drafting tools; different perspective views (isometric, cavalier, and two points); drawing symbols in building plans and electrical and mechanical plans; drawing instructions; common building plans, foundation plans, and girder layouts; views; section cuts.

- **Course Title:** Geology **Number of Credits:** 2

  Descriptions: Role and importance of engineering geology in civil engineering projects; planet earth and its internal structure; geological processes; earth surficial features (bedding planes, folding, faults, fractures, etc.); earth crustal activities (Tectonics. Earthquake); geological materials (rocks and minerals); classification of rocks (Igneous, Sedimentary, Metamorphic) and their characteristics; classification of minerals and their characteristics; rock weathering and formation of soils; soil transporting agents (water, wind, glacier, gravity and their related sediments); rock mass characteristics and introduction to rock mass classification for engineering purposes; landslides and effects of geological features on instability of slopes and trenches; geological investigations (desk studies, site investigation, sub-surface explorations)

- **Course Title:** Calculus 2 **Number of Credits:** 3

  Descriptions: Parametric equations; 3D coordination; vectors in space and types of vector multiplication; 3x3 matrices, linear three-unknown equation systems, matrix inversion, solving equation system, linear independence, base in R2 and R3, linear transformation, 3x3 matrix determinant, Eigen value and Eigen vectors; linear systems, plane and two-degree equations; vector functions and their derivatives, speed and acceleration, curvature and normal vector on curve; multi-variable functions, total and partial derivatives, tangent planes and normal lines, chain rules for partial derivatives, total differential; double and triple integral and their application in geometric and physical problems, integration by substitution (without precise proof) cylindrical and spherical coordinate; scalar and vector field, line integral, surface integral, divergence, Laplace, potentials of Green's theorems and divergence and stokes

- **Course Title: Ordinary** Differential Equations **Number of Credits:** 3

  Descriptions: Properties of differential equations and their solutions; curve families and normal paths; separable equations; linear one-degree differential equations, homogeneous equations; linear two-degree equations, homogeneous equations with constant coefficients, indeterminate multiplier methods, parameter substitution method; applications of two-degree equations in physics and mechanics; differential equation solutions using series, Bessel and Gamma functions; Legendre multinomial; introduction to systems of differential equations; Laplace transformation and its application in differential equation solutions

- **Course Title:** Physical Education 1 **Number of Credits:** 1

  Descriptions: The students will learn following concepts by participate in physical exercises: principles of physical training; objectives of physical educations; principles of maintaining health and fitness; introduction to physical education programs; principles of physical and mobility self-test.

- **Course Title:** Iran Islamic Revolution **Number of Credits:** 2

  Descriptions: Concept of constitutional law and its history in Iran; religious –theory foundations of constitutional law of Islamic Republic of Iran (IRI); cultural and social roots of constitutional law of IRI; fundamental role and chapters of constitutional law of IRI; review of constitutional law; comparison among constitutional laws of IRI with others

- **Course Title:** Statics **Number of Credits:** 3

  Descriptions: Statics is the study of methods for quantifying the forces between bodies. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Students will able to analyze the basic concepts related to the equilibrium and stability of bodies under a variety of force actions and reactions.

  Topics: Introduction: Mechanical science and mechanical engineering, static goals; Particles static, forces in the plate, forces in the space; Particles balance; Static of rigid bodies, equivalent forces system; Balance of rigid bodies, identification of statically stable, unstable, determinate and indeterminate structures; Geometric properties of surfaces: Determination of the geometric center of the surfaces, center of gravity, Pappus-Guldinus Theorem; Distributed forces; Analysis of structures: Trusses and frames; Introducing internal forces in statically determinate structures; Beam analysis: shear force and bending-moment diagrams; Geometric properties of surfaces: Determination of surface inertia moment

- **Course Title:** Environmental Engineering **Number of Credits:** 2

  Descriptions: Introduces students to environmental engineering as an academic major and a career. Covers air quality, aquatic ecology, chemical processing, energy, site remediation, and water resources and treatment. Includes reading and writing on the history of environmental engineering major environmental issues, and professional ethics.

  Topics: Introduction to environmental engineering, major environmental issues, sustainable development, and environmental management; fundamentals of materials balance and contaminant transportation: material balances, reactor types, reactor analyses, reaction kinetics, transport mechanism, mechanism of water movement and pollutants dispersion, and basics of modeling contaminant transportation; aquatic characteristics: the foundations of characteristics of water, water quality criteria, and physiochemical and biological water properties such as oxygen demand (e.g. BOD and COD); surface and ground water quality: river (point sources, non-point sources, and oxygen model), lake and reservoirs (thermal stratification and eutrophication), groundwater (pollutants and salinity), and pollution control methods and types of contaminants for surface and ground water; water treatment: physical treatment (settling, filtration) and chemical treatment (coagulation, flocculation, softening, disinfection); wastewater treatment: physical treatment (sedimentation, sludge thickening), biological treatment including aerobic methods (filtering, biological towers, activated sludge, continuous aeration, aerobic digestion) and anaerobic methods (lagoon and high rate system) and sludge processing (physicochemical and biological); air quality: stationary and mobile sources of air pollution, particulate and gaseous pollutants, emission (atmospheric stability), control (particle and gaseous pollutants), environmental regulations, ozone depletion, acid rain and global warming; solid waste management: municipal solid waste management (production, collection and disposal), solid waste reuse and recycle and sanitary landfills; sustainable development: introduction to sustainable developments and green building water supply.

