FIRAT UNIVERSITY INSTITUTE OF SCIENCE
PhD Program in Civil Engineering Technologies
Fall Semester Course and Thesis Credits and ECTS Credit Information

Course Content

INS600 PhD Thesis
To acquire the ability to conduct independent research, critically analyze scientific phenomena from a broad and in-depth perspective, interpret findings, and identify the necessary steps to achieve new syntheses.

İNS601 Specialization Field Course
Evaluate the research topics and new developments in these topics of all doctoral students at the dissertation level under the supervision of the advisor and following current scientific publications.

INS602 PhD Seminar
This course covers the examination of current or unique issues and problems in the field of Civil Engineering through a seminar approach.

INS603 Urban Transformation Process (3 0 3) ... ECTS: 6
Definition and objectives of urban regeneration. Objectives of urban transformation. Methods of urban transformation. Dimensions of urban transformation. Effects of urban transformation. Applications of urban transformation. Places in need of urban transformation. Preparation of urban transformation strategy document.
Principles of urban transformation implementation. Annexes to the urban transformation strategy document.

INS604 Civil Defense and Sanctuary Buildings (3 0 3) ... ECTS: 6
Types and importance of defense and sanctuary buildings. Threats and basic features of defense and sanctuary Buildings. Technical features of defense and sanctuary buildings. Examples of armoring for different types of radiation. Use of special concrete in defense and sanctuary buildings. Use of armored concrete in defense and sanctuary buildings. Principles of application.

INS605 Heat Flow in Soils (3 0 3) ... ECTS: 6
Introduction. Heat conduction in soils. Frozen soil systems. Seasonal freeze-thaw zones. Soil characteristics in frozen regions. Physical and thermal properties. Composition and structure of frozen soils. Water-ice phase relations. Frost action in the ground. Thermal properties. Heat flow problems in the ground. Heat transfer at the soil surface.

INS606 Use of Geosynthetics in Geotechnical Applications (3 0 3) ... ECTS: 6
General introduction; what are the methods of soil improvement, brief description. History and evalution of geosynthetics. Production technology. Characteristics and functions of geosynthetics. Use of geosynthetics in geotechnical and other fields of civil engineering. Considerations in the use and design of geosynthetics. Regulations and specifications to be followed in the use of geosynthetics. Geometric, physical, mechanical, chemical and hydraulic properties of geosynthetics, design and application, marine and river bank and bed protection, highways and railways, reinforced soils, drainage, mattress and cover systems in landfills.

INS607 Bioharmological Building Design (3 0 3) ... ECTS: 6
Definition, aim and purpose of biopharmology. Theoretical principles. General characteristics of bioharmological buildings. Architectural and engineering features of buildings according to their intended use and user identity. Human and basic needs. Human and housing harmony. Human and environment harmony. Harmony between building and environment - city. Structure-building studies. Application examples and calculations.

INS608 Fracture Mechanics of Engineering Materials (3 0 3) ... ECTS: 6
Theoretical strength calculations. Stress at crack tip. Griffith criterion. Irwin's modification of Griffith's theory. Mechanism of fracture and crack growth. Elastic crack-tip stress field. Crack tip plastic region, energy principle. Energy release rate criterion for crack growth. Linear elastic fracture mechanics. Mode I, II and III. Stress intensity multiplier superposition, mixed mode crack initiation theories. Numerical, analytical and experimental methods for the determination of stress intensity multipliers. Elastic-plastic fracture mechanics, experimental techniques. Fatigue crack propagation. Applications: fracture of concrete, rocks, ceramics and composites, experimental techniques.

INS609 Nonlinear Vibrations (3 0 3) ... ECTS: 6
Introduction. Asymptotic sequence, asymptotic series, definition of O and o symbols. Perturbation series. Conservative single-freedom systems. Quantitative and qualitative analysis. Direct expansion, Lindstedt-Poincaré, multiplicative scales, mean and KBM methods. Uncorrelated single-frequency systems. Damping mechanisms, qualitative analysis, quantitative analysis. Forced oscillations of single-freedom systems. Cubic

nonlinearity systems. Quadratic and cubic nonlinear systems. Principal resonant state. Strong forced state. Non-resonance, upper and lower harmonic resonance phenomena. Parametric forced systems. Mathieu equation. Finite freedom systems. Free oscillations of systems with quadratic nonlinearity. Internal resonance phenomena. Free oscillations of systems with cubic nonlinearity. Forced oscillations. Primary, secondary and combined resonance phenomena. Continuous systems. Beams. Principal, superharmonic, subharmonic and combined resonance phenomena.

