EN.565 (CIVIL ENGINEERING)

Courses

EN.565.604. Structural Mechanics. 3 Credits.
This course presents basic solid mechanics for structural engineers, including stress, strain, and constitutive laws; linear elasticity and visco-elasticity; introduction to nonlinear mechanics; static, dynamic, and thermal stresses; specialization of theory to one- and two-dimensional cases; plane stress and plane strain, rods, and beams; work and energy principles; and variational formulations. Course Note(s): This course is a requirement for the general Civil Engineering program and the Structural Engineering focus area.

EN.565.606. Geotechnical Engineering Principles. 3 Credits.
This course aims to review and reinforce knowledge of soil mechanics and geotechnical engineering principles for application in a variety of structural and civil engineering projects. The course presents examples of geotechnical engineering design problems. The course then discusses the origin of soil and types of soil, and various relations between weight and volume; methods used to characterize the index properties of soil, and classification of soil; theory of compaction; Darcy's law and the role of permeability, and the theory of two-dimensional seepage; stresses induced in soil by footing and other loading; compressibility of soil, and consolidation and consolidation settlements; shear strength of soil and the laboratory methods of determining shear strength parameters; theories of lateral earth pressure and their application to the analysis of retaining walls; fundamentals of slope stability analysis; fundamentals of the bearing capacity analysis of shallow foundations; and methods of subsoil exploration. Prerequisite(s): 560.305 Soil Mechanics or equivalent. 560.305 is offered on-site through the full-time Civil Engineering Department. Course Note(s): This course is a requirement for the general Civil Engineering program.

EN.565.608. BIM Applications in Civil Engineering. 3 Credits.
This course will introduce students to basic building information modeling (BIM) theory with an emphasis on how BIM is used in the design and construction of buildings. Students will learn how to model basic architectural, structural, and MEP systems in buildings using Autodesk Revit and how to schedule various model elements and create 2D drawings from the 3D model. They will be introduced to algorithmically generated content using Autodesk Dynamo.

EN.565.616. Applied Finite Element Methods. 3 Credits.
This course will introduce finite element methods for the analysis of solids and structures. The following topics will be considered: procedure for defining a mechanics problem (governing equations, constitutive equations, boundary and initial value problems); theory and implementation of the finite element method for static analysis using linear elasticity; and the verification/validation of results using finite element analysis software.

EN.565.619. Advanced Structural Analysis. 3 Credits.
The course will focus on matrix implementations of the stiffness method for the analysis of statically indeterminate structures such as plane/space trusses and plane/space frames. Computational aspects of the stiffness method will be discussed with connections made to commercial software. Linear elastic analysis will be the primary focus, but topics in nonlinear analysis will also be introduced.

EN.565.620. Advanced Steel Design. 3 Credits.
This course examines advanced designs of structural steel buildings including consideration of torsion, lateral-torsional buckling, local buckling, plate girder design, connection design, framing systems for seismic design, nonlinear frame behavior, and principles of stability per the Direct Analysis Method. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken a first (undergraduate) course in Steel Design.

EN.565.622. Advanced Reinforced Concrete Design. 3 Credits.
This intensive course covers reinforced concrete materials and specifications and includes the following topics: conception, analysis, and design of beams and columns, slabs, foundations and walls with emphasis on the ultimate strength method. Advanced seismic design topics are then covered building from the basic knowledge of reinforced concrete design. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken a first (undergraduate) course in Reinforced Concrete Design.

EN.565.623. Bridge Design and Evaluation. 3 Credits.
Through lectures, design problems and existing bridge examples, this course illustrates basic bridge knowledge from preliminary design to final design of major structural components. The course covers conventional bridges and other bridge types, including concrete segmental box girders, arch bridges, and cable-stayed bridges. The course is not intended to provide students with intensive training in any particular area of bridge design. The course requires problem solving, a term project, and a final exam. A background in reinforced concrete design and steel design is required. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken a first (undergraduate) course in Steel Design and Reinforced Concrete Design.