- **Course Title:** Computer Programming **Number of Credits:** 3

  Descriptions: Principles of programming, computer and its types, numbers and pointers, binary numbers, data processing, hardware and software, compiler program, library files; methods of programing, steps of create and develop program, algorithm, flowcharts, progress and classifications of programming languages; Fortran programing to learn: operands, keywords, IDs, types of data and their sizes, types of variables, constants and variables, mathematical expressions, input/output expression, conditional expressions, repeating, arrays, global and local, and assistant memories subroutines, create some computer programs

- **Course Title:** Fundamentals of Architectural and Urban Construction **Number of Credits:** 2

  Descriptions: Introduction to deigns of building projects; collaboration methods between architects and civil engineers, definitions of procedures in architecture; principles of module and modular design; interaction of architectural spaces in buildings such as residential, kindergartens, schools, library, industrial plants, clinics, and hospitals; conduct an architectural design project with preparation of plan and details drafts.

- **Course Title:** Statistics and Probability **Number of Credits:** 3

  Descriptions: Part I: Probability Theory: Introduction to probability, properties of probability, counting techniques: combination and permutation, conditional probability, independent events, Bayes' theorem; discrete distributions, discrete random variables, mathematical expectation, moment generating functions, binomial distribution, geometric distribution, Poisson distribution; continuous distributions, continuous data: histograms and percentiles, continuous random variables, uniform, exponential, gamma, beta, and chi-square distributions, normal and lognormal distributions, extreme-value distributions; bivariate distributions, correlation coefficient, conditional distributions, distributions of two continuous random variables, bivariate normal distributions; distributions of functions of random variables, functions of one random variable, transformations of two random variables, several independent random variables, random functions associated with normal distribution, central limit theorem, Monte Carlo simulation.

  Part II: Statistics; estimation, point estimation, confidence intervals for one mean, confidence intervals for two means, confidence intervals for variances, confidence intervals for proportions, confidence intervals for percentiles, sample size, simple linear regression; hypothesis testing, tests for proportions, tests for one mean; tests of equality of two means, tests for variances, analysis of variance; goodness-of-fit tests, chi-square tests, Kolmogorov-Smirnov test; Bayesian methods, subjective probability, Bayesian estimation.

- **Course Title:** Numerical Analysis **Number of Credits:** 2

  Descriptions: Review of the mathematical foundation; physical meaning of derivatives and integrals; Taylor series expansion; definition of matrix and vector: matrix algebra - summation, subtraction and multiplication of matrices; transpose, determinant and rank of a matrix; fundamentals of MATLAB Programming; solving system of linear equations; unique and multiple solutions, trivial and non-trivial solutions, no solution; direct methods - Gauss Elimination method - Gauss Elimination with row pivoting; iterative methods - Jacobi method - Gauss-Seidel method; roots of nonlinear equations; incremental search method; bisection method; Regula Falsi and Secant Methods; Newton-Raphson method; curve fitting and interpolation; polynomial interpolation – Lagrange and Newton's polynomials; cubic and quadratic spline interpolation; curve fitting by function approximation, least squares fit; numerical differentiation, finite difference methods – forward, backward and central difference formulae, derivatives for noisy data, finding absolute extrema on a closed interval; numerical integration: Euler, Trapezoidal, Simpson and Gaussian quadrature schemes; solution of ordinary differential equations: initial value problems, Euler's explicit method, Modified Euler's method, Midpoint method, Runge-Kutta methods (2nd, 3rd and 4th order methods), Modified Euler's predictor-corrector method; solution of ordinary differential equations: boundary-value problems, shooting Method, finite-difference method

- **Course Title:** Physics Lab 1 **Number of Credits:** 1

  Descriptions: Study of conditions of equilibrium for forces in plane; measurement of volumetric- mass of solids and liquids; study of vibration movements in simple pendulum; measurement of water value of calorimeter, measurement of specific heat of solids; measurement of latent heat of water; determination of laten heat of melting ice; determination of volumetric expansion coefficient of liquids; determination of volumetric expansion coefficient of solids; study of thermometers and building thermos-couple; determination of study of thermometers and building thermos-couple; determination of thermal conductivity coefficient.

- **Course Title:** The Commentary of the Nahjalbalagheh **Number of Credits:** 2

  Descriptions: General topics; what type of book Nahjalbalagheh is? Methods of understanding Nahjalbalagheh; prayer and interpretation of Nahjalbalagheh; god in Nahjalbalagheh; god and humans relationship; social relationships in Nahjalbalagheh; divine traditions in Nahjalbalagheh; intuition and thinking in Nahjalbalagheh.

- **Course Title:** Dynamics **Number of Credits:** 3

  Descriptions: The course will be an overview of the application of Newton's Laws to rectilinear and curvilinear motion problems. Plane motion, work/energy, impulse/ momentum, force analysis, and mechanical vibration will be studied as well as motivation to understand and analyze linkages.
  Topics: Particle Kinematic: absolute and relative motion of matter on a straight and curve lines; Particle Kinematic: Newton’s second Law, value of linear motions, motion relationship, dynamic equilibrium, value of angular motion, motion relationships based on radii and tangents, Newton’s gravity law, applications of dynamic equilibrium methods, work, energy, impact and momentum in studies of particle motions; kinematics of rigid bodies: study of rigid bodies in motion in plane and space; kinetics of rigid bodies: magnitude of angular motions in rigid bodies, application of principles of impact and motion field in studies of motion of rigid bodies in space, kinetic energy in space; mechanical vibrations: free and forced vibrations in single degree-of –freedom systems; base motion, introduction to earthquake response spectrum

- **Course Title:** Surveying & Operation **Number of Credits:** 2

  Descriptions: This is an introductory course to plane surveying as related to the construction industry. Emphasis is placed on obtaining field skills in linear measurement and the operation of levels, transits, theodolites and total stations. Elevations, horizontal, vertical, and spiral curves are explored.