INS610 Nonlinear Analysis of Structures Systems (3 0 3) ... ECTS: 6
Factors that disturb the linearity of building systems. Nonlinear theory. Modeling of nonlinear beam systems with respect to material and geometry changes. Analysis and design methods. Elastoplastic theory. Plastic section concept and applications. Second-order and finite displacement theories. Stability and buckling. Performance based design. Nonlinear Static Analysis (Pushover Analysis). Computer Software and Applications. Introduction to nonlinear dynamic analysis.

INS611 Advanced Finite Elements (3 0 3) ... ECTS: 6
Introduction and general information. Principles of the Finite Element Method. Obtaining finite element equations. Calculation of surface bearing systems by finite element method. Application of Finite Element Method to plate systems. Advanced (multi-degree of freedom) triangular and quadrilateral plate finite elements (thin plate elements, thick plate elements, thick plate elements). Obtaining temperature change matrix, mass matrix, elastic support matrix, second-order effect matrices in plate finite elements, applying the finite element method to plate systems. Triangular and quadrilateral plate finite elements (thin plate elements, thick plate elements, thick plate elements). Obtaining temperature change matrix, mass matrix, elastic support matrix, second-order effect matrices in plate finite elements. Shell finite elements (cylindrical finite element, spherical finite element, conical finite element). Advanced (multi-degree of freedom) shell finite elements (thin shell elements, near-thick shell elements, thick shell elements). Obtain temperature change matrix, mass matrix, elastic support matrix, second-order effect matrices in shell finite elements. Ring sector finite element. Obtain element stiffness matrix, element loading matrix, temperature variation matrix, elastic support matrix, mass matrix, second-order effect matrices of ring sector finite element. Application of finite element method to plates resting on elastic ground.

INS612 Theory of Plasticity (3 0 3) ... ECTS: 6
Physical fundamentals of plasticity theory, concepts and definitions. Mathematical foundations, elastic/plastic deformation, stress tensor and its invariants. Incremental and total deformation theories of plasticity. Yield conditions, yield rule, and hardening/softening rules. Tresca, von Mises, Drucker-Prager, and other yield criteria. Isotropic, kinematic, and mixed consolidation rules. Cyclic loading, rate of loading, and temperature effects. Uniqueness and extremum principle, energy methods. Limit analysis, lower and upper bound theorems. Plastic analysis of bar, plate and shell elements. Dynamic plasticity and viscous plasticity. Numerical solution of plasticity problems by finite difference and finite element methods.

INS613 Displacement Based Design of Buildings (3 0 3) ... ECTS: 6
Current structural design codes. Traditional force-based design criteria. Displacement-based design. Design by controlling structural deformations. Displacement-based design of framed buildings, wall and frame buildings, masonry buildings, and bridges. Design examples and solutions. Verification of designs by nonlinear time domain calculations. Displacement-based design method. Preliminary and final design checks for buildings. Examination of design examples of various buildings. Current codes and standards.

INS614 Computer Computational Modeling of Building Materials (3 0 3) ... ECTS: 6
Cement hydration mechanisms and related properties. Computer-based micro-scale models of cement hydration and microstructure. Hymostruc model. Information on the mesoscopic structure of building materials. Mesoscale modeling using finite element software. Models used to describe the material properties of building materials in analysis. Implicit and explicit finite element methods, iterative and incremental methods. Macroscale modeling of construction materials. Elimination of convergence problems. Combining analyses performed at different scales.

