



Qualifying Exam

Department of Civil Engineering

Qualifying Examinations consist of written and oral examinations and are administered by the Qualifying Exam Committee (QEC) on dates specified at least two months before the examination period. The QEC comprises the following faculty members: **Özer Çinicioğlu, Hilmi Luş, Emre Otay (QEC Chair), Beliz Özorhon Orakçal, Nilüfer Özyurt Zihnioğlu.**

Each candidate's oral exam is conducted by the candidate's own Examination Jury (EJ). Each EJ consists of five examiners and it must include the candidate's thesis advisor, two external examiners who are full time faculty members at universities other than Boğaziçi University, and at least one member of the QEC (if the thesis advisor is a member, then this condition is deemed to be satisfied).

Candidates must fill out the "Qualifying Exam Registration Form" (attached), have the form approved by their thesis advisors and submit it to the QEC for approval by the due date announced. The candidates are strongly advised to contact the EJ members for details regarding the topics that will be covered in the exams and the necessary reading materials.

Written exams

All students must complete the three following exams; an absence in any one of these exams will lead to a failing outcome and all exams will have to be repeated:

I. Engineering Mathematics

Overview of topics: Complex functions. Matrix operations, Cramer's rule, Gauss' elimination, strict diagonal dominance. Eigenvalues and eigenvectors. Orthogonality. Cayley-Hamilton Theorem. Gerschgorin's theorem. Vector algebra. Vector valued functions, vector fields, flow lines, curl, divergence, gradient. Tensors and tensor analysis, tensor invariants. Differential equations (separable variables type, exact type, geometric view, linear differential operator, nth order DEQs, Wronskian test). Fourier series and transforms. Laplace series and transforms. Solution of DEQs with Laplace transform.

Suggested courses: CE 503

II. Theoretical Foundations

All candidates must complete one of the following in-class exams:

a. Fluid Mechanics (Coordinator: Emre Otay)

Overview of topics: Fluid properties. Fluid kinematics and statics. Reynolds transport theorem, conservation of mass, momentum and energy. Differential analysis of potential and viscous flows. Dimensional analysis and similitude. Boundary layers. Viscous flow in pipes. Pipe networks, waterhammer, pumps. Open channel flows.

Suggested courses: CE 311, CE 312, CE 514, CE 587

b. Material Science (Coordinator: Nilüfer Özyurt Zihnioğlu)

Overview of topics: **Overview of topics:** Atomic bonding and arrangement. Crystal structures. Structural imperfections. Metals, ceramics, polymers and composites. Cementing materials, aggregates, concrete, masonry, structural metals. Mechanical properties and failure. Rheology of concrete. Rheological models. Stress-strain equations and models. Complex and principal states of stress and strain. Strength, deformation, creep, fatigue and durability concrete. Yielding and fracture under combined stresses, failure criteria. Basic concepts of measurement methods. Measurement system behaviour. Analysis of experimental data. Data acquisition. Sensors for transducers. Resistance type strain gages.

Suggested courses: CE 211, CE 212, CE 544, CE 554

c. Soil Mechanics (Coordinator: Özer Çinicioğlu)

Overview of topics: Physical properties of soils, soil classification, moisture effects, flow processes compressibility and consolidation, stress, deformation, and strength characteristics; stress distribution and analysis; lateral earth pressures. Basic laboratory experiments, definition and physical meaning of tensors, principal stresses, strains, and their invariants. Characteristics of soils such as stiffness, dilatancy, and strength. Definition of soil failure surfaces. Constitutive modelling, physical modelling, dynamic soil properties, liquefaction, elasticity, plasticity, elastic-plastic model, critical states.