  Topics: Understanding different branches of surveying; Cause of errors and their types and accuracy of measurements; Brief introduction to the principles of cartography and understanding the types and standards of maps; An introduction to imaging systems; Indirect methods of measuring length; Levelling; Angle measurement and aligning

determination; Traverse and triangulation: Determination of coordinates and a brief introduction to resection and intersection; Tacheometry and details surveying; Types of curves, curve components, different implementation methods of simple circular curves, composite curves, reverse curves, transition curves, types of transition curves, the advantages of circular curves, vertical curves; An introduction to modern surveying instruments

Field: develop a plan of a relatively flat and limited area with appropriate scale; extraction of section profiles and calculate area and volume from plans; set down plans on ground; measure horizontal angle using repeating method; set down circular curves using consecutive two-part method; set down circular curve using chord method; set down compound curves; set down transition curves

- **Course Title:** Strength of Materials 1 **Number of Credits:** 3

  Descriptions: An introduction to basic principles including stress and strength, deformation and rigidity under different kinds of static loads in elastic and inelastic range

  Topics: Course objectives- definitions of the concepts of stress, normal and shear stress; Types of stress, crushing, stress components in inclined plane, working stress and the concept of safety factor; Definition of strain, the stress-strain relation, axial deformation, stress concentration, Saint-Venant's principle, Poisson's ratio, volumetric strain, bulk modulus and solving some examples; Stress analysis in indeterminate rods under axial load, thermal stresses in rod structures, solving some examples; Inelastic analysis of axial stress, residual stresses and steady deformations; Torsion in circular sections, stress analysis, torsional deformation; Torsion in indeterminate shafts, stress concentration in torsion; Inelastic analysis in torsion, torsion of non-circular sections, torsion of open and closed thin walled sections; Flexural loading, strain and stress analysis in pure bending, moment and stress relation, curvature and bending, stress concentration in bending; combined bending, inelastic bending; eccentric loading, asymmetric bending; transverse loading, shear stress in sections under shear; shear in thin walled sections, shear center; Stress under combined loading, asymmetrical shear

- **Course Title:** Strength of Materials Lab **Number of Credits:** 2

  Descriptions: Theory: Introduction: importance and roles of construction materials in construction; metallic material: structures, strength properties, modulus elasticity, strength corrosion, brittleness, fatigue, other properties of iron, cast iron, steel, copper, zinc, aluminum, and their application in construction industry; wood: production sources and transform methods, physical and mechanical properties, unwanted environmental and chemical effects on woods properties, wood protections, different applications of wood, types of wood; gypsum: production methods, physical and mechanical properties, different applications; lime: production methods, physical and mechanical properties; mortars: productions and properties of different mortars and their applications; brick and ceramics: raw material and production, classifications of bricks, various properties; cement: production, physical, chemical, and mechanical properties; stone: types of stone,

identification of stones, different properties, applications; concrete: methods of production, general properties, application in construction, types of concrete; bituminous materials: methods of production, properties, tests of bituminous materials, applications; isolators: heat and moisture isolators; polymer materials; glass; introduction to chapter 5 of the national building codes

Lab: Conduct different types of tests, study properties of construction material such as brick, gypsum, lime, stone, aggregate, steel tension.

- **Course Title:** Physical Education 2 **Number of Credits:** 1

  Descriptions: The course is theory-practice; introductions to the following concepts: personal and social ethics in athletic environments; health and safety in athletic environments; sport relationship with nutrition and weight gain/loss; obesity and its effects; introductions to sport (table tennis) law and regulations;

- **Course Title:** Islamic thought 1 **Number of Credits:** 2

  Descriptions: Humans and beliefs; concept of God; finding god; monotheism and polytheism; other qualities of god; resurrection and eternity.

- **Course Title:** Islamic thought 2 **Number of Credits:** 2

  Descriptions: Humans and beliefs; concept of God; finding god; monotheism and polytheism; other qualities of god; resurrection and eternity.

- **Course Title:** Strength of Material (II) **Number of Credits:** 3

  Descriptions: Students will be able to recognize physical phenomenon in the context of strength of materials, demonstrate an understanding of the structural mechanics theory for deformable bodies, apply structural mechanics of deformable bodies to solve engineering problems, demonstrate an understanding of the relationships between loads, member forces and deformations and material stresses and strains, demonstrate an understanding of the assumptions and limitations of the structural mechanics theory and competence in problem identification, formulation and solution

  Topics: Transformations of Stress and Strain; Transformation of Plane-Stress; Principal Stresses, Maximum Shearing Stress; Mohrs Circle for Plane-Stress; General State of Stress; Application of Mohrs Circle to the Three-Dimensional Analysis of Stress; Yield Criteria for Ductile Materials under Plane-Stress; Fracture Criteria for Brittle Materials under Plane-Stress; Stresses in Thin-Walled Pressure Vessels; Transformation of Plane-Stress; Mohrs Circle for Pl

- **Course Title:** Soil Mechanics **Number of Credits:** 3

  Descriptions: The course introduces soil mechanics and foundation engineering to the students; teaches the students how to solve certain fundamental problems related to consolidation, shear strength, and design of shallow and deep foundations; and familiarizes students with relevant terms and soil tests so that they can work effectively with geotechnical engineering specialists. The course features soil basics, including their derivation, identification and classification. The principles of water flow in soils, settlement and heave, and shear strength of soils will be discussed. Consolidation problems, factors of safety for foundations, and foundation settlement prediction will also be covered.