EN.565.626. Design of Wood Structures. 3 Credits.
This course introduces students to the design of wood structures. Wood structures may be constructed of sawn lumber, glulam, or engineered wood products. The primary focus in this class is on light-framed low-rise wood buildings constructed of sawn lumber or glulam, but concepts related to heavy timber-framed structures and tall wood buildings using cross-laminated timber (CLT) are introduced. Structural behavior under gravity and lateral loads is emphasized, as are analysis and design of the components within the gravity and lateral load resisting systems. The current version of the National Design Specification (NDS) for Wood Construction is used. A background in Steel Design or Reinforced Concrete Design is required. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken a first (undergraduate) course in Steel Design or Reinforced Concrete Design.

EN.565.628. Preservation Engineering I: Theory and Practice. 3 Credits.
The renovation of existing buildings often holds many advantages over new construction, including greater economy, improved sustainability, and the maintenance of engineering heritage and architectural character in our built environment. Yet, the renovation of existing structures presents many challenges to structural engineers. These challenges include structural materials that are no longer in widespread use (e.g., unreinforced masonry arches and vaults, cast iron, and wrought iron) as well as structural materials for which analysis and design practices have changed significantly over the last half-century (e.g., wood, steel, and reinforced concrete). This first course in the theory and practice of preservation engineering will include a review of the building code requirements related to work on existing buildings and a discussion of the load paths (both vertical and horizontal) through such structures. Further, this course will begin its review of structural materials with those that were available prior to the Industrial Revolutionnamely masonry and timber. The course will conclude with an overview of the response of wood structures to wind and seismic loads. Wood deterioration mechanisms and structural repair strategies for wood will also be presented.

EN.565.630. Prestressed Concrete Design. 3 Credits.
Topics include prestressed concrete concepts for both pretensioning and post-tensioning: materials, types of prestress, and prestress losses; design of sections for flexure, shear, torsion, and compression; load balancing technique; consideration of partial prestress, composite sections, and slab systems. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken a first (undergraduate) course in Reinforced Concrete Design.

EN.565.631. Preservation Engineering II: Theory & Practice. 3 Credits.
Building on the content in Preservation Engineering I: Theory and Practice, this course will begin with materials introduced at the start of the Industrial Revolution-namely with the beginning of the use of iron materials as major structural elements within buildings. The course will continue with the introduction of cast iron, wrought iron, and finally, structural steel members. After introducing iron materials the course will continue with the early use of reinforced concrete as a major structural material. The course will discuss the historic structural analysis methods associated with such materials and contrast such methods with more modern analytical approaches. It will also discuss concrete deterioration and repair methods. Concepts related to masonry facade investigation and repair will be presented along with the analytical methods associated with thin-shell masonry construction from the 19th and 20th centuries. The course will conclude with a review of the assessment and retrofit of historic foundations.
Prerequisite(s): EN.565.628 Preservation Engineering I: Theory and Practice

EN.565.633. Investigation, Diagnosis, and Rehabilitation. 3 Credits.
Why do buildings deteriorate? And how do we investigate and diagnose the causes, as well as design and implement appropriate solutions? This course examines the deterioration of building materials and systems caused by both humans and nature. Through weekly lectures and one weekend workshop, students will learn how to plan and execute an investigation, identify the symptoms, determine what tests are needed, diagnose the causes, and design and administer necessary repairs to address deterioration and system deficiencies. Weekly lectures will use a combination of Virtual Live and online formats; a weekend workshop in Baltimore (date TBD) will include hands-on activities and a field trip to a local project site.