Suggested courses: CE 332, CE 531, CE 532, CE 639

d. Structural Mechanics (Coordinator: Hilmi Luş)

Overview of topics: Internal force distributions. Stress and infinitesimal strain at a point. Axial, shear, bending and torsional deformations and related stress distributions including combined loading. Buckling of bars. Boundary value problems of linear elasticity. Work and energy theorems of structural analysis. Analysis of indeterminate linear structural systems. Newtonian, Eulerian and Lagrangian equations of motion. Free and forced vibrations of single and multi degree of freedom linear systems.

Suggested courses: CE 246, CE 355, CE 546, CE 559

e. Systems Analysis (Coordinator: Beliz Özorhon Orakçal)

Overview of topics: Probability. Statistics. Systems analysis and design, linear and non-linear optimization, simplex algorithm, queueing theory. Feasibility decision making, comparison between investment options, cash flow analysis. Critical path method, resource allocation and leveling, project compression (crashing). Research process, research methodologies, research design. Questionnaires and case studies, data collection. Mathematical modeling, multi-objective optimization, exploratory factor analysis, structural equation modeling. Artificial intelligence, analytic network process, simulation, systems dynamics.

Suggested courses: CE 202, CE 402, CE 563, CE 680

III. Subject Area

A written exam coordinated by the student's thesis supervisor, prepared jointly by the student's thesis supervisor and the external examiners. This exam shall cover the subjects regarded as the main concentration area of the student.

Evaluation Each written exam is evaluated over 100 points. The weighted average WA is calculated as:

$$\text{WA} = [0.2 \times \text{Engineering Mathematics}] + [0.4 \times \text{Theoretical Foundations}] + [0.4 \times \text{Subject Area}]$$

A candidate **must score at least 40/100 in all exams and must have a weighted average of at least 60/100** to be able to take the oral exam. A candidate not satisfying both conditions will fail the Qualifying Exam and will have to **repeat all written exams** during the following examination period.

Oral exams

The oral exam is conducted by the members of the Examination Jury. At the end of the oral exam, the Jury may decide, unanimously or by majority, on one of the following outcomes:

- (i) PASS: The candidate has successfully completed the qualifying exam requirements.
- (ii) FAIL: The candidate is not successful and will have to repeat the written exams AND the oral exam during the next examination period.
- (iii) CONDITIONAL PASS: The candidate is deemed to have successfully completed the qualifying exam requirements but must complete, before graduation, the "conditions" that must be explicitly stated on the Examination Report and signed by the Jury. A "condition" is specification of a certain course that must be completed with a predetermined minimum grade. Note that such conditions may not be guided research or special studies courses.

The candidate will FAIL the qualifying exam if he/she does not take the oral exam on due date and time without any valid and documented excuse.



BU DEPARTMENT OF CIVIL ENGINEERING
QUALIFYING EXAM REGISTRATION FORM

Name of PhD Candidate:

PhD Qualifying Exam Term:

EXAMINATION JURY⁽¹⁾ **(Oral Exam)**

Jury Members	Name of Jury Member
1. Thesis Advisor	
2. External Examiner	
3. External Examiner	
4. Jury Member	
5. Jury Member	

Substitute Members	Name of Jury Member
1. Jury Member ⁽²⁾	
2. External Examiner	

WRITTEN EXAMS

Exam	Topic	Examiner
1. ENGINEERING MATHEMATICS		
2. THEORETICAL FOUNDATIONS	() FLUID MECHANICS () MATERIAL SCIENCE () SOIL MECHANICS () STRUCTURAL MECHANICS () SYSTEMS ANALYSIS	
3. SUBJECT AREA		

⁽¹⁾ At least one member of the Examination Jury must belong to the Qualifying Exam Committee (QEC). If the thesis supervisor is a member of the QEC, then this condition is satisfied. Qualifying Exam Committee members are: Emre Otay (QEC Chair), Özer Çinicioğlu, Hilmi Luş, Beliz Özorhon Orakçal, Nilüfer Özyurt Zihnioğlu.

⁽²⁾ Substitute jury member must belong to the Qualifying Exam Committee (QEC)