الجمهورية الجزائرية الديمقراطية الشعبية République Algérienne Démocratique et Populaire
وزارة التعليم العالي والبحث العلمي
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
اللجنة البيداغوجية الوطنية لميدان العلوم و التكنولوجيا
Comité Pédagogique National du domaine Sciences et Technologies

HARMONIZED ACADEMIC MASTER

National Program

2022 Update

Domain	Field	Speciality
Science and Technology	***Civil Engineering***	***Geotechnics***

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I – Master's Identity Sheet

Access conditions

Field	HARMONIZED ACADEMIC MASTER	Licenses giving access to the master's degree	Ranking by license compatibility	Coefficient assigned to the license
Civil Engineering	Geotechnics	Civil Engineering	**1**	**1.00**
		Hydraulic	**1**	**1.00**
		Public works	**1**	**1.00**
		Mining	**3**	**0.70**
		Other licenses in the ST domain	**5**	**0.60**

II – Semester Teaching Organization Sheets for the Specialty

Semester 1 Master: Geotechnics

Teaching Unit	Subject	Credits	Coefficient	Weekly hour volume			Semester Hour Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment Method	
	Title			Course	DW	PW			Continuous Assessment	Exam
UE Fundamental Code : UEF 1.1.1 Credits : 8 Coefficients : 4	**Continuum mechanics**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Advanced soil mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 1.1.2 Credits : 10 Coefficients : 5	**Slopes and Retaining**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Foundations	4	2	1h30	1h30		45h00	55h00	40%	60%
	Applied Geophysics	2	1	1h30			22h30	27h30		100%
UE Methodological Code : UEM 1.1 Credits : 9 Coefficients : 5	**Programming supplement**	3	2	1h30		1h00	37h300	37h30	40%	60%
	Experimental methods	2	1	1h30			22h30	27h30		100%
	Geotechnical Testing and Site Investigation 1	4	2	1h30		1h30	45h00	55h00	40%	60%
UE Discovery Code : UED 1.1 Credits : 2 Coefficients : 2	***Optional subject***	1	1	1h30			22h30	02h30		100%
	Optional subject	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 1.1 Credits : 1 Coefficients : 1	**Technical English and Terminology**	1	1	1h30			22h30	02h30		100%
Total semester 1		**30**	**17**	**16h30**	**6h00**	**2h30**	**375h00**	**375h00**		

Semester 2 Master: Geotechnics

Teaching Unit	Subject	Credits	Coefficient	Weekly hour volume			Semester Hour Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment Method	
	Title			Course	DW	PW			Continuous Assessment	Exam
UE Fundamental Code : UEF 1.2.1 Credits : 8 Coefficients : 4	**Mechanics of Deformable Solids**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Soil Dynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 1.2.2 Credits : 10 Coefficients : 5	**Rheology of Soils**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Geostatistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Earth Dams	2	1	1h30			22h300	27h30		100%
UE Methodological Code : UEM 1.2 Credits : 9 Coefficients : 5	**Finite element method**	5	3	1h30	1h00	1h30	60h00	65h00	40%	60%
	Geotechnical Testing and Site Investigation 2	4	2	1h30		1h30	45h00	55h00	40%	60%
UE Discovery Code : UED 1.2 Credits : 2 Coefficients : 2	***Optional subject***	1	1	1h30			22h30	02h30		100%
	Optional subject	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 1.2 Credits: 1 Coefficients : 1	**Compliance with standards and rules of ethics and integrity**	1	1	1h30			22h30	02h30		100%
Total semester 2		**30**	**17**	**15h00**	**7h00**	**3h00**	**375h00**	**375h00**		

Semester 3 Master: Geotechnics

Teaching Unit	Subject	Credits	Coefficient	Weekly hour volume			Semester Hour Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment Method	
	Title			Course	DW	PW			Continuous Assessment	Exam
UE Fundamental Code : UEF 2.1.1 Credits : 8 Coefficients : 4	**Dynamics of geotechnical structures**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Failure calculation and limit analysis	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 2.1.2 Credits : 10 Coefficients : 5	**Rock mechanics**	4	2	1h30	1h30		45h00	55h00	40%	60%
	Tunnels and underground structures	4	2	1h30	1h30		45h00	55h00	40%	60%
	Road geotechnics	2	1	1h30			22h30	27h30		100%
UE Methodological Code : UEM 2.1 Credits : 9 Coefficients : 5	**Soil improvement**	4	2	1h30		1h30	45h00	55h00	40%	60%
	Modeling of geotechnical structures	2	1			1h30	22h30	27h30	100%	
	Geographic Information Systems	3	2	1h30		1h00	37h30	37h30	40%	100%
UE Discovery Code : UED 2.1 Credits : 2 Coefficients : 2	***Optional subject***	1	1	1h30			22h30	02h30		100%
	Optional subject	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 2.1 Credits : 1 Coefficients : 1	**Literature review and thesis design**	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**15h00**	**6h00**	**4h00**	**375h00**	**375h00**		

UE Discovery Subjects (S1, S2, S3):

1. *Hydrogeology*
2. *Geotechnical hazards and risks*
3. *Finite difference method*
4. *Discrete element method*
5. *Construction site organization*
6. *Pathology of geotechnical structures*
7. *Public procurement code*
8. *Geotechnical standards*
9. *Construction law*
10. *PGC for geotechnical structures*
11. *Concepts of civil and industrial construction*
12. *Concepts of roads and engineering structures*
13. *Concepts of hydraulic engineering structures*

Semester 4

Internship in a company or in a research laboratory, culminating in a thesis and a defense (this table is provided for indicative purposes).

	VHS	Coeff	Credits
Personal Work	550	09	18
Internship in a company or laboratory	100	04	06
Seminars	50	02	03
Other (Supervision)	50	02	03
Total Semester 4	750	17	30

This table is provided for indicative purposes only.

Evaluation of the Master's End-of-Cycle Project

- Scientific value (Jury evaluation) /6
- Thesis writing (Jury evaluation) /4
- Presentation and response to questions (Jury evaluation) /4
- Supervisor's evaluation /3
- Internship report presentation (Jury evaluation) /3

III - Detailed course program for semester S1

Semester: 1
Teaching Unit: UEF 1.1.1
Subject 1: Continuum mechanics
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the theoretical concepts of continuum mechanics.

Recommended Prerequisites:

Algebra, Thermodynamics, Rational Mechanics, Fluid Mechanics, Strength of Materials.

Course Content:

Chapter 1. General Concepts **(1 Week)**
Chapter 2. Mathematical Preliminaries **(2 Weeks)**
Chapter 3. Stress State Theory **(4 Weeks)**
Chapter 4. Strain State Theory **(4 Weeks)**
Chapter 5. Constitutive Behavior Relationships **(4 Weeks)**

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

1. *P. Germain.* ***Mécanique des milieux continus****. Ed. Masson.*
2. *P. Germain, P. Muller.* ***Introduction à la mécanique des milieux continus****. Ed. Masson.*
3. *J. Salençon.* ***Mécanique des milieux continus, Tomes 1, 2 et 3****. Ed. Ecole Polytechnique, France.*
4. *J. Coirier, C. Nadot-Martin.* ***Mécanique des milieux continus****.Ed.Dunod.*
5. *G. Duvaut.* ***Mécanique des milieux continus****. Ed. Masson.*
6. *J. Botsis, M. Deville.* ***Mécanique des milieux continus****. Ed. Eyrolles.*
7. *R. Temam, A. Miranville.* ***Modélisation mathématique et mécanique des milieux continus****. Ed. Springer.*

Semester: 1
Teaching Unit: UEF 1.1.1
Subject 3: Advanced soil mechanics
VHS: 45h00 (Course: 1h30, Directed studies: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

The purpose of this course is to provide the student with in-depth theoretical and experimental knowledge dealing with the mechanical behavior of granular soils and fine soils in saturated and unsaturated states.

