NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF ENVIRONMENTAL ENGINEERING
SANITARY ENGINEERING PROGRAM

EC511 – SOIL MECHANICS

I. GENERAL INFORMATION

CODE	**:**	EC511 Soil Mechanics
SEMESTER	**:**	--
CREDITS	**:**	4
HOURS PER WEEK	**:**	5 (Theory, Practice)
PREREQUISTES	**:**	AA215 Geology
CONDITION	**:**	Elective

II. COURSE DESCRIPTION

The course prepares students for the analysis of the mechanics of soils and their response to different solicitations, considering the heterogeneous characteristics and composition of different types of soils. Students analyze soil components, soil classifications, and effective stress and capacity. Students also analyze soils shear behavior, stiffness and strength, and solve problems related to foundations, slope stability, bearing capacity, and lateral earth pressure,

III. COURSE OUTCOMES

At the end of the course students:

1. Apply general soil mechanical and physical behavior theories in the solution to foundation, banks, retaining walls and other problems with varied field applications:
2. Apply foundation engineering using spreadsheet for the different assessment methods.
3. Lean and assess natural and artificial bank-related works stability, applying specialized software related to the different limit equilibrium methods.
4. Understand and apply theory concepts to give stability to bridges and works of art, and identify specialized software for designing vertical support elements.
5. Understand and apply the different methods to assess shallow foundation stability for urban and rural buildings.
6. Properly analyze basic conditions for designing dam and works with hydraulic load influence.

IV. LEARNING UNITS

1. CONCEPTS OF SOIL MASS INITIAL STRESSES

Basic concepts of soil mass stresses / Application of learned concepts to practical cases of geotechnical engineering / Specialized instrumentation for calculating neuter pressures / Application and calculation of stress increase due to transferred loads, stress trajectory, etc. / Concept of Interstitial pressure and its in situ measuring using geotechnical instrumentation. Elastic soil equilibrium, fundamental relationships, geostatic stress concept, effective stress in a soil mass point.

2. CONCEPT OF STRESS TRANSFERRED IN SOIL MASS

Application and calculation of stress increase due to transferred loads, stress trajectory, etc. / Soil mass stress due to different types of external load, Influence diagram solution: Newmark, Fadum, Westergard, Carothers, Osterberg, etc.

3. CONCEPTS OF COMPACTION FORMATIONS

Terzaghi's theory for one-dimensional compaction of fine, saturated and soft soils. Application and assessment of compaction average settlement. / Volume change and strain properties. Types of stress-strain and compaction - compressibility relationships, precompaction pressure or stress determination.

4. SHEAR AND ITS RELATIONSHIP WITH SOILS
Shear strength, stress calculation in secondary planes / Main stresses Stress state in Mohr's circle, stress determination in any stress application plane, stress trajectory / Shear strength application to soils and its practical and theoretical grasp.

5. SHEAR STRENGTH
Shear strength. Failure Theory, Mohr–Coulomb theory / Determination of soil shear strength. Interstitial pressure and volume change in shear strength tests / Soil mass resistance parameters acquisition using filed tests. Clay shear strength. Non-cohesive soil shear strength, compacted and partially saturated clay shear strength, Drained and undrained shear strength meaning, cohesion and resistance to internal friction / Analysis of the liquation potential of granular soil saturated due to pore pressure increase effect in dynamic and static conditions.

6. ESTIMATION OF SIDE THRUST OVER VERTICAL ELEMENTS
Assessment of side thrusts for designing contention elements to solve geotechnical engineering problems / Soil pressures, Soil side pressures, Rankine and Coulumb theoretical applications, overload effects, pore and water fluid pressures, practical limitations of theoretical expressions, field measures of soil pressures / Soil plastic equilibrium, rigorous solutions, displacement plane / Rankine's theory for soil-surface, displacement curves, approximate solutions.

7. BANK STABILITY ANALYSIS
Practical identification of definitions and assessment of the bank factor of safety in limit pseudo-static and static equilibrium conditions for bank material mechanical conditions. Practical problems application of geotechnical engineering for establishing bank's stability / Bank's stability, analysis and design concepts, stability and load conditions, saturated clay stability, non cohesive stability, compacted partially saturated clay stability , intermediate soils stability.

8. BEARING CAPACITY AND ELASTICS SETTLEMENTS – FOUNDATIONS
Soil Allowable bearing capacity, Terzaghi's theory for soil bearing capacity, bearing capacity for shallow foundations / Basic designs of shallow foundations, active foundation depth and its practical identification, ground water (phreatic level) influence in the calculation of the foundation stability / Shallow foundations, general aspects about types of foundations made on Peru, allowable settlement, angular distortions.

V. LABORATORY EXPERIENCES

Lab 1: Parameter determination: One-dimensional soil compaction test.
Lab 2: Parameter determination: Unconfined compression strength.
Lab 3: Parameter determination: Direct shear strength, Compacted-drained.
Lab 4: Computer-aided factor of safety determination in static and pseudo-static condition of a bank.

VI. METHODOLOGY

The methodology of this course is directed to encourage students' active participation. Analysis, discussion about the foundation bearing capacity and its factor of geotechnical safety. Experiences and research of other cases.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = (EP+EF+(P1+P2+P3+P4+P5+(L1+L2+L3+L4)/4)/5)/3

EP: Mid-Term Exam EF: Final Exam
P : Quizzes L#: Labs

VIII. BIBLIOGRAPHY

1. **BRAJA M. DAS**
   Principles of Engineering Foundations (Spanish)
   International Thomson Editors. 5th edition
2. **WILLIAM LAMBE AND ROBERTH WHITMAN**
   Soil Mechanics (Spanish)
   Limusa Editorial