INS615 Methods of Change (3 0 3) ... ECTS: 6
Introduction Definitions. Functional Definition. Definition of change. Function space, inner product, metric definitions, definition of change. Euler's equations. Variational derivative, index notation, some integral relations, kinetic relations. Stress and equilibrium equations. Transformation relations. Kinematic relations. Compatibility conditions. Expression of strain in different coordinates and transformation relations. First and second laws of thermodynamics. Composition relations. Survey of equations. Classification of problems and methods of solution. General definition of virtual work. Virtual displacement. Principle of virtual force and applications to mechanics. Principle of total potential energy. Complementary energy. Torsion of several dependent sections. Hamilton's principle for continuous media. Gateaux derivative. Potential operator. Transition from differential to functional operator. Examples from mechanics. Approximation techniques: Ritz method, finite element method, application to one- and two-dimensional problems.

INS616 Nonlinear Behavior of Reinforced Concrete Structural Elements (3 0 3) ... ECTS: 6
Material properties. Adhesion, interlocking, peeling models. Behavior under bending. Fiber approach. Ductility and deformability. Coiled concrete. Plastic joint mechanism. Damage. Repetitive loading. Behavior under seismic action. Behavior under shear action. Interaction of shear and flexural effects. Column beam connections. Shear strength in joints. Joint interlocking and stripping of beam reinforcement. Behavior of prestressed and post-tensioned concrete. Serviceability. Deflection and crack control. Long-term effects.

INS617 Damage Mechanics (3 0 3) ... ECTS: 6
Principles of damage mechanics and applications. Damage variables. Scales of damage assessment, modulus of elasticity change, plasticity change, and viscoplastic behavior. Basic laws of damage mechanics, ductile fracture law, Kachanov creep law, fatigue laws. Damage criteria, released elastic energy density criterion, three-variable criterion, asymmetric deformation criterion, fatigue limit criterion. Thermodynamic formulation, three-dimensional representation, isotropic damage theory, anisotropic damage theory. Specific models; ductile plastic damage, creep damage, fatigue damage, combined effect of fatigue and creep damage.

INS618 Optimization Methods in Building Design (3 0 3) ... ECTS: 6
General definitions: objective function, constraints, properties of convex function. Lagrange Multipliers, Dual Problem. Optimization Methods: Simplex and integer programming methods, intersection plane and sequential linear programming, optimality criterion, artificial intelligence techniques. Optimization in structural design: General definitions and classification in structural optimization. Structural optimization in isostatic and hyperstatic systems, structural optimization in plastics design. Optimal design formulation of truss and frame systems by matrix displacement method. Cost and shape optimization. Structural optimization by genetic algorithm method.

INS619 Material Modeling (3 0 3) ... ECTS: 6
Basic material modeling concepts. Physical mechanisms of deformation and shear. Stress and strain analysis, tension. Rheological classification of real solids, experimental techniques. Schematic representations of real behavior and shear. Elasticity based models. Determination of material properties. Plasticity based models. Some yield criteria used in metal plasticity, plastic stress-strain relationships. Damage models, stress singularity and shear energies, R-curves, the fracture model. Creep and aging.

INS620 Behavioral Models in Reinforced Concrete (3 0 3) ... ECTS: 6
Simulation of a truss system consisting of compression and tension bars. General design principles and modeling. Modeling of B and D regions. Dimensioning of compression and tension bars and nodes. Single and distributed nodes. Concrete compression bars, reinforcement tension bars, utilization, cracks and deformations. Examples of B and D area design. Beams with table and variable sections. Thinned end zones. Short cantilevers. High beams. Bridge beams. Shear walls and slabs. Frame corners. Related Turkish and foreign regulations.

INS621 Stability Theory (3 0 3) ... ECTS: 6
Stability of bars. Equilibrium diagrams. Neutral equilibrium method. Imperfect column behavior. Buckling of inelastic columns. Approximation methods: Finite difference method, matrix stiffness method. Buckling of frames, rings, arches, thin plates and thin cylindrical shells.

INS622 Advanced Structural Dynamics (3 0 3) ... ECTS: 6
BSD System, Response Spectra. Shock Spectra. Torsional structure vibrations. Modal calculation. Spectral calculation. Continuous mass systems: beams. Approximate methods of vibration analysis: Stodola, Rayleigh, Improved Rayleigh, Improved Rayleigh, Rayleigh-Ritz methods. Continuous mass systems: Plates, machine foundations, wind vibration, traffic vibration.