  Topics: Soils formation and structure, weight-volume parameters and their relationships; classification of soils: classification criteria and common methods for soil classification (USCS, AASHTO, B.S., etc.) and their application in engineering projects; soil compaction: compaction mechanisms in soils, compaction tests in laboratory, theoretical compaction curve and the effect of compaction energy, field compaction, compaction control in field works; stress in porous media: geostatic stresses, principal stresses and Mohr's circle, stress paths, stress distribution at depth based on elastic theory, stress distribution beneath different type of foundations, stress contours, Newmark diagrams; water in soil: seepage in soils, Darcy's law, permeability coefficient and methods for its measurement, mathematical equation for flow of water in soils, flow nets, calculating seepage volume beneath walls and dams; total and effective stresses in saturated soils, elevation/pressure/velocity heads in saturated soils, buoyancy force, seepage force, liquefaction state; soil consolidation: cylinder-spring analogy for soil consolidation and settlement, Terzaghi one-dimensional consolidation equation and its solution, effect of time and time-rate of consolidation, secondary compaction in soft soils, consolidation test and method of determining consolidation coefficient for settlement calculations; shear strength of soils: Mohr-Coulomb Failure criterion, determination of shear strength parameters, description of direct shear, unconfined compression, and tri-axial tests for different drainage conditions, total and effective stress paths for laboratory tests; stability of slopes: instability problem for excavations and embankments, stability of saturated clay slopes, stability of sandy slopes (dry and saturated), different methods for stability analysis and calculating the factor of safety for dry/saturated slopes, and slopes under seepage condition.

- **Course Title:** Concrete Technology **Number of Credits:** 2

  Descriptions: Theory: Cement: cement production method, cement chemical properties, cement reactions, physical and mechanical properties, cement tests, cement standards, types of Portland cement and their uses, Pozzolanic cements, high alumina cements, special cements; Aggregate: physical and chemical properties, tests, deleterious substances, gradation; Water: properties of concrete water; Fresh concrete: workability, bleeding and segregation properties; Concrete mix design: conventional methods, example of concrete mix design based on Iran national concrete mix design, concrete mix design in tensile, aerated concrete mix design; Properties and uses of concrete additives; Concrete pouring: proper methods of concrete production, carrying, pouring, compaction, pouring

problems; Concrete curing and maintenance: temperature and humidity effects; Hardened concrete tests; Hardened concrete properties and volumetric stability: modulus of elasticity of concrete, concrete shrinkage, concrete creep; Endurance of concrete: sulfate, chloride and carbonate degradation and alkaline reactions; Concreting in extreme conditions: concreting in hot weather, concreting in cold weather, mass concrete; Types of concrete: light-weight concrete, polymer concrete, high-strength concrete, fiber-reinforced concrete, roller compacted concrete, etc.; Special concrete: high-strength concrete, fiber-reinforced concrete, sulfur concrete, roller compacted concrete, etc.

- **Course Title:** Concrete Technology Lab **Number of Credits:** 1

  Descriptions: Lab: Conduct a complete experimental project including investigation of concrete materials properties, concrete mix design, concrete production, and fresh and hardened concrete tests; Cement tests: determination of mass density, normal concentration, setting time of cement, compressive and flexural strength tests of cement mortar; Aggregate tests: determination of density, water absorption, evaporative concrete humidity, mass density and gradation; Mix design and concrete design and production: mix design, production, pouring (casting), compaction and curing of mass concrete and concrete with additive; Fresh concrete tests: measurement of workability and determination of specific weight, compressive strength, indirect tensile strength and flexural strength; Hardened concrete tests: determination of specific weight, compressive strength, indirect tensile strength and flexural strength; Non-destructive tests: Schmidt hammer tests, ultrasonic wave velocity measurement in concrete; Concrete core test; Concrete water absorption test

- **Course Title:** Fluid Mechanics **Number of Credits:** 3

  Descriptions: This class provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications

  Topics: Introduction to course objectives and evaluation method, properties of fluids, types of fluids, dimensions and units, Newton's law of viscosity; Dynamic and kinematic viscosity, surface tension, capillarity, bulk modulus of elasticity, vapor pressure; Hydrostatic or fluid statics, scalar, vector and tensor quantities, surface and volumetric forces and stresses, concentrated stress, concentrated pressure; Basic equations in fluid statics, pressure changes in compressible fluids, manometers; Calculate the force and its applied point on horizontal surfaces inside the fluid, calculate the pressure on oblique surfaces, pressure center, calculate fluid force with pressure prism method; Investigation of force components on curved surfaces, tensile stress caused by fluid force in pipes, buoyancy-thrust force, stability of floating and submerged bodies; Relative equilibrium of liquids under the influence of acceleration, rotational motion of fluid around a vertical axis; Fluid dynamics, velocity field, the Eulerian and Lagrangian method, the relationship

between system equations and volume control in fluid mechanics; Continuity relation in control volume, continuity equation in two and three dimensions in differential form; Use the control volume method to obtain the momentum equation, the momentum equation application