Recommended prior knowledge:

Soil mechanics 1 and 2

Content of the module:

Chapter 1: Reminder on granular soils and fine soils (3 Weeks)
I-1 : Difference between coarse-grained and fine-grained soils
I-2 : Properties of granular soils
I-3 : Properties of fine soils
I-4 : Plasticity and shear strength
I-5 : Short-term and long-term behavior
I-6 : Stress path in space ($\sigma - \varepsilon$) and ($p - q$)

Chapter 2: Behavior of Granular Materials (4 Weeks)
II-1 : Stress-strain relationship
II-2 : Dilation theory
II-3 : Critical state and characteristic state
II-4 : Influence of lateral stress
II-5 : Behavior under cyclic path: contraction, expansion and liquefaction

Chapter 3: Behavior of fine soils (4 Weeks)
III-1 : shear of a clay, overconsolidated and normally consolidated domain, drained and undrained shear, pore pressure, failure criterion, total stress envelope.
III-2 : Consolidation state and shear strength
III-3 : Relationship between consolidation pressure of fine soils and Cu

Chapter 4: Behavior of unsaturated Soils (4 Weeks)
IV-1 : Definition of suction
IV-2 : Concept of effective stress in unsaturated soils
IV-3 : Shear strength in unsaturated soils
IV-4 : Permeability and suction

Evaluation mode:

Continuous control: 40% ; Exam: 60%

Bibliographic references:

1. *F. Schlosser.* ***Eléments de mécanique des sols****. Ed. Presses des ponts, France.*
2. *F. Schlosser.* ***Exercices de mécanique des sols****. Ed. Presses des ponts, France.*
3. *J. Costet, G. Sanglerat.****Cours pratique de mécanique des sols****. Tomes 1 & 2.Ed. Dunod.*
4. *G. Sanglerat, G. Olivari, B. Cambou.****Problèmes pratiques de mécanique des sols et de fondations****. Tomes 1 & 2. Ed.Dunod.*
5. *G. Philipponnat, B. Hubert.* ***Fondations et ouvrages en terre****. Ed. Eyrolles.*
6. *D. Cordary.* ***Mécanique des sols****. Ed. Lavoisier.*
7. *Robert D. Holtz, William D. Kovacs.****Introduction à la géotechnique****. Ed.Ecole Polytechnique de Montréal, Canada.*
8. *Braja M. Das.* ***Advanced Soil Mechanics****. Ed. Taylor & Francis Group.*

9-Delage P., Cui Y. J. 2001 : **Comportement mécanique des sols non saturés**. Techniques de l'Ingénieur, Construction, C302, 19p.

10-Coussy O. et Fleureau J. M. 2002 : **Mécanique des sols non saturés**. HermesSciencves publication, Paris, 390p.

Semester: 1
Teaching Unit: UEF 1.1.2
Subject 3: Slopes and Retaining
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to enable students to deepen their knowledge in the analysis of slope stability and the design and calculation of retaining structures.

Recommended Prerequisites:

Soil Mechanics 1 and 2, Foundations and Geotechnical Structures.

Course Content:

First Part: Slope and Embankment Stability
Chapter 1. Stability of Slopes with Planar Failure **(2 Weeks)**
Chapter 2. Stability of Slopes with Circular Failure **(3 Weeks)**
Chapter 3. Stability of Slopes with Arbitrary Failure **(3 Weeks)**
Second Part: Retaining Structures
Chapter 4. Classification of Retaining Structures **(1 Week)**
Chapter 5. Actions and Loadings **(3 Weeks)**
Chapter 6. Design and Justifications **(3 Weeks)**

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

1. *F. Schlosser.* ***Eléments de mécanique des sols****. Ed. Presses des ponts, France.*
2. *F. Schlosser.* ***Exercices de mécanique des sols****. Ed. Presses des ponts, France.*
3. *J. Costet, G. Sanglerat.* ***Cours pratique de mécanique des sols****. Tomes 1 & 2. Ed. Dunod.*
4. *G. Sanglerat, G. Olivari, B. Cambou.* ***Problèmes pratiques de mécanique des sols et de fondations****. Tomes 1 & 2. Ed. Dunod.*
5. *G. Philipponnat, B. Hubert.* ***Fondations et ouvrages en terre****. Ed. Eyrolles.*
6. *J.L. Durville, G. Sève.****Stabilité des pentes : glissements en terrain meuble (C254)****. Ed. Techniques de l'ingénieur.*
7. *F. Schlosser.****Ouvrages de soutènement : poussées et butées (C242)****. Ed. Techniques de l'ingénieur.*

Semester: 1
Teaching Unit: UEF 1.1.2
Subject 3: Foundations
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to enable students to deepen their knowledge in the design and calculation of shallow and deep foundations for structures.

Recommended Prerequisites:

Soil Mechanics 1 and 2, Foundations and Geotechnical Structures.

Course Content:

Chapter 1. Types of Actions and Design Loadings (2 Weeks)
Chapter 2. Shallow Foundations (5 Weeks)
Chapter 3. Deep Foundations (5 Weeks)
Chapter 4. Special Foundations (3 Weeks)

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

1. *F. Schlosser.* ***Eléments de mécanique des sols****. Ed. Presses des ponts, France.*
2. *F. Schlosser.* ***Exercices de mécanique des sols****. Ed. Presses des ponts, France.*
3. *J. Costet, G. Sanglerat.* ***Cours pratique de mécanique des sols****. Tomes 1 & 2. Ed. Dunod.*
4. *G. Sanglerat, G. Olivari, B. Cambou.* ***Problèmes pratiques de mécanique des sols et de fondations****. Tomes 1 & 2. Ed. Dunod*
5. *G. Philipponnat, B. Hubert.* ***Fondations et ouvrages en terre****. Ed. Eyrolles.*
6. *R. Frank.* ***Fondations superficielles (C246)****. Ed. Techniques de l'ingénieur.*
7. *R. Frank.* ***Fondations profondes (C248)****. Ed. Techniques de l'ingénieur.*
8. *R. Frank.* ***Fondations superficielles et profondes****. Ed. Presses des ponts.*
9. *P. Bousquet.* ***Pieux et palplanches (C140)****. Ed. Techniques de l'ingénieur.*
10. *Robert D. Holtz, William D. Kovacs.****Introduction à la géotechnique****. Ed.Ecole Polytechnique de Montréal, Canada.*

Semester: 1
Teaching Unit: UEM 1.1.2
Subject 3: Applied Geophysics
VHS: 22h30 (Course: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the theoretical and experimental concepts of applied geophysics in civil engineering.

Recommended Prerequisites:

Soil Mechanics 1 & 2, Continuum Mechanics.

Course content:

Chapter 1. Overview of Geophysics and Its Applications (Geophysics and geotechnical site investigation, Measured physical parameters, Geophysical prospecting methods, Advantages and limitations) (3 Weeks)
Chapter 2. Gravimetric and Micro-Gravimetric Methods (3 Weeks)
Chapter 3. Electrical Methods (3 Weeks)
Chapter 4. Seismic Methods (3 Weeks)
Chapter 5. Electromagnetic Methods (3 Weeks)
Practical Work (Depending on the availability of specialized geophysical testing equipment)

Assessment Method:

Exam: 100%

Bibliographic references:

1. *J. Dubois, M. Diament, J.P. Cogné.* ***Géophysique****. Ed. Dunod.*
2. *L. Lliboutry.* ***Géophysique et géologie****. Ed. Elsevier-Masson.*
3. *R. Lagabrielle.* ***Géophysique appliquée au génie civil (C224)****. Ed. Techniques de l'ingénieur, France.*
4. *M. Chouteau, B. Giroux.* ***Géophysique appliquée II (GLQ 3202) : méthodes électriques (notes de cours)****. Ed. Ecole polytechnique de Montréal, Canada.*
5. *H. Shout, M. Djeddi.* ***Bases physiques de la prospection sismique****. Ed. OPU, Algérie.*

Semester: 1
Teaching Unit: UEM 1.1
Subject 3: Programming supplement
VHS: 37h30 (Course: 1h30 and Practical Work: 1h30)
Credits: 3
Coefficient: 2

Teaching Objectives:

This course aims to deepen students' knowledge in advanced programming.

Recommended Prerequisites:

General Computer Science, Programming Language

Course Content:

Chapter 1. Review of Programming Techniques and Program Structuring (3 weeks)
Chapter 2. Use of Procedures and Functions **(4 weeks)**
Chapter 3. Modular Programming **(4 weeks)**
Chapter 4. Application Examples **(4 weeks)**

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%.

Bibliographical References:

1. *Concepts in programming languages. J.C. Mitchel, Prentice Hall 1997*
2. *M. BOUMAHRAT, A. GOURDIN « Méthodes numériques appliquées » OPU 1993*
3. *VARGA « Matrix iterative analysis »Printice Hall, 1962*
4. *BESTOUGEFF « La technique informatique: Algorithmes numériques et non numériques » Tome 2, Masson, 1975*

Semester: 1
Teaching Unit: UEM 1.1
Subject 2: Experimental methods
VHS: 22h30 (Course: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

This course provides students with knowledge about the most recent developments in common soil mechanics tests, particularly in the laboratory and also on-site.

Recommended Prerequisites:

Soil Mechanics 1 and 2.

Course Content:

Chapter 1: Test Standards : Experimental procedures and techniques for interpreting test results (in-situ and laboratory tests). **(3 weeks)**

Chapter 2: Permeability Tests **(3 weeks)**

Chapter 3: Shear Strength and Triaxial Shear Tests **(3 weeks)**

Chapter 4: Settlement Calculations and Oedometer Tests **(3 weeks)**

Chapter 5: In-Situ Tests **(3 weeks)**

Evaluation Method:

Final Exam: 100%.

Mode d'évaluation:
Examen: 100 %.