INS623 Composite Materials in Construction (3 0 3) ... ECTS: 6
Relationships between basic microstructure and properties in composites. Behavior of granular composites under load. Stress state. Coupled models and relationships. Rheological models. Other models. Classification of fiber composites, general properties. Parallel and non-parallel fiber reinforced composites. Discontinuous fiber composites. Cement based composites.

INS624 Sustainable Building Technologies (3 0 3) ... ECTS: 6
Sustainable development and sustainable building design. Sustainable green building assessment and certification. Sustainable building materials selection. Waste management, indoor air quality, and other considerations. Future high performance sustainable green building technologies.

INS625 Geopolymer Concrete (3 0 3) ... ECTS: 6
Introduction to non-Portland cement-containing materials (definitions, historical background, applications). Differences between Portland cementitious and non-cementitious materials (advantages and disadvantages, chemical reaction mechanism, properties). Types of non-cementitious materials (SCC, UHPC, alkali-activated materials, geopolymeric materials). Differences between alkali-activated materials and geopolymeric materials. Introduction to geopolymers. Future of geopolymers. Chemical reaction mechanism of geopolymers. Production of geopolymers. Main materials of geopolymers. Fly ash based geopolymer composites. Metakaolin based geopolymers, properties of geopolymer composites. Applications of geopolymers. Examples of applications of geopolymers. Present and future applications of geopolymers.

INS626 Plate Theory (3 0 3) ... ECTS: 6
Inlet Thin plates with small deflection. Plate differential equation in Cartesian coordinates. Boundary conditions. Methods of solving the differential equation: Navier solution. Levy method. Ritz and Galerkin methods. Numerical solution methods: Finite difference method. Finite element method. Transition to polar coordinates.
Circular plates. Circular plates loaded symmetrically about the center. Thick plates.

INS627 Stochastic Processes in Hydrology (3 0 3) ... ECTS: 6
Introduction Models. Systems. Time Series and Synthetic Series. Markov chains. Use of stochastic processes in flow and deposition prediction. Stochastic simulation. Stochastic optimization.

INS628 Computational Fluid Dynamics-I (3 0 3) ... ECTS: 6
Introduction. Classification of partial differential equations. Finite differential approximations and equations. Parabolic partial differential equations in fluid dynamics: Finite difference approximation, explicit and implicit approximations, one- and two-dimensional flow problems, stability analysis, applications. Elliptic partial differential equations in fluid mechanics. Hyperbolic partial differential equations in hydrodynamics. Applied problems with finite difference approximations in fluid dynamics. Introduction to other methods. Techniques of computer graphics and computational fluid dynamics.

INS629 Computational Fluid Dynamics-II (3 0 3) ... ECTS: 6
Mesh generation methods. Transformation of the fundamental equations of fluid dynamics from the physical to the computational level. Solution of Euler equations. Solution of parabolized Navier-Stokes equations. Solution of the Navier-Stokes equations. Finite field and volume methods. Introduction to Finite Element Method. Introduction to Boundary Element Method. Survey of other methods.

INS630 Turbulence Models (3 0 3) ... ECTS: 6
Introduction Stability problem. Fundamental equations. Vorticity equation. Introduction to Statistical Turbulence Theory. Correlation analysis of turbulence. Turbulence intensity and correlation factor properties. Damping of turbulence. Measurement of turbulence. Turbulence models. Computational turbulence.

INS631 Quality Management in Construction Projects (3 0 3) ... ECTS: 6
Quality concept, problems of poor quality in the construction industry. Quality management systems: Total Quality Management and the basic philosophy of ISO 9001:2000, principles of application, examples of application in the construction industry, benefits and costs.

INS632 Operations Research in Transportation (3 0 3) ... ECTS: 6
System definition and transportation systems. Problem solving/decision making process and systems approach. Systems approach to planning-design-construction-operation of engineering buildings. Mathematical modeling and model components. Classical optimization and linear programming. Graphical solution of the linear programming model. Analytical solution of linear programming model: simplex method-I. Analytical solution of linear programming model: simplex method-II. Sensitivity Analysis: Graphical and Analytical Methods. Integer programming. Some network problems and linear programming model. Network Problems-I: Transmission Problem, Shortest Path Problem, Maximum Flow Problem, and Minimum Span Problem. Network Problems-II: Critical Path Method (CPM) Algorithm and Linear Programming Model. Project Evaluation and Review Technique (PERT)

INS633 Stations-Station Buildings-Terminals (3 0 3) ... ECTS: 6
Transportation Planning. Logistics Systems. Freight transportation planning. Public transportation planning. Site selection analysis. Queuing theory. Principles of design, construction and operation of urban and interurban freight and passenger terminals.