- **Course Title:** Physics (II) **Number of Credits:** 3

  Descriptions: Primary definitions, intensity of electrical current and voltage, Ohm law, series and parallel joints, electrical kinetics, electrical power, capacitators and behavior of each one in alternative current; Introduction to types of transformers and their applications, introduction to types of electrometer (direct, single and triple phase alternative, synchrony and asynchrony, universal) and their applications; Optics and illumination: nature of light, light diameter, introduction to lenses and mirror rules, light dispersion rules, illumination intensity, light intensity distributions, light dispersion curve, light resources incandescent, introduction to illumination calculation

- **Course Title:** The History of the Immamat **Number of Credits:** 2

  Descriptions: Introduction to history; global status at born of Islam; orientalism; prophets family line; Islam introduction; prophet migration; study of war and peace; prophet successors; prophet's death; introduction to life and policies of Imam Ali; study of Imam Hassan's life; study of Imam Hossein's life

- **Course Title:** Soil Mechanics Lab. **Number of Credits:** 1

  Descriptions: The purpose of the laboratory is to facilitate high-level research and development work within the field of geotechnics and soil mechanics with emphasis on advanced soils laboratory testing, field testing and monitoring. Students will study and measure the general mechanical properties, permeability, consolidation and shear resistance parameters in adhesive and adherent soils.

  Topics: Soil moisture determination; Determination of insitu soil specific weight (sand cone method, rubber balloon method); Mechanical gradation; Hydrometric gradation; Determination of Atterberg limits (plastic limit, liquid limit, shrinkage limit); Compaction (standard, modified); Determination of California Bearing Ratio (CBR); Determination of soil permeability (stationary-potential, falling potential); Adherent soil consolidation; Direct shear test; Determination of unconfined compressive strength; Triaxial test

- **Course Title:** Hydraulics & Lab. **Number of Credits:** 3

  Descriptions: This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The Objective of this course is to enable the student to understand laws of fluid

mechanics and Evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery

Theory: Flow in open channels and their classification, the difference between hydraulics and fluid mechanics, classification of flow in channels, flow state, flow regimes; Open channels and their properties, types of open channels, geometric elements in a channel cross-section, velocity distribution in a channel section, pressure distribution in a channel section; Governing equations, continuity equation (conservation of mass), law of momentum conservation, energy equation; The concept of specific energy, application of specific energy in hydraulic jump flows analysis, gate; The concept of specific force, application of specific force in hydraulic jump, submerged jump, length of hydraulic jump, hydraulic jump in sloping channels; Critical flow, section modulus in critical flow calculation, flow control, flow measurement; Uniform flows development, characteristics of uniform flows, formation of uniform flows, velocity calculation in uniform flow, Chezy relation and Chezy's resistance coefficient calculation, manning equation and calculation of manning roughness coefficient, how to calculate resistance coefficient; The relationship between Darcy-Weisbach roughness coefficient, manning formula, calculate the normal depth of the equivalent roughness coefficient in simple and composite channels, approximate calculation of flood discharge by resistance equations in channels

Lab: Experimental studies on: buoyancy forces; metacentric height; pressure center; jet flow and impact; Reynolds experiment; weirs; flow through orifice; reservoir discharge; flow through sluice gate and hydraulic jump; flow over sill; time bowl; losses in pipes; Bernoulli's theorem; water hammer; pumps; free and forced vortices; sediment transport

- **Course Title:** Design of Concrete Structures (I) **Number of Credits:** 3

Descriptions: The course covers the design of reinforced concrete structural elements of a building. It introduces you to structural analysis techniques and their application in the structural design of concrete buildings. In addition the material properties of concrete and its use as a construction material are addressed. This course builds on your knowledge of statics and structural mechanics and steel structures. You will learn to apply structural analysis tools such as computer software combined with self-checking procedures in designing concrete building structures according to American design practices and processes (ACI-318).

Topics: Mechanical properties of concrete under immediate and long-term loading, concrete compressive, tensile and shear strength, concrete strength under multilateral stresses, concrete deformations (elastic, shrinkage and creep); Types of steel used in reinforced concrete, mechanical properties of steel; Elements design methods, reinforced concrete, safety concepts and limit states, loading compounds, methods of analysis; The behavior of reinforced concrete beams under bending in different loading steps, beam resisting bending moment, beam design calculation for bending and investigation of its requirements (maximum and minimum steel in beam, application of pressed steel in beam, formability in reinforced concrete beams, etc.); Short columns design: investigation of behavior and calculation of components under axial force (simple) and combined bending (axial force and bending moment) and determination of axial force interaction diagram and

column bending moment), column design under biaxial bending); Slender columns design: second order analysis of structure, slenderness effect on column behavior, column behavior in braced and unbraced frames, moment magnification method; The behavior of reinforced concrete forces under shear, beam resistant shear and relevant requirements; Concrete and steel bonding theory, steel restraining in concrete and reinforcement method and curtailment of bars in beams; Investigation of reinforced concrete elements behavior under torsion, shear and torsion simultaneous effect, shear and torsion simultaneous effect with bending and torsion

- **Course Title:** Road Construction **Number of Credits:** 2

  Descriptions: History of highways in the world and Iran; route study; principles of routing from map; soil operations; geometric properties of roads; design of horizontal curve; geometric conditions of horizontal curve of road; design of vertical curve; road drainage.