Bibliographical References:

Tous les ouvragesde mécanique des sols

Semester: 1
Teaching Unit: UEM 1.1
Subject 3: Geotechnical Testing and Site Investigation 1
VHS: 45 hours (Course: 1h30 and Practical Work: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

The aim of this course is to introduce students to the various types of in-situ and laboratory tests used in soil mechanics.

Recommended Prerequisites:

Soil Mechanics 1 and 2

Course Content:

- Boring and Sampling
- In-situ Testing (Part 1)
- Laboratory Testing (Part 1)

Note: The instructor has the freedom to schedule the different types of in-situ and laboratory tests available at their institution, in addition to those already covered in the first cycle (bachelor's degree). These should be distributed over two semesters: S1 (for Part 1) and S2 (for Part 2).

Proposed Course Content:
I- Boring and Drilling (definition, specific features, core drilling, coring techniques, drilling density, investigation depth)
Duration: 2 weeks

II- Sampling and Geotechnical Characteristics
Duration: 2 weeks

III- Mechanical Tests (dynamic probing tests, static penetration tests, piezocone tests, pressuremeter tests, vane shear tests)
Duration: 2 weeks

IV- Destructive Drilling (instantaneous and delayed logging) **Duration: 1 week**

V- Instrumentation and Monitoring of Structures **Duration: 2 weeks**

VI- Geotechnical Study (geotechnical engineer's mission, preliminary survey, different phases and program of geotechnical study) **Duration: 2 weeks**

VII- Variability and Uncertainties (heterogeneity, soil variability, measurement uncertainties) **Duration: 2 weeks**

VIII- Choice of Investigation Techniques **Duration: 2 weeks**

Assessment Method:

Continuous Assessment: 40%, Final Exam: 60%

Bibliographic references:

1. *M. Cassan (1988),* **Les essais in situ en mécaniques des sols1. Réalisation et interprétation**. *Edition Eyrolles.*
2 *M. Rat, (1974*), **Reconnaissance des sols.***Techniques de l'ingénieur, Ref C224 V1*.
3. P. Reiffsteck**,** D. Lossy**,** J. Benoît, *(2012),* **Forages, sondages et essais in situ géotechniques** : Les outils pour la reconnaissance des sols et des roches. Editeur : Presses Des Ponts.
4.**P. Reiffsteck**, **M. Zerhouni**, **J.-L. Averlan** *(2018),* **Essais de laboratoire pour la mécanique des sols et la géotechnique** : **les outils pour la reconnaissance des sols et des roches. Presses de l'Ecole nationale des ponts et chaussées**.
5. *Roy E. Hunt (2005),***Geotechnical investigation methods : afield guide for geotechnicalengineers**. *CRC Press LLC, 2005.*
6. Keith Lawrence H. (1992), **Environmental sampling and analysis : A pratical guide**, Lewis Publisher, Chelsea, Michigan.
*7. Recommandations de l'AFTES, (2012)***Caractérisation des incertitudes et des risques géologiques, hydrogéologiques et géotechniques.***(GT32 R2 F1), 2012*.
*8. G. Philipponnat, B. Hubert, (1998),***Fondations et ouvrages en terre**. Edition Eyrolles.
*9. H. Cambefort (1972) ,***Géotechnique de l'ingénieur et reconnaissance des sols.** Edition Eyrolles.
10. Union syndicale géotechnique – ***Missions*** **géotechniques types** (Projet de Normalisation), 1996.
*11. Martin Van Staveren (2006),***Uncertainty and ground conditions : A risk management approach.***Elsevier.*

Semester: 1
Teaching Unit: UET1.1
Subject 3: Technical English and Terminology
VHS: 45 hours (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

To introduce students to technical vocabulary. Strengthen their knowledge of the English language. Help them understand and synthesize technical documents. Enable them to comprehend conversations held in English within a scientific context.

Recommended Prerequisites:

Basic English vocabulary and grammar

Course Content:

Reading Comprehension : Reading and analyzing texts related to the student's specialty.

Listening Comprehension : Using authentic video materials on scientific topics, note-taking, summarizing, and presenting the content.

Oral Expression : Presenting a scientific or technical topic, crafting and exchanging oral messages (ideas and data), telephone communication, and non-verbal communication.

Written Expression : Extracting ideas from a scientific document, writing a scientific message, exchanging written information, drafting a CV, and writing internship or job application letters.

Recommendation:
It is highly recommended that the instructor present and explain approximately ten technical terms from the specialty at the end of each session (at most), ideally in three languages: English, French, and Arabic (if possible).

Evaluation Method:

Final Exam: 100%.

Examen: 100%.

Bibliographical References:

1. *P.T. Danison.**Guide pratique pour rédiger en anglais: usages et règles, conseils pratiques**. Editions d'Organisation.*
2. *A. Chamberlain, R. Steele.**Guide pratique de la communication : anglai.**Ed. Didier.*
3. *R. Ernst.**Dictionnaire des techniques et sciences appliquées: français-anglais**. Ed.Dunod.*
4. *J. Comfort, S. Hick, A. Savage.**Basic Technical English**.Ed. Oxford University Press.*
5. *E.H. Glendinning, N. Glendinning.**Oxford English for Electrical and Mechanical Engineering**.Ed. Oxford University Press.*
6. *T.N. Huckin, A.L. Olsen.**Technical writing and professional communication for nonnative speakers of English**.Ed. McGraw-Hill.*
7. *J. Orasanu.**Reading Comprehension from Research to Practice**.Ed. Erlbaum Associates.*

Detailed course program for semester S2

Semester: 2
Teaching Unit: UEF 1.2.1
Subject 1: Mechanics of Deformable Solids
VHS : 67h30 (course: 1h30, DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the theoretical and experimental concepts of mechanics of deformable solids.

Recommended Prerequisites:

Rational Mechanics, Thermodynamics, Continuum Mechanics.

Course Content:

Chapter 1. Physical Mechanisms of Deformation and Failure **(2 Weeks)**
Chapter 2. Rheological Classification and Experimental Characterization **(3 Weeks)**
Chapter 3. Elasticity and Viscoelasticity **(5 Weeks)**
Chapter 4. Plasticity and Viscoplasticity **(5 Weeks)**

Assessment Method:

Continuous Assessment: 40%; Exam: 60%

Bibliographic references:

1. *J. Lemaitre, J.L. Chaboche.* ***Mécanique des solides déformables et endommageables****. Ed. Dunod.*
2. *J. Lemaitre, J.L. Chaboche, A. Benallal, R. Desmorat.* ***Mécanique des matériaux solides****. Ed. Dunod.*
3. *D. François, A. Pineau, A. Zaoui.* ***Elasticité et plasticité****. Ed. Lavoisier.*
4. *S. Timoshenko, J.M. Goodier.* ***Théorie de l'élasticité****. Ed. Librairie Polytechnique Ch. Béranger.*
5. *J. Salençon.* ***Elastoplasticité****. Ed. Ecole polytechnique, France.*
6. *B. Halphen, J. Salençon.* ***Elasto-plasticité****. Ed. Presses desponts, France.*
7. *V.A. Lubarda.* ***Elastoplasticity theory****. Ed. CRC Press.*
8. *R. Richards Jr.* ***Principles of solid mechanics****. Ed. CRC Press.*
9. *Robert J. Asaro, Vlado A. Lubarda.* ***Mechanics of solid and materials****. Ed. Cambridge UniversityPress.*

Semester: 2
Teaching Unit: UEF 1.2.1
Subject 3: Soil Dynamics
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

The aim of this course is to introduce the student to the dynamic calculation of soils and foundations for geotechnical structures.

Recommended prior knowledge:

Waves and vibrations, Soil mechanics 1 and 2, Foundations and geotechnical structures, Mechanics of continuous medium.

Contents of the course:

Chapter 1: Characterisation of seismic movement **(3 weeks)**
(Elements of seismology, propagation of seismic waves in soils, notions of polarisation, historical seismicity of Algeria)
Chapter 2: Behaviour of soils under cyclic loading **(3 weeks)**
Chapter 3: Measurement of dynamic soil characteristics **(3 weeks)**
Chapter 4: Seismic response of a soil profile **(3 weeks)**
Chapter 5 : Liquefaction of soils **(3 Weeks)**

Assessment method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical References:

1. *A. Bouafia.* ***Introduction à la dynamique des sols****. Tomes 1 & 2. Ed. OPU, Algérie.*
2. *A. Pecker.* ***Dynamique des sols****. Ed. Presses des ponts, France.*
3. *Braja M. Das, G.V. Ramana.* ***Principles of soil dynamics****. Ed. Cengage Learning, USA.*
4. *Braja M. Das.* ***Fundamentals of soil dynamics****. Ed. Elsevier.*
5. *Shamsher Prakash.* ***Soil dynamics****. Ed. Mc-Graw-Hill.*
6. *A. Verruijt.* ***An introduction to soil dynamics****. Ed. Springer.*
7. *F.E. Richart, J.R. Hall Jr., R.D. Woods.* ***Vibrations of soils and foundations****. Ed. Prentice-Hall, USA.*
8. *S.L. Kramer.* ***Geotechnical earthquake engineering****. Ed. Prentice-Hall, USA.*

Semester: 2
Teaching Unit: UEF 1.2.2
Subject 1: Rheology of Soils
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to impart to students advanced theoretical and experimental knowledge regarding the mechanical behavior of soils under homogeneous stresses, in order to calculate foundations and geotechnical structures.