INS634 Simulation Applications in Transportation (3 0 3) ... ECTS: 6
Simulation Software. Simulation with spreadsheets (MS Excel). Application examples of traffic simulation. Classification of simulation models. Probability and statistics in simulation. Creation of simulation models. Statistical Analysis of simulation data. Comparison of alternative system designs. Variance reduction techniques. Example of building a simulation model. Application of traffic simulation models.

INS635 Inland Waterways (3 0 3) ... ECTS: 6
Inland navigation, interaction between ship and waterway. Cruising speed. Navigation. Design of inland waterway profiles. Natural waterways. Capacity of inland waterways. Types and design of terminals.

INS636 Advanced Soil Dynamics (3 0 3) ... ECTS: 6
Definition of dynamic loads and vibration theory. Dynamics of single degree of freedom linear systems. Dynamics of nonlinear one-degree-of-freedom systems. Dynamics of multi-degree-of-freedom systems. Wave propagation. Dynamic soil properties. Stress-strain behavior and strength properties of soils under dynamic loading. Analysis of field behavior. Effects of liquefaction and settlement due to liquefaction. Seismic slope stability. Dynamic bearing capacity and behavior of pile foundations during liquefaction.

INS637 Treatment Plant Hydraulics (3 0 3) ... ECTS: 6
Transport processes and equations. Substance exchange in surface fields. Contaminant transport and remediation in groundwater. Flows in pipes, ocean outfalls, and structures. Open channel flows in drinking water and wastewater treatment plants. Flow measurements and design of hydraulic control points in drinking water and wastewater treatment plants. Introduction to the types of pumps used. Determination and application of hydraulic applications throughout the plant. Hydraulic profile project example.

INS638 Drinking Water Treatment Technology (3 0 3) ... ECTS: 6
Introduction Treatment method. Accumulation. Aeration, flocculation. Sedimentation. Filtration. Disinfection. Odor and taste control. Iron and manganese removal. Sludge drying, aggressive properties and water stabilization.

INS639 Groundwater Hydrology (3 0 3) ... ECTS: 6
Hydrological cycle. Types of groundwater. Relationship between soil and geology. Groundwater flow and velocity. Darcy's law and permeability. Properties and types of aquifers. Well hydraulics. Methods of solving groundwater flow problems.

INS640 Boundary Element Method (3 0 3) ... ECTS: 6
Numerical solution of surface and line integrals. Review of elastodynamic, acoustic and heat conduction equations. Basic integral equation. Basic solutions. Boundary element equation. Reduced boundary element equation. Numerical applications of the boundary element method.

INS641 Analytical Methods in Engineering-I (3 0 3) ... ECTS: 6
Mathematical preparation. Vectors, partial derivatives of vectors. Gradient of a scalar field. Divergence of a vector field. Rotation of a vector field. Divergence or Green's theorem. Laplace and Fourier transforms. General concepts of partial differential equations. Partial differential equations of first order. Advective transport problem in a reactor column. Heat exchanger problem. Second order partial differential equations and their classification. Reduction to canonical forms. Laplace's equation and its derivation. Flow of irrotational fluids. Flow in porous media. Boundary conditions. Direct solution method. Separation of variables method, integral transformation method. Diffusion equation and its derivatives. Heat transfer in solids. Chemical mass transport through porous media. Drying of porous solids. Thermal oxidation of silicones. Motion of a plate on a viscous fluid. Initial and boundary conditions. Direct solution method. Prediction function approach. Separation of variables method. Wave equation, vibrations of cables and membranes. Longitudinal wave propagation in elastic slender bars. Torsional waves in elastic slender rods. Stagnant water waves.