- **Course Title:** Strength of Material Lab. **Number of Credits:** 1

  Descriptions: Various tests are conducted to study strength and behavior of materials and structures. Loading and data acquisition using measurement tools are introduced. Test set-up and boundary conditions in form of simple and rigid supports will be demonstrated. The experiments show various types of stress in materials and structures. In general, this course connects theory with experiments and presents application aspects of materials and structures. List of experiments: Hook's Law, Cantilever Beam, Maxwell's Law, Torsion, Buckling of Column, Shear Center, Rectangular Frame Displacement, Suspension Bridge, and Tensile Test.

- **Course Title:** Technical English **Number of Credits:** 2

  Descriptions: Training on report writing and oral presentation skills for Civil Engineering purpose; write a technical report in a professional and effective manner through drafting and revision; technical presentation, explaining technical information to the general audience.

- **Course Title:** Foundation Engineering **Number of Credits:** 3

  Descriptions: Site investigation, boring, and soil sampling, in-situ tests, determination of soil parameters based on the in-situ tests results; shallow foundations, types, bearing capacity of shallow foundations under vertical, inclined, and eccentric loads, bearing capacity for foundations on slopes and layered soils with/without effect of ground water surface; foundation settlement, elastic and consolidation settlements, foundations on problematic soils; design of shallow foundations (spread footings, strip foundations, mat foundations) based on rigid method and elastic solutions; retaining walls, flexible retaining elements, lateral earth pressure theories, hydrostatic and hydrodynamic pressure of pore water, analysis and design of different rigid retaining walls; deep foundations (piles),

bearing capacity of piles using static and dynamic methods and in-situ test results, pile settlement, negative skin friction; design of pile groups (bearing capacity and distribution of load among the piles in pile group), design of pile cap

- **Course Title:** Design of Concrete Structures (II) **Number of Credits:** 3

  Descriptions: Introduction to Serviceability Limit States (including cracking and deflections of RC beams), Concepts of Lateral load resisting systems in RC structures (including moment frames and shear walls), Concepts of Seismic design of RC buildings for ductile behavior, Design of one-way and two-way RC slabs.

  Topics: Investigation of compatibility and relevant limitations; Cracking in bending elements, crack width calculation and its limitation method; Deformation (deflection) determination, requirements and limitations; Investigation of resistant systems types, reinforced concrete frames and shear walls, load distribution between bearing elements; Seismic design of reinforced concrete components; Familiarity with different overlays and calculation method of overlays consisting of: joist and block, one way and two way slabs; Familiarity with the principles of pre-stressed concrete, operational and computational principles (bending and shear design); Design of RC members for Torsion; Introduction to Serviceability Limit States including cracking and deflections of RC beam; Different types of lateral load resisting systems in RC structures including moment frames and shear walls; Concepts of Seismic design of RC members for ductile behavior; Design of one-way and two-way RC slabs; Introduction to pre-stressed concrete design

- **Course Title:** Pavement Design **Number of Credits:** 2

  Descriptions: This course outlines pavement design of roads. All three accepted methods of pavement design are covered, including Soil Factor, R-value thickness, and an introduction to MnPAVE for thickness design. design guide will be used to review the importance of and tools for the following elements of roadway design: data collection and accurate traffic projections; subgrade soil evaluation and best practices for enhancements; pavement section materials and specifications; and best construction practices and their effect on pavement life.

  Topics: Geotechnical studies; Base and sub-base materials and relevant tests; Soil stabilization; Bitumen and relevant tests; Asphalt mix design; Familiarity with asphalt plant and fatigue test; Design and implementation of road-mix asphalt and surface asphalt; Drainage and freezing zone calculation; Pavement analysis (one layer, two layer and three layer methods); Equivalent-load factor calculation and traffic growth; AASHTO pavement design method; Pavement design- Asphalt institute method; Familiarity with pavements failures and their repair methods; Paving design

- **Course Title:** Design of Steel Structures (I) **Number of Credits:** 3

Descriptions: The course emphasizes a theoretical understanding of fundamental concepts in analysis and design of steel structures. The focus of the course is building structures but other structures in the built environment will be addressed as time permits.

Topics: Introduction: components of steel structures, types of steel and steel sections; steel physical behavior: stress-strain, fatigue, brittle fracture, corrosion; design philosophies: ASD, LRFD. design codes; tension members: limit states in tension, net section, shear lag, block shear, brace and gusset design; compression members: limit states in compression; effective length, built-up compression members, bracing design; flexural members: limit states in bending, lateral support; beam design: continuous beams, castellated beams, composite beams, built-up beams; biaxial bending, shear strength, deflection control, concentrated load effects; beam-columns: P-Delta effects and effective length, types of analyses; frame design.

- **Course Title:** Industrial Training (I) **Number of Credits:** 2

Descriptions: The training course provides the students with an opportunity to explore career interests while applying knowledge and skills learned in the classroom in a work setting. Students will contribute in a real construction project, which includes either building, highway or water distribution projects, for a minimum of 300 hours (2.5 months).