Recommended Prerequisites:

Soil Mechanics 1 and 2, Continuum Mechanics.

Course Content:

- **Chapter 1.** In-situ and Laboratory Behavior **(1 Week)**

(Compressibility and permeability characteristics, consolidation and creep characteristics, shear and failure characteristics, stress paths, normally consolidated and over-consolidated behavior)

- **Chapter 2.** Elastic Behavior Laws **(4 Weeks)**

(Linear elasticity, non-linear elasticity, application to hyperbolic models)

- **Chapter 3.** Elasto-plastic Behavior Laws **(4 Weeks)**

(Perfect plasticity, plasticity with hardening, application to the CAM-CLAY model)

- **Chapter 4**. Elasto-visco-viscoplastic Behavior Laws **(4 Weeks)**

(Incorporation of creep, application to the MELANIE-LCPC model)

- **Chapter 5.** Behavior Laws and Numerical Resolution **(2 Weeks)**

(Overview of soil behavior models implemented in commercial software such as PLAXIS, FLAC, CESAR-LCPC, etc.)

Evaluation Method:

Continuous assessment: 40%; Final exam: 60%

Bibliographical References:

1. *J.P. Magnan, P. Mestat.* ***Loi de comportement et modélisation des sols (C218)****. Ed. Techniques de l'ingénieur.*
2. *P. Mestat.* ***De la rhéologie des sols à la modélisation des ouvrages****. Ed. IFSTTAR (ex LCPC), France.*
3. *Braja M. Das.* ***Advanced soil mechanics****. Ed. Taylor & Francis Group.*
4. *Sergei S. Vyalov.* ***Rheological fundamentals of soils mechanics****. Ed. Elsevier.*
5. *M.J. Keedwell.* ***Rheology and soil mechanics****. Ed. Elsevier.*
6. *D. Muir Wood.* ***Geotechnical modelling****. Ed. CRC Press.*

Semester: 2
Teaching Unit: UEM 1.1
Subject 2: Geostatistics
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the theoretical concepts of statistical analysis applied to geotechnics.

Recommended Prerequisites:

Statistics, Soil Mechanics.

Course Content:

- **Chapter 1.** Theoretical Foundations of Geostatistics **(3 Weeks)**

(Random functions, stationarity, covariance, fitting a theoretical structure function)

- **Chapter 2.** Variogram Analysis **(4 Weeks)**
- **Chapter 3**. Kriging Theory **(4 Weeks)**
- **Chapter 4.** Software and Applications **(4 Weeks)**

Evaluation Method:

Continuous assessment: 40%; Final exam: 60%

Bibliographical References:

1. *J.P.Chilès, P. Delfiner.* ***Geostatistics: Modeling Spatial Uncertainty****. Second Edition. Ed. Wiley, 2012.*
2. *C. Lantuéjoul.* ***Geostatistical simulation: Models and Algorithms****. Ed. Springer, 2002.*
3. *H. Wackernagel.* ***Multivariate geostatistics : an introduction with applications****. Ed. Springer, 2003.*
4. *R. Webster, M. Olivier.* ***Geostatistics for environmental scientists. Statistics in Practice****. Ed. Wiley, 2001.*
5. *N. Cressie.* ***Statistics for Spatial Data****. Revised Edition. Ed. Wiley, 2015*

Semester: 2
Teaching Unit: UEF 1.2.2
Subject 3: Earth Dams
VHS: 22h30 (Course: 1h30)
Credits:2
Coefficient: 1

Teaching objectives:

The purpose of this course is to introduce the student to the earth dams design and calculation.

Recommended prior knowledge:

Advanced soil mechanics, Foundations, Slopes and supports, Finite difference method FDM, Finite element method FEM.

Content of the module:

Chapter I : Design of earth dams (**4weeks)**
- Different types of earth dams
- Earth dam project
- General profile of an earth dike

Chapter II : Study of infiltration in an earth dam (**4weeks)**
- Infiltration network
- Leakage debit by infiltration
- Infiltrations through the foundations
- Phenomenon of piping

Chapter III : Combating against infiltration in an earth dike **(4weeks)**
- Waterproof screens
- Upstream facing covering
- Drains and filters

Chapter IV : Stability of earth dams (**3weeks)**
- Fellenius method
- Bishop method

Evaluation mode:

Exam:100%

Bibliographic references:

1. *A.J. Schleiss, H. Pougatsch.* ***Les barrages – Du projet à la mise en service****. Ed. Presses polytechniques et universitaires romandes.*
2. *P. Le Delliou.* ***Les barrages : conception et maintenance****. Presses universitaires de Lyon, France.*
3. *L. Vulliet, L. Laloui, J. Zhao.* ***Mécanique des sols et des roches****. Ed. Presses polytechniques et universitaires romandes.*

Semester: 2
Teaching Unit: UEM 1.1
Subject 1: Finite element method
VHS: 60 hours (Course: 1h30, DW: 1h00 and Practical Work: 1h30)
Credits: 5
Coefficient: 3

Teaching Objectives:

This course aims to introduce students to the calculation of geotechnical structures using the finite element method.

Recommended Prerequisites:

- Mathematical analysis, Matrix calculus, Strength of materials, Numerical methods, Soil Mechanics 1 and 2.

Course Content:

- **Chapter 1**. General Principles **(3 Weeks)**
- **Chapter 2**. 1D Finite Element Method **(4 Weeks)**
- **Chapter 3.** 2D Finite Element Method **(4 Weeks)**
- **Chapter 4.** 3D Finite Element Method **(4 Weeks)**

Practical Work (TP) Program:

Part 1 (using Matlab or other software):

- Matrix manipulation, Lagrange interpolation, numerical integration using the trapezoidal and Simpson methods, practical applications.

Part 2 (using a geotechnical finite element software such as Plaxis or other):

- Study of a practical case: Software presentation, creation and implementation of the computational model (geometry, soil layer data, boundary conditions, initial conditions, loading, structural elements, calculation phases, presentation and interpretation of results), practical applications.

Evaluation Method:

Continuous assessment: 40%; Final exam: 60%

Bibliographical References:

1. *G. Dhatt. G. Touzot, E. Lefrançois.* ***Méthode des éléments finis****. Ed. Hermès-Lavoisier.*
2. *J. Chaskalovic.* ***Méthode des éléments finis pour les sciences de l'ingénieur****. Ed. Lavoisier.*
3. *J.C. Craveur.* ***Modélisation par éléments finis****. Ed. Dunod.*
4. *M. Bonnet, A. Frangi.* ***Analyse des solides déformables par la méthode des éléments finis****. Ed. Ecole polytechnique, France.*
5. *F. Frey, J. Jirousek.* ***Méthode des éléments finis****. Ed. Eyrolles.*

Semester: 2
Teaching Unit: UEM 1.1
Subject 3: Geotechnical Testing and Site Investigation 2
VHS: 45 hours (Course: 1h30 and Practical Work: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

The aim of this course is to introduce students to the various types of in-situ and laboratory tests used in soil mechanics.

Recommended Prerequisites:

Soil Mechanics 1 and 2

Course Content:

- Boring and Sampling
- In-situ Testing (Part 2)
- Laboratory Testing (Part 2)

Note: The instructor has the freedom to schedule the different types of in-situ and laboratory tests available at their institution, in addition to those already covered in the first cycle (bachelor's degree). These should be distributed over two semesters: S1 (for Part 1) and S2 (for Part 2).

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

All textbooks on soil mechanics.

Semester: 2
Teaching Unit: UET 1.2
Subject: Compliance with standards and rules of ethics and integrity.
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

To develop students' awareness of the ethical principles and rules that govern university life and the professional world. To raise their awareness about respecting and valuing intellectual property. To explain the risks of moral issues such as corruption and how to combat them, and to alert them to the ethical challenges raised by new technologies and sustainable development.