EN.565.636. Lateral Forces: Analysis and Design of Building Structures. 3 Credits.
From earthquakes to wind events, lateral forces constitute some of the most extreme loading conditions for which new and existing building structures must be analyzed and designed to resist. This course provides a fundamental yet practical introduction to the development and application of earthquake and wind loadings on building structures, the dynamic response and behavior of structures to lateral forces, and the bases and requirements for ductile design and detailing of steel, concrete, wood, and masonry lateral force resisting elements. The course will build on these analysis and design fundamentals to examine the technical considerations and methodologies for evaluating the lateral force resisting systems of existing, oftentimes monumental, building structures, and for designing and implementing repairs and retrofits to these lateral systems, including the application of Performance Based Design. This course is co-listed with 560.615.

EN.565.637. Preservation Engineering in the Urban Context. 3 Credits.
Technical expertise is fundamental to design and construction within and around historic buildings in the urban context. This course will cover topics related to both design and construction. For below-grade engineering, the course will cover underpinning, bracket piles, secant piles, slurry walls, tie-backs and general shoring approaches to building below or adjacent to existing constructions. For upward additions to existing construction, the course covers strengthening techniques (including temporary shoring and bracing, temporary access options, and temporary protection) and the requirements of the International Existing Building Code (IEBC). Each class will provide both technical guides and case studies, offering perspectives from guest speakers practicing the diverse range of professions tasked to meet this challenge.

EN.565.641. Fundamentals of Construction Management. 3 Credits.

EN.565.658. Natural Disaster Risk Modeling. 3 Credits.
Natural hazards such as floods, earthquakes, and hurricanes exert a heavy toll of victims and economic losses every year. Yet, concentrations of population in hazard-prone-areas, the growth of infrastructure and climate change are aggravating the risk of future losses. Consequently, adequate interventions must be implemented to mitigate the damaging effects of natural hazards. To do this, public agencies, non-profits, and companies formulate mitigation actions such as emergency preparedness plans and building retrofits. Catastrophe models are tools to inform all these efforts, which simulate the socioeconomic risk resulting from the interaction of geophysical events and the spatial distribution of infrastructure.Course note(s): This course is cross-listed with 575.658 Natural Disaster Risk Modeling.

EN.565.664. Advanced Foundation Design. 3 Credits.
This course will introduce the principles and specifics of the geotechnical design of shallow and deep foundations. Topics include design of shallow foundations, including spread footings, combined footings and mat foundations; design of deep foundations, including single piles, pile groups and drilled shafts; design of laterally-loaded piles; construction monitoring and testing methods for driven piles; design of foundations for vibration control; foundations on difficult soils; underpinning; and design of buried culverts.
Prerequisite(s): EN.560.305 Soil Mechanics (or equivalent) or EN.565.606 Geotechnical Engineering Principles.

EN.565.680. Marine Geotechnical Engineering. 3 Credits.
This course introduces students to soil mechanics in the marine environment. Topics covered include the nature of marine sediments, soil behavior due to cyclic loading, marine geotechnical investigations, shallow foundations and dead-weight anchors, pile foundations and anchors, penetration and breakout of objects on the seafloor, and project planning. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken 565.606 Geotechnical Engineering Principles.

EN.565.682. Design of Ocean Structures. 3 Credits.
This course presents a review of structural design theory and practice related to ocean structures. Basic elements of ocean structures are designed using current engineering design codes developed by the American Institute of Steel Construction (AISC) and American Petroleum Institute (API). Topics include ocean environmental forces, material selection, foundation design, and analysis/design of ocean structures.

EN.565.684. Port & Harbor Engineering. 3 Credits.
Planning and engineering of ports and harbors has received renewed worldwide interest as the newest super-large cargo ships push the envelope for channel depth and berth space. This course covers planning of marine terminals and small craft harbors, ship berthing and maneuvering considerations, operational and environmental loads, fender system design, and mooring loads and design principles.

EN.565.686. Sustainable Coastal Engineering. 3 Credits.
This course presents a review of sustainable engineering related to the ocean environment. Sustainable shore protection designs will be investigated such as living shorelines and sills, beach nourishment, and other sustainable methods in order to adapt to coastal hazards such as hurricanes, tsunamis, and sea level rise. Sustainable energy such as coastal wind energy, wave energy, tidal energy, and other sustainable energy sources will be also investigated as alternative energy designs. The importance of sustainable food production will be discussed and aquaculture system designs such as ocean aquaculture, shellfish aquaculture, and other sustainable food production will be studied.