- **Course Title:** Design of Concrete Structures Project **Number of Credits:** 1

Descriptions: Students will learn about the application of concrete structures design principles in planning a structure. This course involves completing a concrete structure project by the students based on the provided architectural plans.

Topics: Loading including: permanent loads , weather and accidental loads, etc., load combination calculations based on Iran standards, calculation of dead, live and lateral loads; Two-dimensional and three-dimensional structural system analysis methods; Type method and structural elements design; Structural system selection and foundation system design

- **Course Title:** Principles of Earthquake Engineering & Wind **Number of Credits:** 3

Descriptions: This course is closely tied to the ASCE 7-05 and 2006 IBC seismic load requirements, will benefit all structural engineers who would like to improve their earthquake engineering skills through mastery of the fundamental principles. It will be of value to engineers at all levels of experience. The course focuses on fundamental concepts, and is designed for practicing structural and architectural engineers, contractors, building officials, facilities managers, and educators. You will: understand the cause and effect of earthquake ground motions; develop a feel for the dynamic behavior of structures; understand the principles of dynamic analysis of structures; understand why inelastic behavior and associated damage may be unavoidable; learn how to control damage through special detailing procedures, and develop a clear understanding of the theory behind the complex building code provisions for earthquake resistant design.

Topics: Course Introduction; Earthquake Ground Motions and their Effects; Development of Earthquake Response Spectra; Seismic Hazard Maps; Inelastic Behavior; Overview ASCE-7 Seismic Load Provisions; Basic Requirements for Seismic Design; Selection of Structural Systems; Seismic Load Analysis using Equivalent Lateral Forces and Modal Analysis; Computer Modeling of Structures; Torsion and Orthogonal Loading Requirements; Load Combinations; Drift and P-Delta Effects; Detailing Requirements for Steel and Concrete Structures

- **Course Title:** Design of Steel Structures (II) **Number of Credits:** 2

  Descriptions: The course covers more advanced topics in steel design. These are elastic bending of plates, theory for elastic buckling of axially loaded and shear loaded plates, effect of stiffeners, capacity of plates and plated structures, shear lag, advanced cross-sections, joints, cross sectional classes, torsion, lateral torsional buckling of beams, torsional buckling and torsional-flexural buckling. Further topics are behaviour of steel structures exposed to fire and design for fatigue loading. The course gives examples of structures and components, as large steel beams, thin walled sections, stiffened plate elements, bridge box cross-sections.

  Topics: Design of beams without lateral support; Column-beam design; Plate girders design; Welded connections design; Bolted connections design; Beams and columns splice design, beam and column seating design; Design of Composite Sections; Stability Analysis; Design of Connections; Introducing of All Types of Seismic Resisting Steel Structures; Introducing of Bracing Types

- **Course Title:** Transportation Engineering **Number of Credits:** 2

  Descriptions: Introduction (role of transportation in society, transportation and urban structure, transportation as a system, and transportation system components); transportation planning process; problem identification and objective setting; definition of study area and zoning; data needs and information gathering in supply and demand of transportation, land use, and socioeconomic variables; transportation demand (trip generation and distribution, mode and path of travel); transportation supply (shortest path, traffic assignment) supply relations; transportation externalities (air and noise pollution); evaluation and decision-making; transportation system management (TSM) country-wide transportation planning; other modes of transportation.

- **Course Title:** Construction Cost Estimation **Number of Credits:** 1

  Descriptions: Theory: Introduction to types of contracts, bids, contract conditions; introduction to preparation of material list; introduction to relationships between owner, consultant, contractor, and their responsibilities; methods of quantity take-off of various constructions; cost analysis of different construction tasks; methods of take-off transfer to first degree tables;

  Lab: student need to calculate an estimate and take off of an actual construction project.

- **Course Title:** Building Construction Method **Number of Credits:** 2

  Descriptions: Introduction to primary construction site and site equipment; principles of welding; identifying standard bolts and rivets; methods of steel frame erections; study of concrete falsework principles; introduction to reinforcing bars plans; introduction to concrete production and transportation to site; methods of concrete cast; study of methods of concrete curing; introduction to on-site tests; study of methods of estimating strength of structure after construction; introduction to precast construction.

- **Course Title:** Design of Steel Structures Project **Number of Credits:** 1

  Descriptions: Application of steel structures design principles in planning a structure. This course involves completing a steel structure project by the students based on the provided architectural plans.

  Topics: Loading including: permanent loads , weather and accidental loads, etc., load combination calculations based on Iran standards, calculation of dead, live and lateral loads; Two-dimensional and three-dimensional structural system analysis methods; Type method and structural elements design; Structural system selection and foundation system design

- **Course Title:** Road Construction Equipments **Number of Credits:** 1

  Descriptions: The application of road construction principles in planning a route. The student will able to design a suitable alignment using topographic maps and provide the desired technical, economic and economic justification by providing details

  Topics: Introduction; Familiarity with the software – Civil3D; Familiarity with Topography and work with it; Horizontal alignment design; Vertical alignment design; Cross section design; To Export data from the software and report the project

- **Course Title:** Fundamentals of Bridge Engineering **Number of Credits:** 2

  Descriptions: Introduction to bridge engineering; bridge loadings: different dead loads, different live loads, moving load, uniform and gradient temperature loads, wind load, seismic load; different superstructure systems; Analysis of superstructure: slab design forces, girder internal forces, influence line, push of moving loads, bearing forces, connection forces; Concrete superstructure system design: slab design, concrete I-girder design, connection design; Steel I-girder design: slab design, steel-I girder design, shear stud and other connection design; Bearing design: different types of bearing, bearing gravity and lateral forces, stress and deflection limitations for elastomeric bearings; Sub-structure design: internal forces under gravity and seismic forces; Seismic design, seismic recommendations in high seismic zones; Abutment design: different types of abutments, earth-pressure force, super-charged force, seismic forces

- **Course Title:** Strength of Materials Lab **Number of Credits:** 1

  Descriptions: Measurement of beams reactions, and deflection, tension and compression of bars, torsion test, impact test, stability of columns, strain measurement in beams, stability of structures.