Recommended Prerequisites:

Ethics and Deontology (Foundations)

Course Content:

A. Respect for Ethical Rules and Integrity

- Overview of the MESRS Ethics and Deontology Charter :
- Integrity and honesty. Academic freedom. Mutual respect. Commitment to scientific truth. Objectivity and critical thinking. Equity. Rights and obligations of students, teachers, administrative, and technical staff.
- Integrity and Responsible Research :
- Adherence to ethical principles in teaching and research.
- Responsibilities in teamwork: Equal professional treatment. Actions against discrimination. Pursuit of the common good. Inappropriate behaviors in collective work settings.
- Adopting responsible behavior and combating misconduct: Responsible conduct in research. Scientific fraud. Anti-fraud measures. Plagiarism (definition, forms of plagiarism, procedures to avoid unintentional plagiarism, detection methods, sanctions against plagiarists, etc.). Falsification and fabrication of data.
- Ethics and Professional Deontology in the Workplace :
- Legal confidentiality in companies. Loyalty to the company. Responsibility within the company. Conflicts of interest. Integrity (corruption at work: its forms, consequences, ways to combat it, and sanctions).

B. Intellectual Property

I. Fundamentals of Intellectual Property

- Industrial property. Literary and artistic property.
- Rules for citing references (books, scientific articles, conference papers, theses, dissertations, etc.).

II. Copyright

- Copyright in the Digital Environment :
- Introduction. Copyright for databases and software. Specific cases of free software.

Copyright on the Internet and in E-commerce :

- Domain name rights. Intellectual property on the internet. E-commerce site rights. Intellectual property and social media.

- Patents :
- Definition. Rights in a patent. Utility of a patent. Patentability. Filing for patents in Algeria and worldwide.

III. Protection and Valorization of Intellectual Property :

- How to protect intellectual property. Violation of rights and legal tools. Valorization of intellectual property. Protection of intellectual property in Algeria.

C. Ethics, Sustainable Development, and New Technologies

The link between ethics and sustainable development, energy efficiency, bioethics, and new technologies (artificial intelligence, scientific progress, humanoid robots, drones, etc.).

Evaluation Method:

Final Exam: 100%

Bibliographical References:

1. Charte d'éthique et de déontologie universitaires, https://www.mesrs.dz/documents/12221/26200/Charte+fran_ais+d_f.pdf/50d6de61-aabd-4829-84b3-8302b790bdce
2. Arrêtés N°933 du 28 Juillet 2016 fixant les règles relatives à la prévention et la lutte contre le plagiat
3. L'abc du droit d'auteur, organisation des nations unies pour l'éducation, la science et la culture(UNESCO)
4. E. Prairat, De la déontologie enseignante. Paris, PUF, 2009.
5. Racine L., Legault G. A., Bégin, L., Éthique et ingénierie, Montréal, McGraw Hill, 1991.
6. Siroux, D., Déontologie : Dictionnaire d'éthique et de philosophie morale, Paris, Quadrige, 2004, p. 474-477.
7. Medina Y., La déontologie, ce qui va changer dans l'entreprise, éditions d'Organisation, 2003.
8. Didier Ch., Penser l'éthique des ingénieurs, Presses Universitaires de France, 2008.
9. Gavarini L. et Ottavi D., Éditorial. de l'éthique professionnelle en formation et en recherche, Recherche et formation, 52 | 2006, 5-11.
10. Caré C., Morale, éthique, déontologie. Administration et éducation, 2e trimestre 2002, n°94.
11. Jacquet-Francillon, François. Notion : déontologie professionnelle. Letélémaque, mai 2000, n° 17
12. Carr, D. Professionalism and Ethics in Teaching. New York, NY Routledge. 2000.
13. Galloux, J.C., Droit de la propriété industrielle. Dalloz 2003.
14. Wagret F. et J-M., Brevet d'invention, marques et propriété industrielle. PUF 2001
15. Dekermadec, Y., Innover grâce au brevet: une révolution avec internet. Insep 1999
16. AEUTBM. L'ingénieur au cœur de l'innovation. Université de technologie Belfort-Montbéliard
17. Fanny Rinck etléda Mansour, littératie à l'ère du numérique : le copier-coller chez les étudiants, Université grenoble 3 et Université paris-Ouest Nanterre la défense Nanterre, France
18. Didier DUGUEST IEMN, Citer ses sources, IAE Nantes 2008
19. Les logiciels de détection de similitudes : une solution au plagiat électronique? Rapport du Groupe de travail sur le plagiat électronique présenté au Sous-comité sur la pédagogie et les TIC de la CREPUQ
20. EmanuelaChiriac, Monique Filiatrault et André Régimbald, Guide de l'étudiant: l'intégrité intellectuelle plagiat, tricherie et fraude… les éviter et, surtout, comment bien citer ses sources, 2014.
21. Publication de l'université de Montréal, Stratégies de prévention du plagiat, Intégrité, fraude et plagiat, 2010.
22. Pierrick Malissard, La propriété intellectuelle : origine et évolution, 2010.
23. Le site de l'Organisation Mondiale de la Propriété Intellectuelle www.wipo.int

24. http://www.app.asso.fr/

Detailed course program for semester S3

Semester: 3
Teaching unit: UEF 2.1.1
Subject 1: Dynamics of geotechnical structures
VHS: 45h00 (course: 1h30, Pratical Work: 1h30)
Credits: 4
Coefficient: 2

Course objectives:

The purpose of this course is to introduce the student to the dynamic calculation of geotechnical structures and their interaction with their environment .

Recommended Prerequisites:

- Advanced soil mechanics, Foundations, Slopes and supports, Soil dynamics.

Course Content:

- **Chapter 1**. General information on soil-structure interaction **(1 week)**
- **Chapter 2.** Behavior of foundations under vibrating machines **(4 Weeks)**
- **Chapter 3.** Seismic Bearing Capacity of Foundations **(4 Weeks)**
- **Chapter 4.** Seismic stability of retaining walls **(3 weeks)**
- **Chapter 5.** Seismic stability of slopes and embankments **(3 weeks)**

Assessment Method:

Continuous Assessment: 40%, Final Exam: 60%

Bibliographical References:

1. *A. Bouafia.* ***Introduction à la dynamique des sols****. Tomes 1 & 2. Ed. OPU, Algérie.*
2. *A. Pecker.* ***Dynamique des sols****. Ed. Presses des ponts, France.*
3. *Braja M. Das, G.V. Ramana.* ***Principles of soil dynamics****. Ed. Cengage Learning, USA.*
4. *Braja M. Das.* ***Fundamentals of soil dynamics****. Ed. Elsevier.*
5. *Shamsher Prakash.* ***Soil dynamics****. Ed. Mc-Graw-Hill.*
6. *S.L. Kramer.* ***Geotechnical earthquake engineering****. Ed. Prentice-Hall, USA.*

Semester: 3
Teaching Unit: UEF 2.1.1
Subject 3: Failure calculation and limit analysis
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the theoretical concepts of limit state analysis and plasticity in structures and their ultimate load capacity assessment.

Recommended Prerequisites:

Continuum Mechanics, Mechanics of Deformable Solids, Soil Mechanics.

Course Content:

- **Chapter 1.** Concept of Limit Loads and Common Failure Criteria **(3 Weeks)**
- **Chapter 2.** Static Approach (Lower Bound Theorem) **(3 Weeks)**
- **Chapter 3.** Kinematic Approach (Upper Bound Theorem) **(3 Weeks)**
- **Chapter 4.** Practical Applications **(6 Weeks)**

Structures (beams, frames, thin plates, and slabs)
Geotechnical Works (stability of excavations, lateral earth pressures, bearing capacity of foundations)

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%.

Bibliographical References:

1. *J. Salençon.* ***Calcul à la rupture et analyse limite****. Ed. Presses des ponts, France.*
2. *J. Salençon.* ***Yield design****. Ed. Wiley-ISTE.*
3. *P. De Buhan.* ***Plasticité et calcul à la rupture****. Ed. Presses des ponts, France.*
4. *J. Lemaitre, J.L. Chaboche.* ***Mécanique des solides déformables et endommageables****. Ed. Dunod.*
5. *J. Lemaitre, J.L. Chaboche, A. Benallal, R. Desmorat.* ***Mécanique des matériaux solides****. Ed. Dunod.*

Semester: 3
Teaching Unit: UEF 2.1.2
Subject 1: Rock mechanics
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the theoretical and experimental concepts of rock mechanics as applied to civil engineering structures.

Recommended Prerequisites:

- Soil Mechanics 1 and 2, Foundations and Geotechnical Structures, Continuum Mechanics.