EN.565.720. Special Topics in Civil Engineering Structures. 3 Credits.

EN.565.731. Structural Dynamics. 3 Credits.
This course provides an overview of rigid-body dynamics, free and deterministic forced vibration of undamped and damped single- and multi-degree-of-freedom systems, vibration of continuous systems, approximate methods of analysis, and introduction to random vibration of linear systems. Applications of the principles of structural dynamics to determine a structure's earthquake response are also covered. Instructor assumes that students who enroll in this course have a basic understanding of stiffness and stiffness matrices.
Prerequisite(s): EN.535.641 Mathematical Methods for Engineers.

EN.565.732. Earthquake Engineering. 3 Credits.
Topics for this course include plate tectonics, seismicity of Earth, and engineering seismology-including quantification and classification of earthquake ground motions, dynamics of structures subjected to earthquake loads, design spectra, building code provisions, design concepts and detailing, soilstructure interaction, and response of special structures.

EN.565.734. Wind Engineering. 3 Credits.
This course covers atmospheric circulation, atmospheric boundary layer winds, bluff-body aerodynamics, modeling of wind-induced loads, introduction to random vibration theory, response of structures to fluctuating wind loads, aeroelastic phenomena, wind-tunnel and full-scale testing, computational wind engineering, non-synoptic winds (hurricanes, tornadoes, etc.), and wind-load standards and design applications.

EN.565.736. Structural Fire Engineering. 3 Credits.
This course will discuss the analysis and design of structures exposed to fire. It will cover the fundamentals of fire behavior, heat transfer, the effects of fire loading on materials and structural systems, and the principles and design methods for fire resistance design. Particular emphasis will be placed on the advanced modeling and computational tools for performance-based design. Applications of innovative methods for fire resistance design in large structural engineering projects, such as stadiums and tall buildings, will also be presented.

EN.565.740. Structural Stability. 3 Credits.

EN.565.762. Ground Improvement Methods. 3 Credits.
This course addresses the selection, cost, design, construction, and monitoring of ground improvement methods for problematic soils and rock. Ground improvement methods covered include wick drains, micropiles, lightweight fill materials, soil nailing, mechanically stabilized slopes and walls, grouting, stone columns, dynamic compaction, and soil mixing. Prerequisite(s): 560.330 Foundation Design or equivalent and 565.606 Geotechnical Engineering Principles. 560.330 is offered on-site through the full-time Civil Engineering Department.
Prerequisite(s): EN.565.606 Geotechnical Engineering Principles.

EN.565.764. Retaining Structures and Slope Stability. 3 Credits.
Topics for this course include earth pressure theories; design and behavior of rigid, flexible, braced, tied-back, slurry, and reinforced soil structures; stability of excavation, cut, and natural slopes; methods of slope stability analysis; effects of water forces; shear strength selection for analysis; and stability and seepage in embankment dams. Prerequisite(s): Open to EP Civil Engineering students only, or students who have taken 565.606 Geotechnical Engineering Principles.

EN.565.800. Independent Study in Civil Engineering. 3 Credits.
In this independent study course, qualified students are permitted to pursue short-term research or design projects under the guidance and direction of faculty members.Course prerequisite(s): The Independent Study/Project Form (ep.jhu.edu/student-forms) must be completed and approved prior to registration.Course note(s): This course is open only to candidates in the Master of Civil Engineering program.

EN.565.801. Independent Study in Civil Engineering. 3 Credits.
In this independent study course, qualified students are permitted to pursue short-term research or design projects under the guidance and direction of faculty members.Course prerequisite(s): The Independent Study/Project Form (ep.jhu.edu/student-forms) must be completed and approved prior to registration.Course note(s): This course is open only to candidates in the Master of Civil Engineering program.