INS642 Analytical Methods in Engineering-II (3 0 3) ... ECTS: 6
Partial differential equations and their classification. Representation of the difference equation. Laplace equation, iterative methods. Poisson's equation. Derivative boundary conditions. Irregular domains. Matrix models. Sparsity. Name method. Parabolic partial differential equations. Explicit method. Crank-Nicholson method. Generalized theta method. Derivative boundary conditions. Hyperbolic partial differential equations. Wave equation. Finite difference solution. Characteristic method. Introduction to the finite element method.

INS643 Solids Transport (3 0 3) ... ECTS: 6
Solids Material properties. Solids and flow. Transport modes of solids. Suspended solids and sediment transport. Bottom shapes and formation. Solids transport in streams. Solids movement in reservoirs. Solids measurement techniques.

INS644 Special Topics in Geotechnical Engineering (3 0 3) ... ECTS: 6
Introduction to soil investigation methods. Soil investigation techniques in the field. Standard penetration. Vane shear and pressiometer field experiments. Design of soil mechanics laboratory test program. Preparation of field and laboratory test data and idealized geotechnical profile for static and dynamic analysis. Examples of geotechnical investigation reports. Geotechnical report writing. Stress distribution under irregularly shaped foundations. Bearing capacity and settlement analysis of raft foundations. Dynamic site response analysis. Axial capacity analysis of pile foundations. Analysis of groups of piles under horizontal loads. Kinematic analysis of piles.

INS645 Waste Geotechnics (3 0 3) ... ECTS: 6
Introduction. Urban solid waste generation rates. General waste management, transformation of solid waste. Transformation of hazardous waste into municipal solid waste, incineration of municipal solid waste. Groundwater flow. Water flow through the soil. Darcy's law. Concept of hydraulic conductivity. Laboratory rules for hydraulic conductivity. Types of parameters in hydraulic conductivity experiments. Field hydraulic conductivity methods. Clay mineralogy. Types of clay minerals. Double layer in clays. Cation exchange properties of clays. Landfill layers. Types of impermeable layers. Compacted clay layers. Design of compacted clay layers. Alternative layers (sand-bentonite mixtures, zeolite-bentonite layers). Composite layers. Types of composite layers. The role of geotextiles in landfills. The role of geomembranes in landfills. Geosynthetic clay covers, infiltration through layers, infiltration through compacted clay layer, infiltration through composite layers, transport processes (advection, diffusion, mechanical weathering). Infiltration through Layers (continued), Unstable Transport. Influence of material properties. Application to one-dimensional problems. Leachate treatment. Leachate treatment/disposal. Wastewater treatment. Wetland systems. Leachate recirculation systems. Landfill Gases. Components of Landfill Gases. Landfill gas management systems. Major types of gas management systems. Landfill slope stability. Failure modes of slope stability. Selection of strength parameters. Stability analysis. Stability of the layer system. Stability of the cover system. Cover layers-traditional covers. Functions of cover layers. Cover types. Cover components. Cover layers-water balanced covers. Monolithic barriers. Capillary barriers. Unsaturated soil properties.

INS646 Soil-Structure Interaction (3 0 3) ... ECTS: 6
Introduction to soil-structure interaction. General principles. Buildings resting on the ground. Static loads. Definition of relative displacement of building foundations. Damage criteria for building evaluation. Elastic beam method for continuous and raft foundations. Introduction to numerical methods. Undetermined parameter methods. Energy methods. Finite difference methods. Undetermined parameter methods. Collocation. Subregion collocation. Least squares. Galerkin Method. Energy Methods. Ritz Method. Finite Element Method. Analysis of foundations by numerical methods. Shallow foundations. Raft pile foundations. General concepts. Analytical methods for raft foundations. Soil-Pile interaction under horizontal loads. Single piles. Load-displacement curves of soil-pile interaction. Soil-Pile Interaction under Horizontal Loads. Groups of piles.

INS647 Structural Earthquake Engineering (3 0 3) ... ECTS: 6
Earthquakes and their effects on buildings. Seismic design of buildings. Earthquake codes and general principles. Seismic load calculation and methods. Seismic design rules for reinforced concrete buildings. Seismic design of reinforced concrete elements (foundation, beams and columns). Ductility in shear walls. Ductility in shear walls. Determination of seismic performance of buildings. Application examples. Project analysis.