Course Content:

- **Chapter 1. General Overview of Rocks and Rock Masses (4 Weeks)**

(Origin of rocks, physical and thermal properties of rocks - Discontinuities in rock masses: typology, description, and geometric representation of joints - Classification of rocks and rock masses)

- **Chapter 2. Mechanical Behavior of Rocks and Rock Masses (6 Weeks)**

(In-situ and laboratory characterization - Rock matrix: mechanical properties, strength criteria, and failure modes – Discontinuities: characteristics and strength of rock joints, flow through joints – Rock masses: RQD/RMR/QS/GSI classification)

- **Chapter 3. Stability of Rock Slopes (3 Weeks)**

(Failure modes of rock slopes, role of water, limit equilibrium stability, toppling, stabilization techniques)

- **Chapter 4. Stability of Rock Cavities (2 Weeks)**

(State of stresses, calculation methods, case of stratified masses, calculation of swelling pressure on linings)

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

1. *J.L. Durville.* ***Mécanique des roches : Généralités (C350)****. Ed. Techniques de l'ingénieur.*
2. *J.L. Durville, H. Héraud.* ***Description des roches et des massifs rocheux (C352)****. Ed. Techniques de l'ingénieur.*
3. *P. Duffaut, F. Homand.* ***Manuel de mécanique des roches****. Tomes 1 & 2. Ed. Presses des ponts, France.*
4. *R.E. Goodman.* ***Introduction to rock mechanics****. Ed. John Wiley and Sons, New York.*
5. *E. Hoek.* ***Practical Rock engineering****. Ed. https://www.rocscience.com*

Semester: 3
Teaching Unit: UEF 2.1.2
Subject 2: Tunnels and underground structures
VHS: 45 hours (Course: 1h30 and DW: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the design and calculation of tunnels and other underground structures.

Recommended Prerequisites:

- Advanced Soil Mechanics, Mechanics of Deformable Solids, Rock Mechanics, Finite Difference Method, Finite Element Method.

Course Content:

- **Chapter 1.** Definition and Classification of Underground Structures **(2 Weeks)**
- **Chapter 2.** Design and Construction Techniques for Tunnels **(3 Weeks)**
- **Chapter 3.** Calculation and Design Methods for Tunnels **(4 Weeks)**
- **Chapter 4.** Pathology and Tunnel Reinforcement Techniques **(2 Weeks)**
- **Chapter 5.** Practical Application (Calculation of a Road or Railway Tunnel) **(4 Weeks)**

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%

Bibliographical References:

1. *M. Panet.* ***Le calcul des tunnels par la méthode convergence-confinement****. Ed. Presses des ponts, France.*
2. *A. Bouvard-Lecouanet, G. Colombet, F. Esteulle.* ***Ouvrages souterrains : conception – réalisation - entretien****. Ed. Presses des ponts, France.*
3. *L. Vulliet, L. Laloui, J. Zhao.* ***Mécanique des sols et des roches****. Ed. Presses polytechniques et universitaires romandes.*
4. *F. Martin.* ***Mécanique des roches et travaux souterrains : cours et exercices corrigés****. Ed. BG Ingénieurs Conseils, ENS Cachan, France.*

Semester: 3
Teaching Unit: UEM 1.1
Subject 3: Road geotechnics
VHS: 45 hours (Course: 1h30)
Credits: 2
Coefficient:1

Teaching Objectives:

This course aims to enable students to conduct a geotechnical study applied to the design of road and highway pavements.

Recommended Prerequisites:

Soil Mechanics

Course Content:

- **Chapter 1**. Classification of Soils According to GTR **(1 Week)**
- **Chapter 2.** Road Earthworks **(2 Weeks)**
- **Chapter 3.** Soil Compaction **(4 Weeks)**
- **Chapter 4**. Soil Bearing Capacity **(4 Weeks)**
- **Chapter 5.** Design of Flexible and Rigid Pavements **(4 Weeks)**

Proposed Course Content:

Chapter I: General Overview of Roads **(3 Weeks)**

Introduction to roads
Types of pavements
Composition of a flexible pavement
Road materials

Chapter II: Pavement Design **(3 Weeks)**

Definition of pavement design
CBR Method
Improved CBR Method

Chapter III: Road Earthworks **(3 Weeks)**

Earthwork volume calculations
Measurement of volumes
Earth movement

Chapter IV: GTR Soil Classification **(3 Weeks)**

Definitions
Soil classification
Classification parameters
GTR classification table
Chapter V: Soil Compaction (3 Weeks)

Evaluation Method:

Final Exam: 100%

Bibliographical References:

1. *LCPC-SETRA.* ***Guide des terrassements routiers : Réalisation des remblais et des couches de forme****.Guide technique, France. Ed. IFSTTAR (ex. LCPC), France.*
2. *R. Coquand.* ***Routes****. Ed. Eyrolles.*
3. *P. Carillo.* ***Conception d'un projet routier. Guide technique****. Ed. Eyrolles.*

Semester: 3
Teaching Unit: UEM 2.1
Subject 1: Soil improvement
VHS: 45 hours (Course: 1h30 and Practical Work: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This course aims to introduce students to the various techniques of soil stabilization and reinforcement of geotechnical structures.

Recommended Prerequisites:

Soil Mechanics, Geotechnical Testing 1 & 2, Road Geotechnics.

Course Content:

- General Overview of Stabilization, Reinforcement, and Repair of Geotechnical Structures.

Chemical Stabilization of Soils (Treatment with hydraulic binders).

- Reinforcement of Geotechnical Structures (Preloading, Retaining Structures, Soil Nailing, Reinforced Earth, Geotextiles, Stone Columns, Injections (jet grouting, soil mixing, etc.), Dynamic Compaction).
- Criteria for Choosing Methods.

Practical Work (TP) Program:

TP No. 1: Atterberg Limits of Reinforced Soils.
TP No. 2: Proctor Test for Reinforced Soils.
TP No. 3: CBR Test for Reinforced Soils.
TP No. 4: Simple Compression Test for Reinforced Soils.
TP No. 5: Direct Shear Test on Reinforced Soils Using the Shear Box.
TP No. 6: Triaxial Shear Test on Reinforced Soils.
TP No. 7: Soil-Fiber Shear Test.
TP No. 8: Soil-Geotextile Shear Test.

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%.

Bibliographical References:

1. Bell F. G., (1993): Engineering treatment of soils. E & FN Spon. 302 p.
2. GTS, Guide technique(2000) : « Traitement des sols à la chaux et/ou aux liants hydrauliques. Application à la réalisation des remblais et des couches de forme », LCPC-SETRA (Paris-Bagneux) jan. 2000, 240p.
3. Mouroux P. et Al. (1989) « *La construction économique sur les sols gonflants* **».** Manuels et méthodes, BRGM. France.
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5. Davidovici, V et Lambert, S. (2013). Fondations et procédés d'amélioration du sol, Guide d'application de l'EC8 parasismique: Dispositions du renforcement du sol par colonnes ballastées en zones sismiques, AFPS (2012). s.l. : Eyrolles, 2013. ISBN: 978-2-212-13831-3.
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7.Dhouib, A. et Blondeau, F. (2005). Colonnes ballastées: Techniques de mise en oeuvre, domaines d'application, comportement, justification, contrôle, axes de recherche et de développement. Presses de l'Ecole Nationale des ponts et Chaussées- ISBN 2- 85978- 401-2, 2005 (ENPC), Paris.
8.Schlosser S. et Unterreiner P. : Renforcement des sols par inclusions. Techniques de l'ingénieur, C245.
9. Guide technique AFPS (2012) : Procédés d'amélioration et de renforcement de sols sous actions sismiques – Presse de Pont, Paris, 231 pages.
10.Magnan J. P. (1983) : Théorie et pratique des drains verticaux. Edition Technique et Documentation – Lavoisier. Paris.
11.Queyroi D., Chaput D., Pilot G. (1985) : Amélioration des sols de fondation, choix des méthodes d'exécution. Note d'information technique du Ministère de l'Urbanisme, du Logement et des Transports. Editions du LCPC - 53p.
12. Guide technique : recommandations pour l'inspection détaillée le suivi et le diagnostic des murs en remblai renforcé par éléments géosynthétiques. Laboratoire central des ponts et chaussées Juillet 2003.
13.Holtz, R. D., (2001) : Geosyntetic For SoilReinforcment, The Ninth Spencer J. Buchanan Lecture, College Station, University Drive
14. Les ouvrages de soutènement : Guide de conception générale. SETRA- Service d'Etudes Techniques des Routes et Autoroutes - Décembre 1998.
15. Lesouvrages en Terre Armée(1979) *:* Recommandations et Règles de l'Art. Document LCPC-SETRA(1979).
16. Recommandations Clouterre (1991) pour la conception, le calcul, l'exécution et le contrôle des soutènements réalisés par clouage des sols. Presses de l'ENPC, 1991, Paris.
17. Le-Kouby A.,:Renforcement des digues par la technique du DeepSoilMixing. Synthèse des résultats d'essais des chantiers expérimentaux du Val d'Orléans.IFSTTAR – GERS – Laboratoire Sols Roches et Ouvrages géotechniques – 19 novembre 2014.
18.Corté J-F., Poupelloz B., et Washkowski E., (1984) : Confortement par injections des fondations d'ouvrages d'art. Rapport des laboratoires LCPC, Mai 1984.

Semester: 3
Teaching Unit: UEM2.1
Subject 3: Modeling of geotechnical structures
VHS: 45 hours (Course: 1h30 and Practical Work: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:

To acquire practical knowledge for the design of foundations, retaining structures, and protective structures using one of the following software: Plaxis, Geo5, Flac, Z-SOIL, COMSOL, etc.