- **Course Title:** Fundamentals od Traffic Engineering **Number of Credits:** 2

  Descriptions: Elements of traffic engineering, travel time and delay studies, spot

  speed studies, volume studies, traffic theory, highway capacity, parking studies, traffic control devices.

- **Course Title:** Strength of Materials II **Number of Credits:** 2

  Descriptions: Torsion and angle of twist. Beam bending. Flexural and shear equations. Compound stresses. Theories of failure. Deflection of beams. Euler's formula for columns and its modification for codes. Inelastic behaviour of members. Experimental laboratory work involving flexural stress, deflection of beams and buckling load of columns.

- **Course Title:** Restoration od Structures **Number of Credits:** 2

  Descriptions: Rehabilitation of civil infrastructure systems including aspects of deterioration science, nondestructive assessment, maintenance, renovation, rehabilitation and preservation of infrastructure; mechanisms of mechanical, chemical and biological infrastructure degradation; corrosion of steel condition surveys and evaluation of buildings and bridges repair and preservation materials, techniques and strategies; renewal engineering, construction planning, management, public policy, codes and guidelines; case studies.

- **Course Title:** Railway Engineering **Number of Credits:** 2

  Descriptions: An introduction to highway-rail grade crossings and railroad track system design, components, roadbeds, and maintenance. This is followed by consideration of railroad rolling stock design, running gear and other mechanical components, train braking system design, function and dynamics, and locomotive design, operation and function. Quantitative analysis of train resistance and consequent power and train energy requirements including effects of aerodynamics, grade and curvature are covered. The course concludes with consideration of train speed, power, acceleration and an introduction to railway traffic control and signaling.

- **Course Title:** General Chemistry **Number of Credits:** 3

  Descriptions: Chemical principles with applications in engineering. Stoichiometric calculations, properties of gases, properties of liquids and solutions, gas phase chemical equilibrium, ionic equilibrium in aqueous solution, oxidation-reduction reactions, chemical kinetics.

- **Course Title:** Computer Applications in Civil Engineering **Number of Credits:** 2

  Descriptions: Introduction to computer programming, examples of efficient numerical algorithms for basic scientific computations. Programming and problem solving concepts introduced in the course will be incorporated into group projects involving civil, environmental, or geological engineering applications. The language of instruction will be Matlab.

- **Course Title:** Design of Wood Structures **Number of Credits:** 2

  Descriptions: Provides students with fundamental skills in structural engineering wood design. Focus is placed on the underlying principles behind design procedures for wood members in residential, commercial and industrial applications. Through class examples and assignments, students learn techniques for designing individual wood components including: beams, columns, trusses, wood/steel connections, and diaphragms using lumber and timber as well as engineered wood products.

- **Course Title:** Fundamental of GIS in Civil Engineering **Number of Credits:** 2

  Descriptions: Create a web-based learning system that supports student learning on how to apply GIS within the context of civil engineering. To implement learning modules in existing undergraduate civil engineering courses. To carry out a series of summative and formative evaluation studies (including external evaluators) with components and iterations of this learning system under development, and, to disseminate the developed educational materials and learning system to other universities in order to test the ability of our results to scale and port.

- **Course Title:** Soil Mechanics II **Number of Credits:** 2

  Descriptions: Soil variability, shear strength, and deformation of multilayered systems; critical state soil mechanics, Convection and Diffusion of ground water flow; settlement analysis; static and dynamic slope stability, dynamic behavior of soils, Computer applications.

- **Course Title:** System Engineering **Number of Credits:** 2

  Descriptions: This course intends to help you develop the capability of systems thinking by introducing classical and advanced systems engineering theory, methods, and tools. After taking this class, you should be able to:

  -Develop a systems engineering plan for a realistic project.

  -Judge the applicability of any proposed process, strategy, or methodology for systems engineering using the fundamental concepts from disciplines such as probability, economics, and cognitive science.

  -Understand system engineers' role and responsibilities. Understand the role of organizations.

  -Apply systems engineering tools (e.g., requirements development and management, robust design, Design Structure Matrix) to realistic problems.

  -Recognize the value and limitations of modeling and simulation.

  -Formulate an effective plan for gathering and using data.

- **Course Title:** Physics 1 lab **Number of Credits:** 2

  Descriptions: Apply experimental methodology to investigate physical phenomena. Set up and use laboratory equipment to demonstrate certain aspects of mechanical physics. Apply the theory of physics to experimental situations.Explain differences between observed and expected results in experiments. Investigate motion in straight line. Investigate the conservation of thermal energy and conservation of momentum. Use an oscilloscope to measure the speed of sound. Measure resonance and standing waves in a string. Use vector addition to add forces vectors. Use Hooke’s Law and simple harmonic motion to find the spring constant of a spring.