INS648 Shrinkage in Concrete (3 0 3) ... ECTS: 6
General introduction, definitions, and explanations. Theoretical fundamentals. Types and properties of shrinkage: plastic (early plastic) shrinkage, structural (hydration-autogenous) shrinkage, carbonation (chemical) shrinkage, drying (hydraulic-ecological) shrinkage, thermal shrinkage. Factors influencing shrinkage: cement factors, concrete factors, environmental factors, concrete production factors. Criteria for modeling shrinkage. Some precautions against shrinkage.

INS649 Creep in Concrete (3 0 3) ... ECTS: 6
General introduction, definitions, and explanations. Theoretical Fundamentals. Factors influencing creep. Components of creep. Age effect in creep. Coefficient of creep. Principle of superposition. Size effect of structural elements in creep. Effect of creep on Young's modulus. Assumptions. Criteria for creep modeling. Some precautions against creep. Example calculations.

INS650 Protection of Reinforced Concrete from External Effects (3 0 3) ... ECTS: 6
Basic information on cement and concrete technology. Interface zone in concrete. Water as a damaging effect. Permeability. Classification of causes of damage to concrete. Superficial abrasion and freeze-thaw damage. Effect of high temperature on concrete. Deterioration due to chemical reactions. Effect of sulfates on concrete and protection measures. Alkali-Silica Reaction and expansion mechanism. Corrosion of reinforcement embedded in concrete. Protection of reinforced concrete structures exposed to sea water. Materials used in the repair of damaged reinforced concrete structures.

INS651 Numerical Analysis in Engineering Applications (3 0 3) ... ECTS: 6
Introduction to Matlab. Introduction to Matlab-Simulink. Different Types of Differential Equations. Wave equation. Heat equation. Second order ordinary differential equations and applications. Fourier series, transform and applications to engineering problems. Discrete Fourier transform and engineering applications. Laplace transform and Matlab-Simulink applications. Linear algebra. Finite element formulation. Strong and weak forms. Case studies, applications, and computations.

INS652 Metallic Building Materials (3 0 3) ... ECTS: 6
Phase diagrams of metal alloys. Iron-Carbon System. Phase transformations. Heat Treatment of Metals and Alloys. Mechanical properties. Determination of mechanical properties. Factors influencing mechanical properties. Structural steels. Low carbon structural steels. Micro-alloyed structural steels. Brainitic steels. High Temperature Materials. High strength steels. Stainless steels. Aluminum-based structural materials. Other engineering metals and alloys.

INS653 Modeling of Transportation Systems (3 0 3) ... ECTS: 6
Introduction and definitions. Algorithms and flowcharts in modeling. Constants, variables, arithmetic and logical operators. Condition/Comparison. Loops. Trip distribution algorithms (augmentation factor methods). Trip distribution algorithms (synthetic methods). Species distribution algorithms (maximum likelihood). Shortest path algorithms (Floyd-Warshall and Brunch and Bound). Allocation models. Optimization, objective functions and constraints. Optimization in Transportation Systems. Case studies and computations.

INS654 Special Topics in Advanced Structural Statics (3 0 3) ... ECTS: 6
Stress-strain properties and constitutive relations of building materials, calculation principles of building systems, nonlinear systems with respect to materials. The case of nonlinear displacements are distributed. Linearization techniques. Nondispersive case of nonlinear strains. Plastic connection concept. Calculation of limit loads. Angle method. Nonlinear systems with respect to geometry change. Second order theory. Calculation of buckling loads.

INS655 Structural Fire Safety (3 0 3) ....ECTS: 6
History Definitions. Properties. Behavior of Building Materials and Structural Metals in Fire. IV. Fire-resistant design of reinforced concrete structures. V. Simply supported slabs and beams with free expansion restraint. continuous slabs. beamless slabs and beams. statistical approach to fire safety for columns.

INS656 Advanced Strength Fundamentals and Equations (3 0 3) ....ECTS: 6
Introduction Concepts. Principles. Internal Force and Stress State. Deformation State. Kinematic relations. Stress-strain relations (Hooke's law). Strain energy. Safety stresses. Principles of beam strength. Cross section effects. Equivalence relations. Axial normal force. Shear Force. Simple bending. Torsion. Application examples and calculations.

İNS699 PhD Qualification (- - -) ... ECTS: 24