Recommended Prerequisites:

- Soil Mechanics, Geotechnical Testing 1 & 2, Finite Element Method (FEM), etc.

Course Content:

(Not specified in the provided text)

Evaluation Method:

Continuous Assessment: 100%

Bibliographical References:

User manual of the software selected for the practical sessions (TPs).

Semester: 3
Teaching Unit: UEM 1.1
Subject 3: Geographic Information Systems
VHS: 37 h30 (Course: 1h30 and Practical Work: 1h30)
Credits: 3
Coefficient: 2

Teaching Objectives:

This course aims to familiarize students with Geographic Information Systems (GIS) and their application in geotechnics.

Recommended Prerequisites:

Topography, Computer Science, Mathematics

Course Content:

- **Chapter 1**. General Overview of GIS **(3 weeks)**
- **Chapter 2.** Geographic Information in GIS **(3 weeks)**
- **Chapter 3.** Coordinate Systems and Map Projections **(3 weeks)**
- **Chapter 4.** Databases in GIS **(3 weeks)**
- **Chapter 5.** Data Processing in GIS **(3 weeks)**

Practical Work (TP) Program:

TP1: Components of a GIS
Basics of GIS design, Introduction to GIS software

TP2: Modes of Representing Geographic Data in a GIS
Vector mode, Raster mode, Digital Terrain Model (DTM)

TP3: Importing and Displaying Data
Georeferencing data, Projection systems

TP4: Data in GIS
Attribute data, Spatial data

TP5: Applications
Spatial analysis

Evaluation Method:

Continuous Assessment: 40%; Final Exam: 60%.

Mode d'évaluation:

Contrôle continu: 40 % ; Examen: 60 %.

Bibliographical References:

1. PORNON, Henri. SIG: la dimension géographique du système d'information. Dunod, 2015.
2. CHANG, Kang-Tsung. Introduction to geographic information systems.Boston : McGraw-Hill, 2008.
3. DENÈGRE, Jean et SALGÉ, François. Introduction aux systèmes d'information géographique. Que sais-je?, 2004, vol. 2, no 3122, p. 5-11.
4. Guides du logiciel SIG.

Semester: 3
Teaching Unit: UEM 1.1
Subject 3: Literature review and thesis design
VHS: : 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

To provide students with the necessary tools to research useful information and effectively utilize it in their final-year projects. To help them navigate the various stages leading to the writing of a scientific document. To highlight the importance of communication and teach them how to present their work rigorously and pedagogically.

Recommended Prerequisites:

- Writing methodology, Presentation methodology.

Course Content:

Part I: Literature Review

Chapter I-1: Defining the Topic (2 Weeks)

- Title of the topic
- List of keywords related to the topic
- Gathering basic information (acquisition of specialized vocabulary, meaning of terms, linguistic definitions)
- Information being sought
- Assessing one's knowledge in the field

Chapter I-2: Selecting Information Sources (2 Weeks)

- Types of documents (Books, Theses, Dissertations, Journal Articles, Conference Proceedings, Audiovisual Documents, etc.)
- Types of resources (Libraries, Internet, etc.)
- Evaluating the quality and relevance of information sources

Chapter I-3: Locating Documents (1 Week)

Research techniques
Search operators

Chapter I-4: Processing Information (2 Weeks)

- Organizing work
- Initial questions
- Synthesis of selected documents
- Links between different sections
- Final outline of the literature review
-

Chapter I-5: Presenting the Bibliography (1 Week)

- Systems for presenting a bibliography (Harvard system, Vancouver system, Mixed system, etc.)

Document presentation
Citing sources

Part II: Thesis Design

Chapter II-1: Structure and Steps of Writing a Thesis (2 Weeks)

- Defining and delimiting the topic (Abstract)
- Problem statement and objectives of the thesis
- Other useful sections (Acknowledgments, List of abbreviations, etc.)
- Introduction (Writing the introduction last)
- Literature review
- Hypothesis formulation
- Methodology
- Results
- Discussion
- Recommendations
- Conclusion and perspectives
- Table of contents
- Bibliography
- Appendices

Chapter II-2: Writing Techniques and Standards (2 Weeks)

- Formatting. Chapter, figure, and table numbering.
- Title page
- Typography and punctuation
- Writing. Scientific language: style, grammar, syntax.
- Spelling. Improving general linguistic competence in terms of comprehension and expression.
- Saving, securing, and archiving data.

Chapter II-3: Workshop: Critical Analysis of a Manuscript (1 Week)

Chapter II-4: Oral Presentations and Thesis Defense (1 Week)

How to present a poster
How to deliver an oral presentation
Thesis defense
Chapter II-5: How to Avoid Plagiarism? (1 Week)
(Formulas, sentences, illustrations, graphs, data, statistics, etc.)

Quoting
Paraphrasing
Providing complete bibliographic references

Evaluation Method:

Final Exam: 100%

Mode d'évaluation :
Examen : 100%

Bibliographical References:

1. *M. Griselin et al., Guide de la communication écrite, 2e édition, Dunod, 1999.*

2. *J.L. Lebrun, Guide pratique de rédaction scientifique : comment écrire pour le lecteur scientifique international, Les Ulis, EDP Sciences, 2007.*
3. *A.Mallender Tanner, ABC de la rédaction technique : modes d'emploi, notices d'utilisation, aides en ligne, Dunod, 2002.*
4. *M. Greuter, Bien rédiger son mémoire ou son rapport de stage, L'Etudiant, 2007.*
5. *M. Boeglin, lire et rédiger à la fac. Du chaos des idées au texte structuré. L'Etudiant, 2005.*
6. *M. Beaud, l'art de la thèse, Editions Casbah, 1999.*
7. *M. Beaud, l'art de la thèse, La découverte, 2003.*
8. *M. Kalika, Le mémoire de Master, Dunod, 2005.*

IV- Detailed Course Programs for Some Discovery Teaching Units (S1, S2, S3)

Semester: X
Teaching Unit: UED X.X
Subject: Hydrogeology
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the mastery of groundwater flow and its impact on the stability of geotechnical structures.

Recommended Prerequisites:

- Geology, General Hydraulics, Soil Mechanics.

Course Content:

- **Chapter 1.** Behavior of Aquifer Systems as Reservoirs **(4 Weeks)**
- **Chapter 2.** Behavior of Aquifer Systems as Conduits **(4 Weeks)**
- **Chapter 3.** Flow Networks **(4 Weeks)**
- **Chapter 4**. Water Flow Control **(3 Weeks)**

Evaluation Method:

Final Exam: 100%

Bibliographical References:

1. *E. Gilli. C. Mangan, J. Mudry.* ***Hydrogéologie : objets, méthodes, applications****. Ed. Dunod.*
2. *G. Castany.* ***Hydrogéologie : principes et méthodes****. Ed. Dunod.*

Semester: X
Teaching Unit: UED X.X
Subject: Geotechnical hazards and risks
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the understanding of certain geotechnical risks, their analysis, and evaluation in order to better manage crisis situations and make appropriate decisions.

Recommended Prerequisites:

Knowledge acquired in probabilities and statistics, MDS (Structural Design Models).

Course Content:

- **Chapter 1.** Introduction to Geotechnical Risks **(1 Week)**
- **Chapter 2**. General Methodology for Risk Analysis **(4 Weeks)**
- **Chapter 3**. Remote Sensing Applied to the Natural Environment **(4 Weeks)**
- **Chapter 4**. Methodology for Data Analysis and Processing **(4 Weeks)**
- **Chapter 5**. Warning Systems and Crisis Management **(2 Weeks)**

Proposed Course Content:

- **Chapter 1**. Introduction to Geotechnical Risks **(1 Week)**
- **Chapter 2.** Analysis of Various Geotechnical Risks **(3 Weeks)**
- **Chapter 3.** General Methodology for Risk Analysis **(3 Weeks)**
- **Chapter 4.** Remote Sensing Applied to the Natural Environment **(3 Weeks)**
- **Chapter 5**. Methodology for Data Analysis and Processing **(3 Weeks)**
- **Chapter 6**. Warning Systems and Crisis Management **(2 Weeks)**

Evaluation Method:

Final Exam: 100%

Bibliographical References:

1. *M. Merad.* ***Aide à la décision et expertise en gestion des risques****. Ed. Lavoisier.*
2. *J.P. Louisot.* ***Risk Management et stratégie****. Ed. AFNOR.*
3. *J.L. Wybo.* ***Maitrise des risques et prévention des crises****. Ed. Lavoisier.*

4-Techniques et Méthodes : Retrait gonflement : Analyse et traitement des désordres créés par la sécheresse. Guide 3, Edition IFSTTAR, Juillet 2017.

5-Office Fédérale des routes OFROU : Analyse de risques pour les tunnels des routes nationales Edition ASTRA ; 2014.

6-Kergomard C. : La Télédétection aéro-spatiale : une introduction. Cours de L'Ecole Nationale Supérieure de Paris.

7-Recommandations de l'AFTES : Caractérisation des incertitudes et des risques géologiques, hydrogéologiques et géotechniques. GT32R2F1, Juillet –Août 2012.

8-Guide méthodologique : La gestion des risques dans les grands projets d'infrastructure publique. Edition : Infrastructure Québec.

9-Techniques de l'Ingénieur : Dossier ''Sécurité et gestion des risques''. (www.techniques-ingénieur.fr/traite/securite_et_gestion_des_risques/T1112)

Semester: X
Teaching Unit: UED X.X
Subject: Finite difference method
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the calculation of geotechnical structures using the finite difference method.

Recommended Prerequisites:

- Mathematical analysis, Matrix calculus, Strength of materials, Soil mechanics.

Course Content:

- **Chapter 1**. General Principles **(3 Weeks)**
- **Chapter 2.** Finite Difference Methods in 1D **(4 Weeks)**
- **Chapter 3.** Finite Difference Method in 2D **(4 Weeks)**
- **Chapter 4.** Study of Some Real Cases **(4 Weeks)**

Practical Work (TP) Program:

Part 1 (using Matlab or other software):

- Implementation of the finite difference method for a simple case (e.g., beam bending, consolidation problem).

Part 2:
Use of finite difference software in geotechnics (e.g., FLAC or other) and study of a practical case:

- Problem modeling,
- Domain discretization,
- Meshing,
- Introduction of boundary and initial conditions,
- Solving and interpreting results.

Evaluation Method:

Continuous assessment: 40%; Final Exam: 60%.

Bibliographical References:

1. *A. Curnier.* ***Méthodes numériques en mécanique des solides.****Ed. Presses polytechniques et universitaires romandes.*
2. *M. Deville, M. Rappaz.****Modélisation numérique en science et génie des matériaux.*** *Ed. Presses polytechniques et universitaires romandes.*
3. *M. Rappaz, M. Bellet, M. Deville.****Traité des matériaux 10.*** *Ed. Presses polytechniques et universitaires romandes.*
4. *G. Allaire.****Analyse numérique et optimisation : une introduction à la modélisation****. Ed. Ecole polytechnique, France.*

Semester: X
Teaching Unit: UED X.X
Subject: Pathology of geotechnical structures
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to present students with the main pathological cases related to geotechnical structures, diagnostic techniques, and possible repair methods.

Recommended Prerequisites:

Course Content:

It covers the following points:

- Analysis of the causes of disorders (execution errors, site instability, structural defects, changes in foundation soil characteristics, environmental modifications).
- Causes related to structures (constituent materials, under-design, execution faults).
- Causes related to problematic soils (expansive soils, collapsible soils, and liquefiable soils).
- Pathologies of shallow and deep foundations.
- Pathologies of retaining structures.
- Prevention and repair methods for damaged structures.

Proposed New Course Content:

- Definition of pathology and general information on diagnosis and causes of pathologies.
- Pathologies of shallow and deep foundations.
- Pathologies of retaining structures.
- Pathologies of tunnels and underground structures.
- Pathologies of drainage structures.
- Pathologies of roadways and roads.
- Prevention and repair methods for damaged structures.

Evaluation Method:

Final Exam: 100%

Bibliographical References:

1. *M. Lor. (2015),* ***Pathologie, diagnostic, prévention et maintenance des structures (C7100 V1)****. Ed. Techniques de l'ingénieur.*
2. *J. Delefosse.* ***Pathologies du béton armé – Actions physico-chimiques, cas particuliers et ouvrages spécifiques (C6200 V2)****. Ed. Techniques de l'ingénieur.*
3. *A. Plumier. (2011),* **Pathologies et réparations structurales des constructions.***Cours de l'université de liège.*
4. *L. Logeais (2012),* **La pathologie des fondations** – Fondasol. *Edition Moniteur.*
5. **Pathologie des fondations superficielles : diagnostic, réparation et prévention – maisons individuelles et bâtiments assimilés**. *CSTB Editions 2015.*

6. **Guide de l'inspection du génie civil des tunnels routiers.** Du désordre vers le diagnostic – **livre 1** – Catalogue des désordres – **livre 2** – *Les Guides du CETU – 2015.*
7. **Retrait et gonflement des argiles : Analyse et traitement des désordres créées par la sécheresse**. Technique et Méthodes – Guide 3 – *Quide Technique IFSTTAR 2017.*

Réparation et renforcement des fondations.*Guides STRRES N°1* – Fédération Nationale Des Travaux Publics (FNTP).

1. *M. Lor.* ***Pathologie, diagnostic, prévention et maintenance des structures (C7100 V1)****. Ed. Techniques de l'ingénieur.*
2. *J. Delefosse.* ***Pathologies du béton armé – Actions physico-chimiques, cas particuliers et ouvrages spécifiques (C6200 V2)****. Ed. Techniques de l'ingénieur.*

Semester: X
Teaching Unit: UED X.X
Subject: Public procurement code
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

Recommended Prerequisites:

Course Content:

Evaluation Method:

Final Exam: 100%

Bibliographical References:

Semester: X
Teaching unit: UED X.X
Subject: Geotechnical standards
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

The purpose of this course is to introduce the student to the various geotechnical standards operative in Algeria and to raise awareness of compliance with regulatory requirements in geotechnical projects (design, calculation, execution, contractual relations, etc.).

Recommended prior knowledge:

Soil mechanics 1 and 2 ; Foundations and geotechnical structures.

Content of the module:

It covers the following points:

- Test standards: experimental procedures and techniques for exploiting test results (in-situ and laboratory tests).
- Sizing and calculation standards (foundations, retaining structures, screens, etc.).
- Standards for the execution, monitoring and control of geotechnical structures.
- Overview of European standards (Eurocode 7), American standards (ASTM: Geotechnical Engineering Standards), etc.

Evaluation mode:

Exam: 100%

Bibliographic references:

1. *Algerian standars published under the aegis of the Algerian institute of standarization (IANOR, 2010).*
2. *European standars : https://www.icab.fr/guide/eurocode/eurocode7.html*
3. *American standars :* https://www.astm.org/Standards/geotechnical-engineering-standards.html

Semester: X
Teaching Unit: UED X.X
Subject: Construction law
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

Recommended Prerequisites:

Course Content:

Evaluation Method:

Final Exam: 100%

Bibliographical References:

Semester: X
Teaching Unit: UED X.X
Subject: PGC for geotechnical structures
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to the general processes of constructing foundations and geotechnical structures.

Recommended Prerequisites:

- Soil Mechanics 1 and 2, Foundations and Geotechnical Structures.

Course Content:

It covers the following points:

- Design.
- Regulatory principles for sizing/dimensioning.
- Construction techniques.

Evaluation Method:

Final Exam: 100%.

Bibliographical References:

Any document dealing with geotechnical structures.

Semester: X
Teaching Unit: UED X.X
Subject: Concepts of civil and industrial construction
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to civil and industrial constructions.

Recommended Prerequisites:

Construction materials, Strength of materials, Reinforced concrete, Metal framework.

Course Content:

It covers the following points:

- Design.
- Regulatory principles for sizing/dimensioning.
- Construction techniques.

Evaluation Method:

Final Exam: 100%.

Bibliographical References:

Any document dealing with civil and industrial constructions.

Semester: X
Teaching Unit: UED X.X
Subject: Concepts of roads and engineering structures
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to roads and civil engineering structures.

Recommended Prerequisites:

Construction materials, Strength of materials, Reinforced concrete, Metal framework.

Course Content:

It covers the following points:

- Design.
- Regulatory principles for sizing/dimensioning.
- Construction techniques.

Evaluation Method:

Final Exam: 100%.

Bibliographical References:

Any document dealing with roads and civil engineering structures.

Semester: X
Teaching Unit: UED X.X
Subject: Concepts of hydraulic engineering structures
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to introduce students to hydrotechnical structures.

Recommended Prerequisites:

Construction materials, Strength of materials, Reinforced concrete, Metal framework.

Course Content:

It covers the following points:

- Design.
- Regulatory principles for sizing/dimensioning.
- Construction techniques.
- Proposed Course Content:

Part I: Retaining Structures

- General Information on Dams
- Definition of a dam
- Purposes of a dam
- Constituent structures of a dam
- Types of dams
- Choosing the Site for a Dam
- Topography
- Hydrology
- Geotechnics
- Calculation of Concrete Gravity Dams
- Forces applied to the dam
- Overturning stability
- Sliding stability
- Drainage of concrete dams

Part II: Port Structures

- General Information on Port Structures
- External and Internal Structures of Ports
- Composition and Sizing of a Rubble Mound Breakwater

Evaluation Method:

Final Exam: 100%

Bibliographical References:

Any document dealing with hydrotechnical structures.